



INVESTMENT REPORT  
2018/2019



European  
Investment  
Bank



*The EU bank*

retooling  
europe's economy







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EUROPEAN INVESTMENT BANK INVESTMENT REPORT  
2018/2019

# RETOOLING EUROPE'S ECONOMY

## **EIB Investment Report 2018/2019: retooling Europe's economy**

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### **About the Report**

The EIB annual report on Investment and Investment Finance is a product of the EIB Economics Department, providing a comprehensive overview of the developments and drivers of investment and its finance in the EU. It combines an analysis and understanding of key market trends and developments with a more in-depth thematic focus, which this year is devoted to innovation, climate change mitigation, equity markets, skills and corporate digitalisation activities. The report draws extensively on the results of the annual EIB Investment Survey (EIBIS). It complements internal EIB analysis with contributions of leading experts in the field.

### **About the Economics Department of the EIB**

The mission of the EIB Economics Department is to provide economic analyses and studies to support the Bank in its operations and in the definition of its positioning, strategy and policy. The Department, a team of 40 economists, is headed by Debora Revoltella, Director of Economics.

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## Executive summary

**The Investment Report, issued annually by the European Investment Bank, provides a comprehensive overview and analysis of investment and the financing of investment in the European Union.** It combines the exploration of investment trends with in-depth analysis, focusing especially on the drivers and barriers to investment activity. The report leverages on a unique set of databases and survey data, including EIBIS, an annual survey of 12 500 firms in Europe, which focuses on their assessment of investment and investment finance conditions, and which allows analysis with firm balance sheet information. The report provides critical inputs to policy debates on the need for public action on investment, and on the types of intervention that can have the greatest impact.

**This year's report addresses a moment of economic recovery in which investment growth, overall, is strong, but downside risks to the economic outlook are rising.** It identifies many ways in which current investment is still structurally inadequate, given the legacy effects of the recent crisis and the great challenges that lie ahead. There is an urgent need to retool Europe, from its infrastructure and innovation ecosystem, through to its businesses and workers, to enhance prosperity and social cohesion.

### Investment in Europe is back, the recovery has broadened...

**Investment growth is consolidating across the European Union.** Measured as gross fixed capital formation, investment grew by 4% on average in 2017 and the first half of 2018.

**Investment rates have reached historical averages, except in the "periphery" group of countries.** While investment intensity in the "cohesion" group might be expected to be high, reflecting the process of catching-up, it is paradoxically almost as high in the more advanced "other EU" group.<sup>1</sup>

**Investment is becoming more balanced across asset classes and institutional sectors.** While investment in machinery and equipment continues its robust growth, investment in dwellings and other buildings and structures has picked up in most EU countries. Investment by corporations remains strong, while investment by households is supported by real income growth and the recovery of house prices.

**Public investment is gradually picking up but remains low, especially in the periphery.** It is above its long-term average in only six countries. The composition of public spending is still skewed away from investment, particularly with regard to infrastructure, but the situation is slowly improving.

**Survey data shows firms expecting to increase investment, on average, in nearly all countries.** The share of firms investing was higher in the other EU group, and lower in the cohesion and periphery countries.

### ... but looking forward, we need to retool Europe's economy

**After years of underinvestment, potential growth remains depressed: the cyclical upswing belies the existence of structural weaknesses and investment needs, while downside risks mount.** Favourable monetary policy and global demand conditions have helped push output growth above this potential, but the need for a retooling of Europe's economy to sustain growth and meet future challenges remains. The growing perception of downside risks to the global outlook for growth and investment makes this task even more urgent.

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<sup>1</sup> In this report, EU countries are grouped as "Cohesion" (those that joined the EU since 2004), "Periphery" (Italy, Spain, Portugal, Greece, Cyprus and Ireland) and "Other EU".

**Compared to the post-crisis experience in the US, Europe's recovery suffers from weak investment, and a large gap in machinery and equipment investment has opened.** Meanwhile the gap in investment in intellectual property, including R&D, shows no signs of closing. The EU risks repeating the experience of the 1990s when the US took a lead in productivity through heavy investment in information technologies.

**Despite expanding investment, the need for further investment perceived by EU firms remains unchanged.** More firms think their past investment was too little, rather than too much, by a margin of 16 percentage points (p.p.). Perceived shortfalls in investment are not related to capacity concerns but to capital quality issues, such as the degree to which firms see their machinery and equipment as "state-of-the-art". Being state-of-the-art increasingly means investing in digital technologies, which make up nearly 30% of the value of investment in machinery and equipment in manufacturing firms, and 20% in services.

**Downside risks are increasing.** Global trade tensions have given rise to increasing uncertainty, something that has proven to be a key impediment to investment in recent years. While monetary conditions remain accommodative, the process of policy normalisation is leading to the emergence of asymmetric dynamics, accompanied by the repricing of risk.

## Investment in infrastructure remains depressed

**Infrastructure investment continued its downward trend in 2016, and preliminary data suggest no marked reversal in 2017.** At 1.7% of GDP, overall infrastructure investment now stands at about 75% of its pre-crisis level. While this investment has been more or less stable in the other EU countries (as a share of GDP), it has been volatile and declining in the periphery and cohesion countries.

**The fall in infrastructure investment activities has not been due to need saturation.** One in three large municipalities in Europe said that infrastructure investment was below needs, while infrastructure investment fell most in regions where infrastructure quality is relatively low.

**The government sector accounts for about 80% of the fall in total infrastructure investment over the past decade.** The fall in government infrastructure investment was most pronounced in countries subject to adverse macroeconomic conditions and more severe fiscal constraints. This trend has been aggravated by a tendency to protect current expenditure at the expense of capital expenditure.

**Corporate infrastructure investment has held up better, but suffers from falling returns.** Falling returns reflect the general macroeconomic environment, but also the fall in allowed returns – for firms in regulated sectors – that are set with reference to interest rates that are currently historically low. Meanwhile, investment through public-private partnerships fell to EUR 9 billion in 2017, from EUR 30 billion in 2005. The emergence of a very cautious political attitude to PPPs largely explains this trend.

**Good governance matters.** At the municipal level, poor infrastructure quality is associated with external financing constraints and a lack of technical capacity to select and implement complex projects. At the regional level, it is similarly associated with limited technical capacity and weak regional governance. Infrastructure gaps should be addressed in a comprehensive way, encompassing finance, technical capacity and governance issues.

## Investment in climate change mitigation needs to accelerate

**EU investment in climate change mitigation (CCM) continues to stagnate at just under 1.3% of GDP, having fallen from 1.5% between 2012 and 2014.** While CCM investment in transport and in energy efficiency shows a gradual rising trend, it is investment in renewable energy and related grid infrastructure that has fallen. CCM investment trends have been influenced by a mix of regulatory changes, ineffective market mechanisms, technological developments and fossil fuel price changes and subsidies.

**Investment in energy efficiency needs to be increased dramatically to meet EU targets for 2030 and beyond.** Firms treat energy efficiency measures – which make up some 8% of firm investment – similarly to other types of investment, with the expected internal rate of return and interest rates the dominant factors in decision-making. There is little evidence that firms consider energy efficiency investments to be less risky than other types of investment, but they often lack information. Carrying out an energy audit makes firms 38% more likely to invest in energy efficiency measures. Energy audits can therefore play an important role in helping firms to overcome the information gap that is one of the main barriers to energy efficiency investments. Firms are more likely to go ahead with energy audits when they receive financial support.

## The recovery is revealing a structural gap in skills

**Almost eight out of ten European firms consider the limited availability of staff with appropriate skills to be an impediment to investment.** While unemployment across the EU is approaching pre-crisis levels, structural trends, including demographic change and the advance of digital technologies, are also transforming EU labour markets.

**This skills gap reflects a structural process of adjustment to changing technology and skill requirements,** exacerbated by a tight labour market (in the other EU countries) and migration (in cohesion countries). At the firm level, it is the more competitive, innovative and fast-growing firms that more often report limited skills availability as a constraint. 60% of firms expect digitalisation to increase demand for higher-skilled staff. Persistent skill shortages and mismatches can negatively affect productivity and technology adoption.

**Firms that provide training for employees are more productive on average, yet 21% of firms consider their recent investment in training to have been insufficient.** Small firm size as well as financial constraints can limit companies' investment in training, as can a firm's ability to internalise benefits from training. Investing in skills is essential to the European retooling effort, with positive implications for competitiveness and social cohesion. Yet just 1% of spending on education in the EU is at the European level. The existence of a single market for labour, and the growing importance of skill-related issues, calls for closer European coordination in this area.

## The EU is losing ground on innovation

**Investment in innovation is critical for the growth of productivity and future prosperity.** Going beyond R&D, it is necessary to consider investment in the full range of intangible assets – software, data, organisational capital, employee skills, all kinds of intellectual property rights, and so on – that are closely associated with innovation in advanced economies.

**EU spending on R&D lags competitors because of weaker business R&D. Business investment in intangibles is also lower in the EU than in the US.** EU R&D investment remains stable at 2% of GDP, a level recently matched by China and below spending in the US at 2.8%. EIBIS data shows that US firms devoted 48% of total investment to intangibles as a whole, compared to 36% in the EU.

**The EU is losing ground among the world's top companies for R&D investment, with fewer new entrants in this group, reflecting the challenges EU firms face in scaling-up.** Among the top 2 500 firms, accounting for around 90% of global business R&D, the US and China represent 37% and 25% of new entrants, respectively. With only 13% of new entrants, the EU is more reliant on long-established companies. The EU is a global leader in automotive industries, but has a much weaker presence in the electronics and technology sectors.

**Only 8% of EU firms can be categorised as "leading innovators", compared to 16% in the US, but EU firms are twice as likely to focus on adopting innovations.** Survey evidence shows that innovators grow faster than other firms and are more likely to see finance constraints and limited skills availability as obstacles.

## EU firms are waking up to the challenge of digitalisation

**The adoption of digital technologies by EU firms lags behind that of US firms in the service sector, but not in manufacturing.** Firms that adopt digital technologies tend to be more productive, to invest more and to engage more in innovation activities. They also estimate that adopting digital technologies has enhanced sales by 10% on average. These are some of the findings of a special add-on to the EIB Investment Survey, focused on digitalisation, covering 1 700 firms in the EU and the US.

**On balance nearly 50% of manufacturing firms and just over a third of services sector firms consider their past investments in digital technologies to have been too low.** While EU firms seem particularly motivated by efficiency gains, US firms tend to focus more on using new technologies like "big data" to open up new market opportunities. This is a concern because digitalisation is also associated with higher mark-ups, suggesting the importance of path-dependency and winner-takes-all dynamics.

**Barriers to digitalisation in Europe include the prevalence of small firms, market fragmentation and a financial system that is largely skewed towards debt finance.** Notably, the heavy dependence of European firms on debt finance, as opposed to equity, adversely affects younger firms that want to digitalise. Policymakers need to pay attention to managing the potential risks of further digitalisation that include labour market polarisation, cyber security threats and weakened competition in some segments, but these risks only enhance the need for Europe to be at the forefront of this technological wave.

## Financial conditions are still favourable overall, but the financial sector remains ill-suited to supporting innovation and transformation

**While financing costs are still low, the EU banking sector has strengthened, with only pockets of weakness and some vulnerability to monetary policy normalisation.** EU banks have increased their capital positions and ratios of non-performing loans to assets are gradually improving. Monetary policy normalisation may affect bank asset valuation via possible depreciation of sovereign debt. It needs to be accompanied by the reactivation of cross-border inter-bank lending to ensure that firms that are dependent on bank lending are not adversely affected.

**The number of finance-constrained firms in the EU has fallen to only 5%, but young, small and innovative firms are proportionally more affected.** Many EU firms have undergone a process of deleveraging, particularly in the periphery countries, so that few firms now face financing constraints. Nonetheless, constraints are more prevalent in certain countries and among firms that are small, young, engaged in innovation or that invest heavily in intangibles. Collateral requirements and financing costs are the main sources of dissatisfaction.

**Large differences in firm performance call for targeted policies.** Some finance-constrained firms outperform unconstrained ones in measures such as total factor productivity, employment growth and return on assets, while others notably underperform. This suggests that policies to address access to finance need to discriminate between firms with regard to performance, to alleviate constraints whilst avoiding further misallocation of resources.

## Europe needs more equity finance for innovation and digitalisation...

**Equity financing in Europe is comparatively underdeveloped, undermining resilience to shocks, innovation and participation in new technology sectors.** Private equity, venture capital and listed equity funding all lag the US and advanced Asian countries on several dimensions, leaving European firms more dependent on bank lending, weakening resilience to financial shocks and creating a “growth-stage trap” in firm development.

**The cost of equity remains high and issuance activity low.** While the cost of debt now stands at around 400 basis points below its pre-financial crisis level, the equity risk premium remains elevated. Reasons for the underdevelopment of equity include corporate culture, reluctance to dilute power and tax bias in favour of debt, as well as financial sector regulation, transaction costs and financial illiteracy.

**However, as financial integration across the EU gradually recovers, there is a promising compositional shift away from cross-border bank lending towards equity.** The share of equity (both portfolio equity and foreign direct investment) in cross-border liabilities has risen in all European regions, with the share for periphery countries rising particularly rapidly.

## ... and enhanced efforts to improve the environment for investment

**Targeted public investment needs to be complemented by further actions to address barriers to investment and improve investment conditions.** The slow recovery and wide dispersion of corporate returns are evidence of the inefficient allocation of resources across the corporate sector. This in turn suggests barriers to firms’ exit and entry and a need for greater market flexibility.

**Addressing Europe’s infrastructure gaps requires a focus on long-term needs, strong institutions and technical capacity.** This is required at all levels of government, including at the EU level to overcome the fragmentation of the single market.

**Support for innovation should seek to create an ecosystem that enables effective commercialisation, adoption and adaptation of new products and processes.** Patenting activity is highest in sub-national regions that are ranked better for institutional quality, R&D expenditure and a skilled workforce.

**Improvements in the institutional and regulatory environment are needed to facilitate equity financing,** to help EU corporates raise capital at more competitive rates. The capital markets union can play a pivotal role in creating better incentives and fostering the geographical diversification of financial holdings within the EU.

## Recommendations

**Europe's economy still lacks the tools to meet the urgent challenges of the future:** remaining globally competitive in the face of rapid innovation and digitalisation, achieving sustainability, and creating an inclusive and cohesive society. Retooling means a process of transformation. It means learning new skills, innovating and adopting new technologies, renewing our infrastructure and cutting dependence on fossil fuels. It requires not just more investment but better investment and great attention to issues of governance, namely the creation of an enabling regulatory and institutional environment.

### Encourage a dynamic, innovative business sector:

- **Improve regulatory conditions for firm growth, and market entry and exit.** The small average size of EU firms is associated with less innovation, digitalisation and investment in training, and with more financial constraints. Removing barriers such as size-specific regulation will facilitate firm growth. Reducing barriers to firm entry and exit will improve resource allocation and productivity.
- **Address the conditions that reduce both the supply of and demand for equity financing** for EU corporates, particularly to avoid the growth-stage trap. These include issues such as tax bias against equity, financial regulation and financial literacy.

### Overcome the fragmentation of Europe's markets:

- **Deepen the single market for services** to improve opportunities and incentives for the rapid adoption of digital technologies, investments in intangibles and the scaling-up of innovative firms.
- **Facilitate the reintegration of Europe's financial markets, particularly through cross-border equity** for improved financial stability, risk-sharing and equity financing for firms. This requires institutional and regulatory changes, as foreseen under the capital markets union.

### Work together on skills:

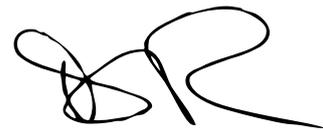
- **Recognise the skills gap as an opportunity for EU joint action**, in view of the benefit-sharing brought by the free movement of labour. Agenda-setting, funding and the creation of conditions that encourage public and private investment in skills can all make a difference.

### Unblock critical investment in infrastructure, innovation and climate change mitigation:

- **Promote better infrastructure governance, with careful project selection, at all levels** to ensure the efficient use of available funds, including at the EU level to remove bottlenecks in the single market.
- **Complement lending instruments and grant support with advisory services to address backlogs in disadvantaged regions**, and to ensure that gaps are addressed in a comprehensive way.
- **Set the right price signals to promote investment in climate change mitigation**, including the removal of fossil fuel subsidies, a higher carbon price and the alignment of market design with the low carbon transition objective. Financial instruments and information can promote energy audits as an effective way to help unblock energy efficiency investments.
- **Support innovation and adoption of new technologies**, considering the complementarities between the upgrading of technology and investments in different classes of intangible assets, and also the complementarities between private and public investment.

**There is a need for concerted efforts, using the instruments at Europe's disposal.**

- Member States' policy efforts and budgetary resources should be more targeted at addressing the long-term growth challenges at the national level, having in mind potential spillover effects at the European level.
- The EU budget needs to be effectively leveraged to target enhanced levels of sound investment in intangibles and innovation, skills, climate change and infrastructure, accelerating the transformation of European business and enhancing its competitiveness, while addressing the social challenges that such transformation might imply.
- As the Member States' own treaty-based investment bank, with a proven track record – not only in lending, but in the targeted use of guarantees and equity financing, blending with EU resources and technical advisory support to maximise impact – the EIB has a unique capability to facilitate these efforts.



*Debora Revoltella*  
Director, Economics Department  
European Investment Bank



## Introduction

**EU real GDP continued its expansion at a robust pace in the sixth year of the economic recovery from a double-dip recession and a twin financial crisis.** In 2017, real GDP growth slightly accelerated relative to the three preceding years, exceeding the pre-crisis historical average. The economic expansion is underpinned by solid growth of private demand. Unemployment declined and reached pre-crisis values, while employment rates are well above their peak before 2008. Consumer and business confidence are near historical maxima.

**In 2018, European investment reached pre-crisis levels ten years after it plunged during the financial crisis of 2008.** Investment in the EU picked up in 2013 and gradually accelerated to reach a rate of growth close to its historical average during expansions. In the first four years of the recovery, investment growth was supported mostly by investment in machinery and equipment and in intellectual property products. As a result, the mix of assets that the EU economy invests in became more balanced compared to the pre-crisis boom, during which investment in dwellings and other buildings had a much higher share.

**Aggregate developments hide a lot heterogeneity across the Member States.** The recent investment upturn in countries in the European periphery has not been enough to bring their investment rates up to historical averages. The household and government sectors contribute the most to the weakness of investment rates in those countries. Corporate investment lags in most cohesion countries and in Portugal and Italy.

**A significant investment backlog piled up during the crisis years that remains to be addressed.** Infrastructure investment was among the main casualties of the deep economic recession and the fiscal retrenchment in the years that followed. Investment in research and development (R&D), especially in the business sector, remains well below that of peer countries and has been broadly flat, relative to GDP, over the past few years. After record levels before the financial crisis, investment in climate change mitigation is not consistent with ambitious policy targets. Investment in digital infrastructure and digital technologies also lags behind global peers.

**Low growth rates of potential output mean that economic well-being is not improving at the rates of the post-war period.** Potential output growth rates in most Member States of the EU remain very low – well below post-war averages and below the growth rates of other advanced economies. These low levels may remain for a long time if EU Member States fail to address the structural problems that hold down potential output growth. The urgency of such policy action increases with the prospects of rising uncertainty emanating from intensifying tensions in international trade relations, monetary policy normalisation and current repricing of risks.

**The European economy is in need of retooling.** Several critical areas require decisive action by European policymakers to:

- increase innovation;
- move confidently into the digital age and adapt to the related changes such as ensuring the availability of relevant skills and infrastructure;
- green the economy;
- reshape the financial system to facilitate all of the above.

**The thrust of this report is to monitor and evaluate cyclical developments and to provide in-depth analysis of structural issues holding down investment and potential output growth in Europe.** The first part of the report monitors developments in tangible and intangible assets in the EU. Chapter 1 gives

an overview of investment developments in the EU. Chapter 2 focuses on infrastructure investment and stresses the need for better governance of infrastructure investment. Chapter 3 looks at innovation and the intangible economy and makes the case for the urgency of increasing innovation in Europe. Chapter 4 follows developments in investment in climate-change mitigation in the context of an ambitious plan to decarbonise the European economy. The second part of the report is devoted to investment finance. Chapter 5 monitors credit conditions, demand and supply for investment finance. Chapter 6 zooms in on equity financing in Europe, arguing that EU financial systems have to adjust to better serve a more innovative economy with a lot of intangible investment. The last part of the report focuses on skills, in Chapter 7, and digitalisation activities of businesses, in Chapter 8. All these analytical pieces provide stark evidence of the need to retool Europe's economy.

**While still an innovation leader, the EU is falling behind global peers.** The EU economy remains unable to close the gap in R&D expenditure, a key input into innovation, with the US. On this measure, the EU was overtaken by China in 2014 and is falling further behind South Korea and Japan. The EU creates too few new innovation leaders. Since 2011, European firms joining the group of top R&D spenders have made up 13% of the total newcomers, Chinese firms 25% and US firms 37% of all new firms. Even those EU firms that belong to this group spend less on R&D than their competitors in China and the US.

**The EU is falling behind in the adoption of digital technologies.** 42% of EU firms assess their investment in digital technologies as insufficient. This relative lack of investment is reflected in firm productivity, as the estimated productivity gap between firms investing substantially in digital technologies and the rest is about 17%. The overwhelming predominance of small firms in the EU aggravates the problem, as smaller firms are much less likely to invest in digital technologies: only 55% of firms with fewer than 50 employees invest in such technologies, compared to 72% among larger firms. The digital gap is most evident in the EU services sector, where 74% of firms have adopted some digital technology, whereas in the US the share is 83%. The consequences of this gap may be stark, as digital giants in the service sector have benefited substantially from their first-mover advantage to become market leaders in their respective segments.

**Nearly eight out ten firms consider lack of staff with the right skills to be a barrier to their investment activities.** This share has increased by 10 percentage points in the past three years. The problem of the shortage of a workforce with relevant skills may further worsen with the rise of the intangible economy that will be associated with more innovation and digitalisation. These trends have increased social polarisation as the demand for workers with high and low skills increases at the expense of those in the middle, threatening social cohesion.

**The EU is a global leader in addressing climate change, but the challenge is so steep that much more remains to be done.** The global economy has to decarbonise radically to ensure that climate change remains manageable: by 2050 net greenhouse gas emissions should be practically zero. This cannot happen without an enormous change in the ways in which we live and work. Such a change entails much more spending than the current 1.3% of GDP in the EU, but also substantial behavioural changes, most of which have to be incentivised by policy measures.

**The EU financial system needs to change.** The substantial bank bias of the EU financial system is no news. With stock market capitalisation lower by 80 percentage points of GDP relative to the US, the EU financial system offers too little equity financing as the EU economy becomes more innovative and based on intangible assets. Lack of equity growth finance is among the major reasons for the dearth of new leading innovators in the EU, especially in the digital and technological sectors. Innovative firms are 62% more finance-constrained and 54% more dissatisfied with collateral requirements than non-innovative firms.

**Governance is a problem, even in well-governed countries.** Where governance is not up to standard, investment and innovation remain suboptimal. Firms in regions with high scores on governance are nine times more likely to have published a patent over the past five years, compared to firms in regions with lower scores. In infrastructure, governance can mean the technical capacity to select and implement complex projects. Many decision-makers in the EU, especially sub-sovereign, lack this technical capacity:

43% of municipalities with poor infrastructure quality report limited technical capacity to implement infrastructure projects as major obstacle.

**To remain among global leaders, Europe should act promptly to reap the benefits of the digital era, addressing its long standing structural issues.** The need for European governments, and the EU as a whole, to identify and address the roots of the problems in these areas is urgent. This report contributes to detecting causes and suggesting solutions by offering analysis of several critical areas of the EU economy: innovation, digitalisation, skills, infrastructure and finance.

**An original feature of this report is the incorporation of the latest results from the annual EIB Investment Survey (EIBIS).** The survey covers some 12 000 firms across the EU and comprises a wide spectrum of questions on corporate investment and investment finance. It thus provides a wealth of unique firm-level information about investment decisions and investment finance choices, complementing standard macroeconomic data.

**The add-on module of the EIBIS this year was a survey of 1 700 firms across the EU and the US on their demand for skills and digitalisation activities.** The survey comprised both manufacturing and services sector firms, which were surveyed on, among other things, their awareness of adoption activities with respect to certain digital technologies, barriers to adoption and their views on the impact of digital technologies on labour markets, competition, and investment needs.

**The analysis in the report draws significantly on the add-on module of EIBIS 2017, which was a survey of 555 large municipalities across the EU inquiring about infrastructure needs, planning and financing.** The survey thus follows a bottom-up approach to evaluate infrastructure needs and the administrative capacity to plan and implement infrastructure projects. The answers to this survey shed light on the relationship between infrastructure investment activities and infrastructure investment needs and gaps, and the bottlenecks for infrastructure investment activities from planning to actual implementation.

Throughout the report, EU countries are often grouped into three groups of countries that have several common features. The countries that joined the EU since 2004 and rely substantially on EU cohesion and structural funds are grouped in the “cohesion countries” group. The countries in the EU periphery – Italy, Spain, Portugal, Greece, Cyprus and Ireland – are grouped in the “periphery” group. All other remaining countries are in the “other EU” group.

## Investment growth

in 2017-2018 is

# 4%

which is above the **historical average**

# 8%

of **EU firms** are  
leading  
innovators vs

# 16%

of **US firms**

**Infrastructure  
investment is**

# 75%

of the **pre-crisis level**

In regions with  
**high quality  
institutions**

firms are **3x**  
more likely to **innovate**

# 9x

more likely to  
**introduce a patent**

# 43%

of **municipalities** with  
poor infrastructure say  
**technical capacity is a  
major obstacle**

EU investment in **climate  
change mitigation is**

# 1.3%

of **GDP**  
down from **1.6%**  
in 2016

PART I

# Investment in tangible and intangible capital



## Chapter 1

### Gross fixed capital formation in the European Union

**The economies of all EU Member States have strengthened since 2017.** That said, the recovery remains weaker than previous European recoveries. The low potential growth rate sets a speed limit on economic expansion and reveals structural weaknesses in Member States' economies. At the same time, prospects of rising uncertainty, ongoing asymmetric repricing of risks and slowing international trade threaten to slow down investment and growth in the EU.

**Investment composition has become more balanced, but investment levels are still not enough to deal with the legacy of ten years of low investment.** After four years of investment largely in machinery, equipment and intellectual property products, investment in buildings and structures has started to catch up. Nevertheless, significant investment backlogs remain.

**Corporate investment expanded and exceeded expectations, except for cohesion countries, but a gap in equipment investment with the US may herald another decline in the competitiveness of EU firms.** Non-financial corporations in the EU were the most important contributor to investment in 2017, investing more than expected a year earlier. This led firms to revise upwards their expectations for investment in 2018. This was despite increasing concerns about the political and regulatory environment. That said, a gap in equipment investment between the EU and the US has opened, adding to the gap in research and development. Weaker investment in the EU is associated with declining and more dispersed returns, suggesting a polarisation of corporates between winners and losers.

**A large backlog in government investment should be addressed by the planned fiscal expansions across the EU.** This expansion, in 2018 and 2019, should focus on productivity-enhancing expenditure, such as investment projects, neglected during the six years of fiscal retrenchment.

## Introduction

**In 2018, the European economy entered its sixth year of expansion following a prolonged period of economic decline and stagnation.** During these six years, investment increased gradually and unevenly across Member States and asset types. This increase was not enough to clear the investment backlogs accumulated during the twin recession in the EU or close long-existing gaps relative to global peers such as the US. Worse still, new gaps have appeared as European investment has lagged behind the US since 2009.

**The main aim of this chapter is economic scrutiny and analysis.** The first section places recent investment developments into the broader context of economic developments. The second section discusses both general investment trends and investment by asset type in more detail. The next three sections analyse investment by institutional sector: general government (third section), corporate (fourth section) and residential (fifth section). The last section concludes with the policy implications of the analysis.

## Economic environment in the European Union

**EU real GDP continued its expansion in 2017 and 2018.** In 2017, the EU economy continued to grow; real GDP growth slightly accelerated relative to the three preceding years, exceeding the pre-crisis historical average of 2.5% per year (Figure 1, panel a). Despite some differences in growth rates among Member States, real GDP expanded everywhere in the EU. Consumer and business confidence remained high.

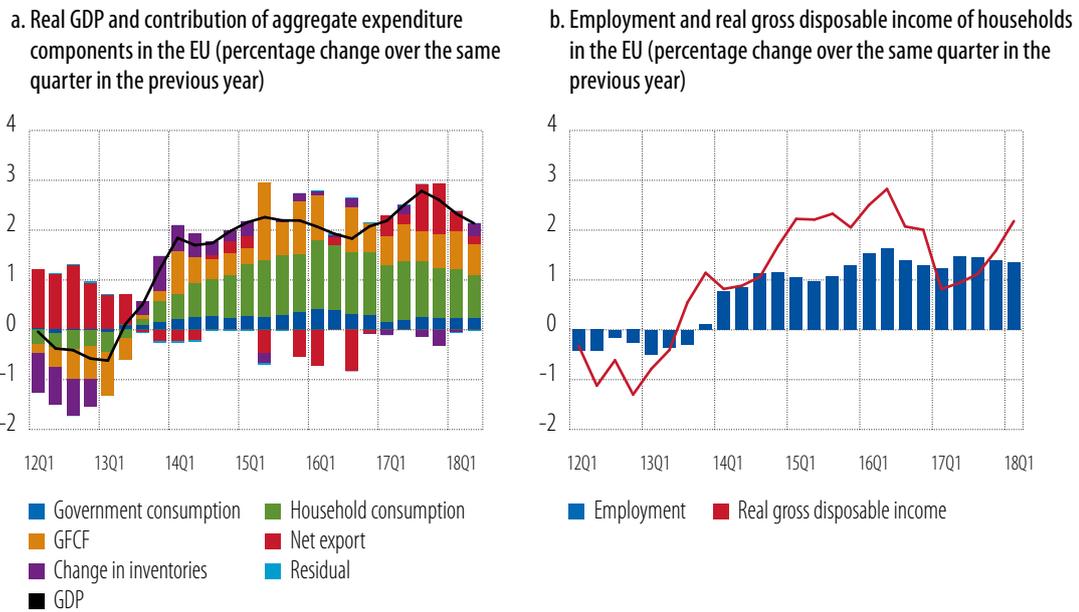
**Private domestic demand is the main driver of the ongoing economic expansion.** In 2017 and the first half of 2018, growth in private domestic demand maintained its pace and accounted for nearly three-quarters of total GDP growth. Household consumption and, increasingly, investment have underpinned private domestic demand.<sup>1</sup>

**Net exports provided an additional boost to GDP growth in 2017 helped by the broad-based synchronised global upswing.** In 2017, global growth was faster than in 2016, and growth increased in two-thirds of the world's economies. World GDP grew at its fastest pace since 2011; in real terms, world trade grew by 4.9% in 2017. A large part of this momentum was due to the emerging Asian economies, but since Europe is not greatly exposed to this region, it cannot reap the benefits of export demand. It nonetheless benefits from the strong ongoing worldwide economic momentum.

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<sup>1</sup> Investment and gross fixed capital formation are used interchangeably in this chapter.

**Figure 1**  
**Evolution of real GDP and the labour market**



Source: Eurostat.

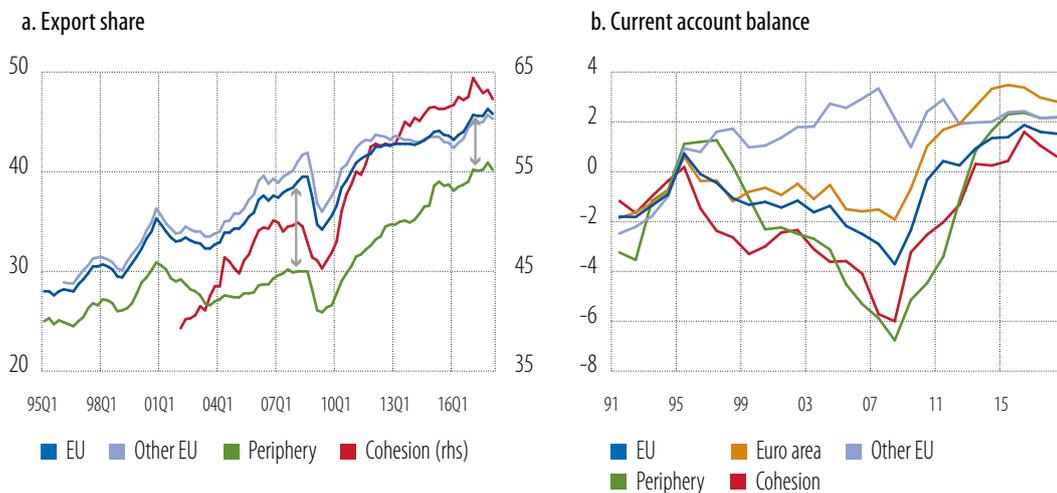
Note: Real variables are in euro 2010 chain-linked volumes. Employment is measured as the number of people employed. Bars represent the four-quarter growth rate of employment.

**The major economic rebalancing towards exports continued.** Following the Global Financial Crisis, periphery and cohesion economies embarked on a set of measures that improved their overall export competitiveness. Consequently, the export share of GDP increased faster than in other economies (Figure 2, panel a). The gap between the periphery and other EU countries has partly closed.

**In this upturn, EU countries continue to record current account surpluses (Figure 2, panel b).** In the wake of the sovereign debt crisis, periphery and cohesion countries experienced a sudden stop in capital inflows. This forced a current account rebalancing, from elevated deficits to substantial surplus. Since the end of the crisis, these countries have recorded current account surpluses of a similar magnitude to the EU average and even more sizeable in the euro area when the UK deficit does not influence the average.

**The improvements in current account balances in cohesion and periphery economies suggest a change in the growth model.** These improvements were the result of internal devaluations and the associated gains in competitiveness that enabled the tradable sector of these economies to become a major driver of economic growth. This is in contrast to the pre-crisis period, when economic growth came mostly from the non-tradable sector.

**Figure 2**  
**Export share and current account balance (% of GDP)**

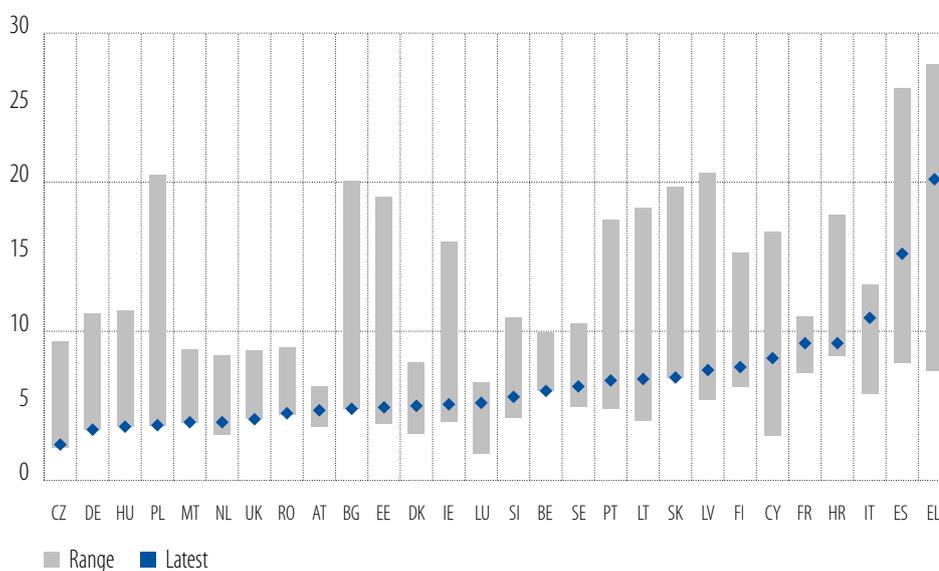


Source: ECON calculations based on (a) Eurostat and (b) AMECO.

Note: Nominal values are used for the export share, based on seasonally and calendar adjusted series. The last observation on current account balances (2018) on panel b is partially forecast.

**Steady improvements in labour markets and in real disposable income support the growth of private consumption and investment.** The solid growth in private demand resulted in an employment growth rate that has averaged 1.7% per year since 2014 (Figure 1, panel b). Robust gains in employment reduced unemployment rates across the EU. The aggregate EU share of employment in total population reached its highest level since 1995. Unemployment rates are at or near historic lows in 21 EU economies. Strong domestic demand, moderate wage growth and labour market reforms in several EU countries promoted this remarkable performance. These positive developments raised real disposable household income, which further boosted private demand. Accordingly, real GDP per capita in the EU, a common measure of economic prosperity, grew faster than in the rest of the advanced economies.

**Figure 3**  
**Unemployment rates in the EU since 1995**



Source: Eurostat.

**These positive developments notwithstanding, some Member States have still a long recovery path ahead.** Unemployment remains stubbornly high in Greece, Spain and Italy. A significant investment backlog exists in all periphery countries and many other EU countries.

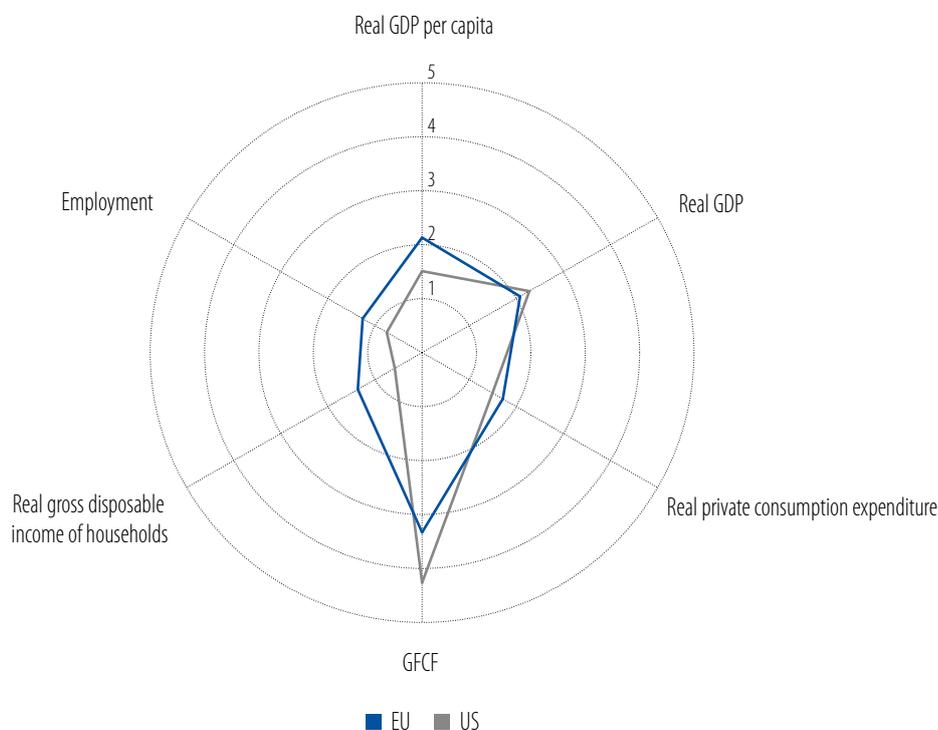
**Real GDP growth in the whole EU, and in most individual Member States, has exceeded the low potential growth rate.** A combination of a low potential growth rate, favourable macroeconomic conditions and growth-enhancing reforms recently introduced in many European economies led to a positive output gap. One immediate consequence is that current rates of GDP growth are not sustainable unless the potential growth rate picks up. It also means that the impressive improvements in the labour market cannot be sustained much longer. That said, there is much uncertainty around real-time estimates of the potential output growth rate, making it difficult to assess the output gap.

**Policymakers should focus on raising the growth rate of potential output, which remains very low in EU economies.** They should enhance competition, remove barriers to entry and exit for firms, modernise labour markets and introduce a series of measures to improve the business environment. While an improving economy may help to mitigate the lack of popular support and strong vested interests, headwinds remain significant. The departure of the UK from the EU and the continuing rise of Eurosceptic political parties across the EU pose imminent threats of economic turbulence and lack of agreement on the ways to address EU-wide policy issues. Increasing tensions in international trade relations pose additional risks to many EU economies.

**Positive economic news notwithstanding, this recovery is not as strong as previous ones.** Many studies argue, however, that this recovery should not be compared with the historical average because of the financial crisis that accompanied the preceding downturn. Recoveries after financial crises are typically weaker and more gradual than the average recovery, largely due to weak banking sectors, impaired collateral values and balance-sheet adjustments. Studies suggest their impact was further reinforced in this recovery by a large fiscal retrenchment across the EU (EIB, 2016; Kalemli-Ozcan et al., 2018; Reinhart and Rogoff, 2014). These studies argue that the suitable yardstick to gauge the strength of the current recovery is recoveries following financial crises.

**The strength of the ongoing EU recovery is comparable to that of the US economy after the 2008 financial crisis, with the exception of investment performance (Figure 4).** The EU economy outperformed the US in the period after the last business cycle trough – 2013:Q1 for the EU and 2009:Q2 for the US – when comparing growth of real GDP per capita, employment growth, growth of real gross disposable income and growth of private consumption expenditure. The growth rate of real GDP in the EU was comparable with that in the US. Investment growth in the EU, while still good by EU standards, remained below that in the US.

**Figure 4**  
**Strength of the economic expansion in the EU relative to the US since the last recession trough**



Source: Eurostat, OECD Statistics.

Note: The chart compares the average annual growth rates of the six macroeconomic aggregates in the first 22 quarters following the last business cycle trough in the US (2009:Q2) and in the EU (2013:Q1). Real variables are in euro 2010 chain-linked volumes for the EU and US dollar 2009 chain-linked volumes.

## Evolution of gross fixed capital formation in the European Union

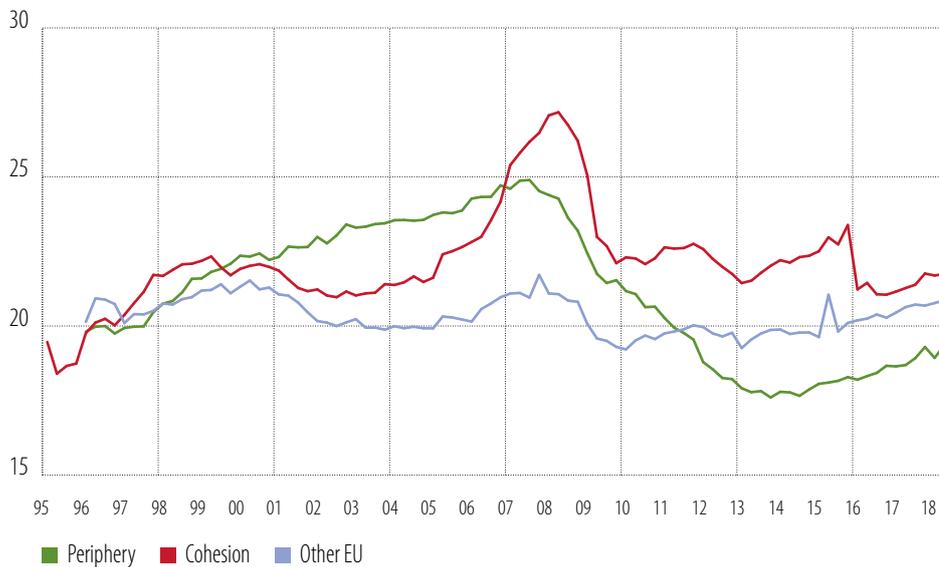
**Gross fixed capital formation (GFCF) increased across the EU in 2017 and the first half of 2018.**<sup>2</sup> The average rate of growth of GFCF in the EU in this period was around 4%. Real investment increased in all Member States except Estonia, Luxembourg and Malta, where it temporarily declined in the course of 2017, before recovering in 2018.

**Investment rates remain low in periphery countries.** The recent investment upturn in periphery countries has not been enough to bring their investment rates up to historical averages. Spain is the only periphery country where the investment rate returned to its early 1990s level before its long-lasting real-estate investment boom. The household and government sectors contribute the most to the weakness of investment rates in periphery countries. In Portugal, and in Italy to some extent, the corporate sector also plays a substantial role. In the cohesion and other EU countries groups, investment rates normalised in all countries except Slovenia, where households and corporations invest significantly less (relative to GDP) than they used to.<sup>3</sup>

<sup>2</sup> See footnote 1 on p. 16.

<sup>3</sup> Investment rates may not necessarily return to their historical averages. As explained in Box D, for the same level of total capital stock there may be different equilibrium investment rates depending on the asset composition of the total stock.

**Figure 5**  
**Real GFCF in the EU (% of real GDP)**



Source: Eurostat.

Note: The Republic of Ireland is excluded from the group of periphery countries. Real variables are in euro 2010 chain-linked volumes.

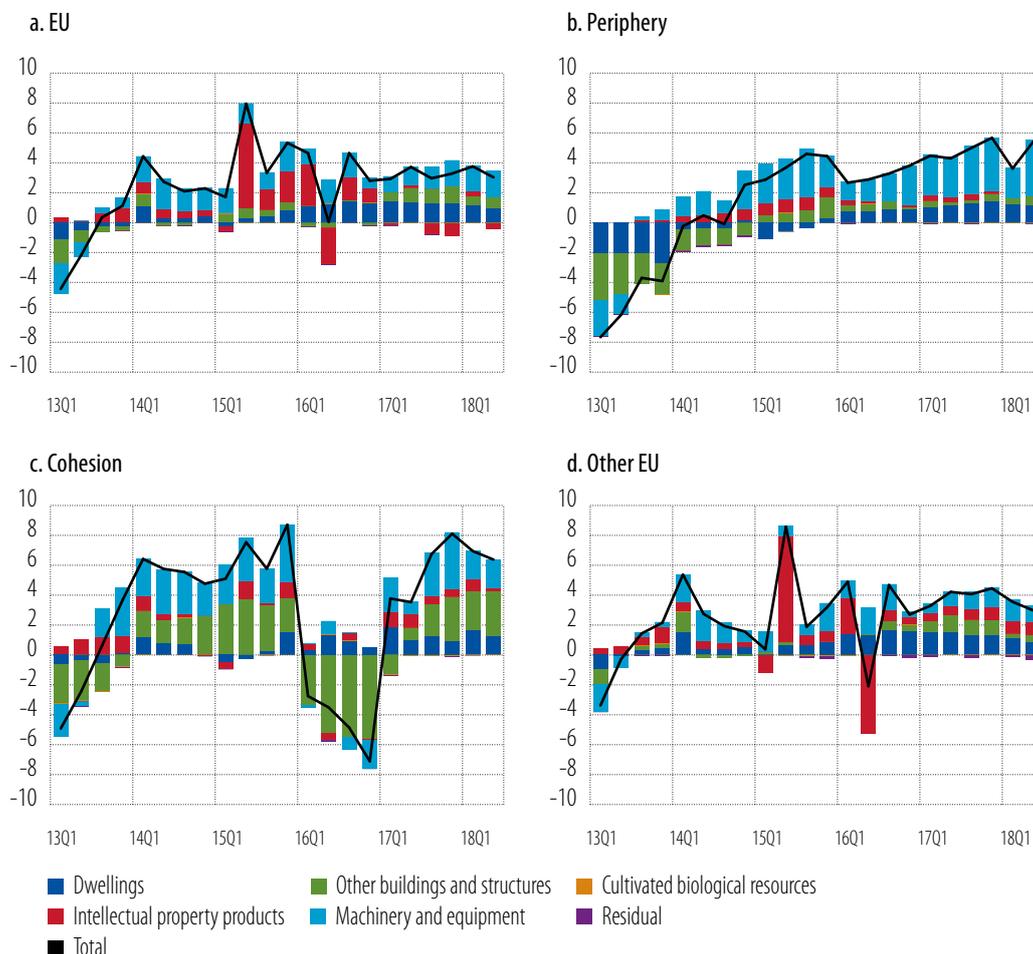
Despite these increases, a significant backlog, especially in infrastructure (see Chapter 2 in this report) remains in the periphery and in many other Member States. Investment in research and development (R&D), especially in the business sector, remains well below that of peer countries (Chapter 3) and investment in climate change mitigation is not consistent with ambitious policy targets (Chapter 4).

**The asset composition of investment is now more balanced.** Investment in machinery and equipment and in intellectual property products (IPP) led investment growth in most EU countries during the first four years of the current recovery (EIB, 2017). Since 2017, investments in dwellings and in other buildings and structures have started to catch up in many countries, including Spain and Ireland (Figure 6).<sup>4</sup>

**Investment in machinery and equipment in the EU continued its robust growth.** Relative to GDP, it is close to the highest levels attained in the past 22 years nearly everywhere in the EU. Investment in this asset type continues to be the main driver of overall investment in periphery countries (Figure 6, panel b), where it accounts for two-thirds of the total investment growth since the beginning of 2014. Investment in machinery and equipment levelled off, however, in cohesion countries, with a contribution of one-third of total growth since the beginning of 2014 and only one-tenth since the beginning of 2017.

<sup>4</sup> Investment in dwellings and other buildings and structures, also called investment in construction in this chapter, includes investment in new buildings and structures, investment in improvements in existing buildings and structures and certain expenditure for maintaining existing buildings and structures.

**Figure 6**  
**Real GFCF by asset type** (percentage change over the same quarter in the previous year)



Source: Eurostat.

Note: The Republic of Ireland is excluded from the group of periphery countries. Real variables are in euro 2010 chain-linked volumes.

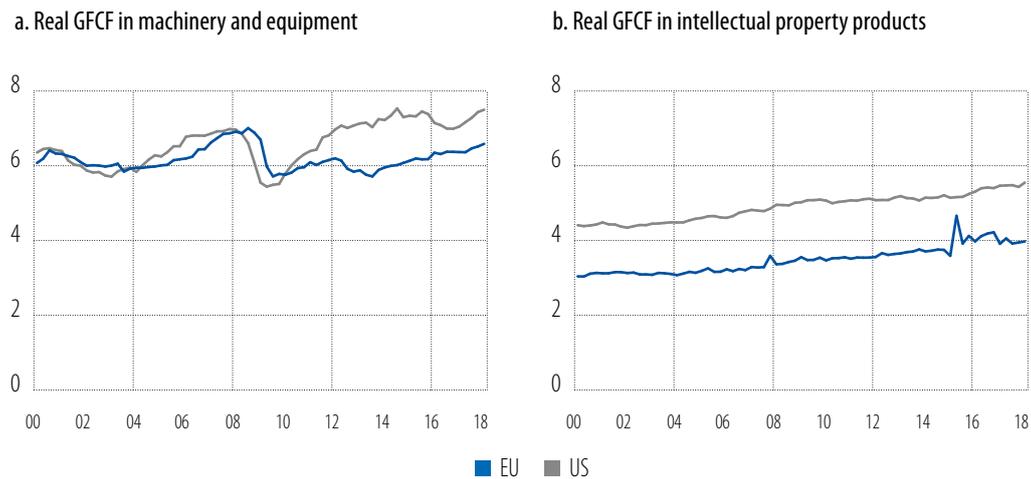
**Investment in intellectual property products (IPP) has been an important driver of the investment recovery in the EU (Figure 6).** It accounts for 20% of total investment growth in the EU since the beginning of the recovery. Its contribution to investment growth in cohesion countries is even higher, at 33%, but is only 13% for periphery countries. Investment in IPP has risen steadily in most countries since 2013, with the notable exception of Finland, where the effects of Nokia's decline are still present. In addition, investment in IPP has not been very dynamic in Greece, Latvia, Portugal and Slovenia.<sup>5</sup> Chapter 3 of this report analyses IPP investment in detail.

**Despite being the drivers of the EU recovery, investment in machinery and equipment and IPP remain well below those in the US, as a share of GDP (Figure 7).** The enduring gap between the EU and the US in R&D investment (Figure 7, panel b), the main component of IPP, is a well-known and well-studied fact (Van Ark et al., 2008; Moncada-Paternò-Castello et al., 2010). Little is known, however, about the divergence in the investment rates in machinery and equipment between the EU and the US (Figure 7,

<sup>5</sup> Investment in IPP displayed large swings in Ireland in the period 2015–17 and in the Netherlands in 2015. In both cases, the substantial increases and subsequent declines were related to the shifting into or purchasing of existing IPP by large corporations in the respective country.

panel a). Investment rates were very similar and moved in line with each other between 2000 and 2009. The divergence coincided with the beginning of the investment recovery from the financial and economic crisis in 2008–9.

**Figure 7**  
**Real GFCF in machinery and equipment and IPP in the EU and the US (% of real GDP)**



Source: OECD Statistics.

Note: Real variables are in euro 2010 chain-linked volumes for the EU and US dollar 2009 chain-linked volumes for the US.

**Three industrial sectors account for a significant part of the gap between the US and the EU at its peak in 2014–15.** Transport and storage contributed some 40% to the gap at its peak. The significant increase in investment in machinery and equipment in this industrial sector relates to the hydrocarbon extraction boom in the US and the related investment in moving the extracted oil – equipment for pipelines, specialised rolling stock, etc. The second-largest contributor to the gap, with 20%, is the finance and insurance sector. The agriculture sector added 15% to the gap between investment rates in machinery and equipment in the US and the EU at its peak in 2014–15. Businesses in this sector have significantly increased investment in automation and digitalisation, as labour shortages have become more common in the US and the regulatory burden has increased.

**The investment surge in machinery and equipment in the US may further consolidate and improve the competitive position of the US relative to the EU in the digital economy.** Many studies have found that the US increased the productivity gap with the EU in the 1990s, when US businesses invested heavily in information and communications technology (ICT) equipment in the retail sector and information and communication sector.<sup>6</sup> The current wave of investment in automation and digitalisation is likely to further increase the productivity gap between the two economies and strengthen the competitive position of US businesses, unless their EU counterparts follow suit.

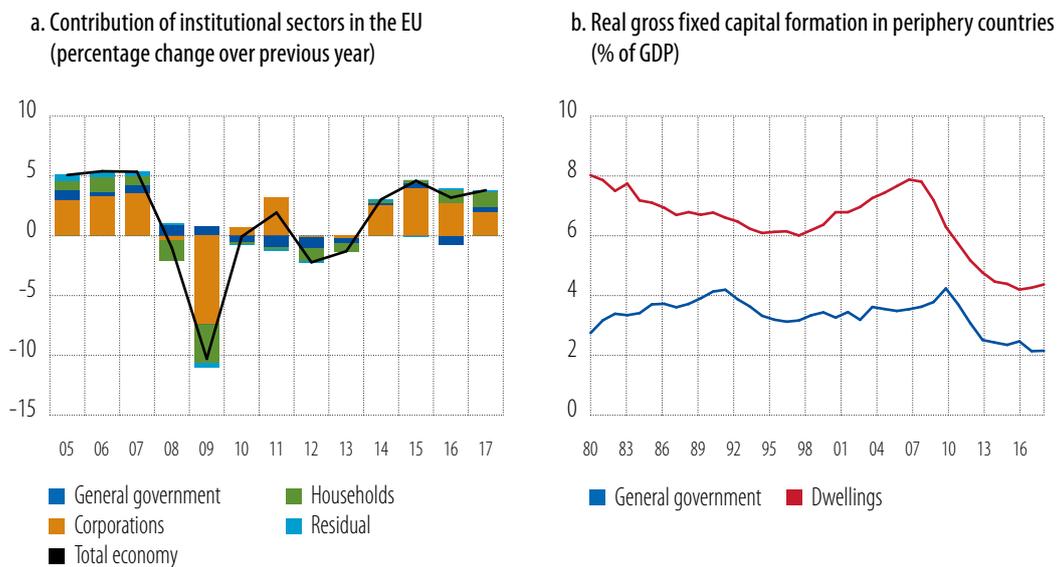
**Investment in dwellings and other buildings and structures gradually picked up after years of decline and stagnation, in line with its historically strong pro-cyclical pattern (Figure 6).** The cyclical upturn across the EU resulted in solid employment gains and robust growth in disposable income. This, combined with low interest rates, fuelled demand for dwellings. Investment in other buildings and structures by corporates and governments also gained momentum as the economy strengthened, while interest rates remained low and European governments loosened their fiscal stance in favour of more investment (Figure 8, panel a).

6 See Uppenberg (2011) and the references therein.

**Despite these improvements in construction investment, investment rates remain at historically low levels in the periphery and some cohesion countries.** For the periphery countries, the investment rate is about four percentage points (p.p.) of GDP lower than the pre-crisis low in 1998. In the cohesion countries, the current ratio of investment in other buildings and structures to GDP is the lowest in 22 years. The beginning of the new programming period for European Structural and Investment Funds and weak corporate investment explain the current low level.

**The household and government sectors in the periphery countries account for most of the weak performance of aggregate EU GFCF, and of construction investment in particular.** Despite improving numbers, real investment by the household and government sectors in the periphery countries is very low by historical standards (Figure 8, panel b). The household sector in cohesion countries continued to increase investment in 2017, while real GFCF of the general government slightly declined. Both sectors increased real investment in other EU countries in 2017.

**Figure 8**  
**Real gross fixed capital formation and contribution of institutional sectors**



Source: Eurostat European Sector Accounts, AMECO and EIB staff calculations.

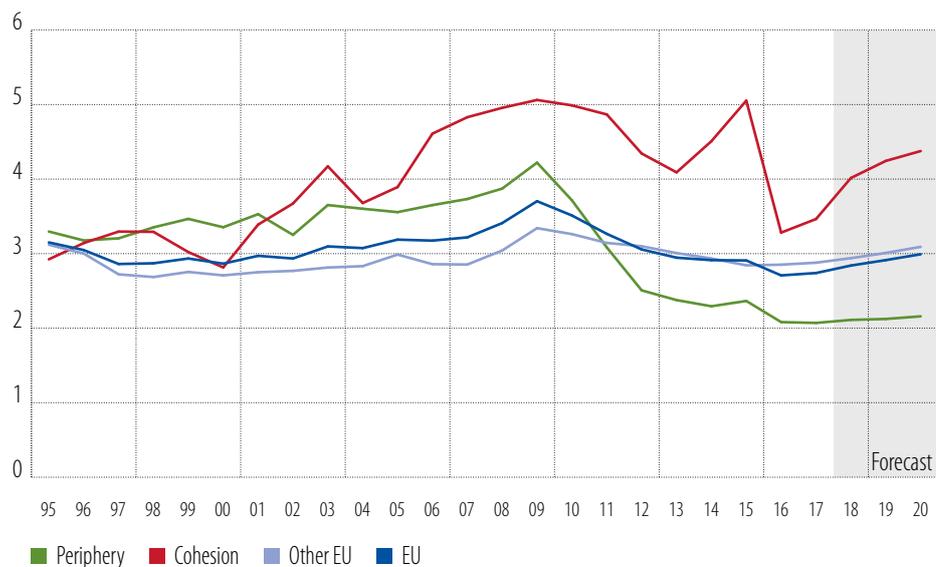
Note: GFCF series are deflated using price deflators for 2010 chain-linked volumes for the total economy GFCF, except for the household sector, where price deflators for GFCF in dwellings are used.

## Investment by general government

### Recent developments

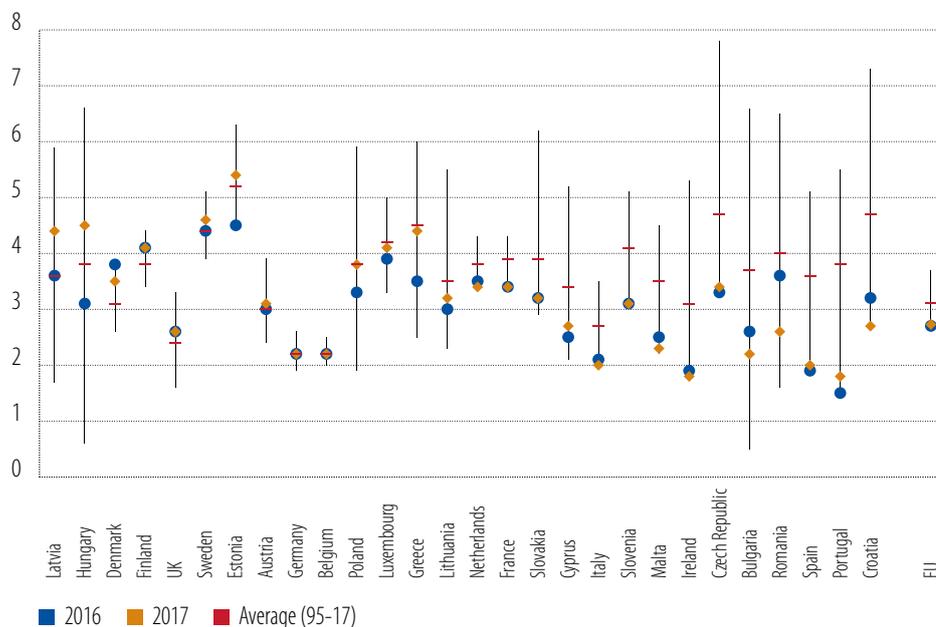
**Government investment is gradually increasing, but remains at low levels, especially in the periphery (Figure 9).** Gross fixed capital formation of the general government was broadly stable in 2017, at 2.7% of GDP, remaining at its lowest level in more than two decades. Public investment is expected to increase to 2.8% in 2018. This level is still significantly below the average between 2003 and 2017 (3.1% of GDP). Cohesion countries have shown a limited increase in public investment over the last year (from 3.3% to 3.5% of GDP), following the large decline in 2016. The rebound in capital spending in cohesion countries is expected to be stronger in 2019, reaching 4.2% of GDP. In periphery countries, public investment contracted almost constantly for a decade, until 2016. In 2017, public investment remained stable, while in 2018, 2019 and 2020 it is expected to expand only marginally, according to the European Commission (EC) Autumn 2018 forecast (European Commission, 2018d).

**Figure 9**  
**Gross fixed capital formation of the general government (% of GDP)**



Source: AMECO. Autumn 2018 forecast, European Commission.

**Public investment, as a share of GDP, has been very stable in other EU countries (Figure 9 and Figure 10).** Over the forecast period (2018–20), other EU countries are expected to increase investment from its long-term average (2.9% of GDP) to 3.1% of GDP. While cohesion and, to some extent, periphery countries have registered considerable variation in public investment relative to GDP, core euro area countries such as Germany, Belgium, France and the Netherlands have witnessed almost stable levels. One major difference, beyond the existence of country-specific fiscal rules over the business cycle and political decisions over fiscal composition, is eligibility for European Structural and Investment Funds, with their significant support and their inherent financial cyclicity.

**Figure 10**  
**Public investment in 2017 (% of GDP)**

Source: AMECO.

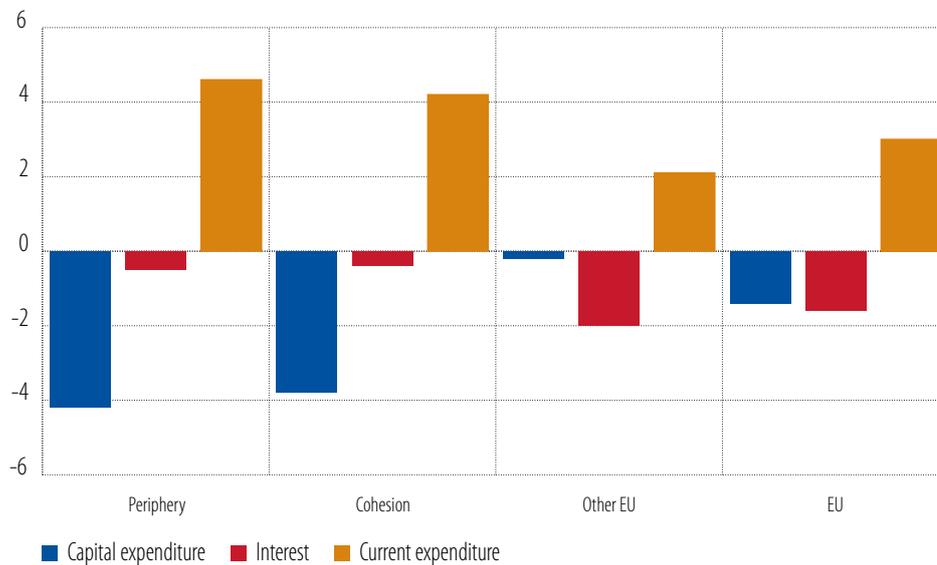
Note: Ranked by gap between 2017 level to long-term average (1995–2017).

**In 2017, public investment was above the long-term average in only six countries (Figure 10).** Public investment in 2017 was below the long-term average in 15 countries, while in the rest of the EU public investment levels were broadly aligned with the long-term average. Over the last year, public investment increased in Hungary (by 1.4 percentage points of GDP), Greece, Estonia and Latvia. However, in Romania, public investment contracted by more than a percentage point of GDP. Over the last two decades, public investment in Europe has ranged between 2.7% and 3.7% of GDP.

**Compared with the long-term average, capital spending made up a smaller part of total public expenditure (Figure 11).<sup>7</sup>** In 2017, according to Eurostat, capital spending represented 8.2% of total public expenditure, compared with a long-term average (1995–2016) of 9.3%. On the other hand, current expenditures were more than three percentage points above average. Lower interest rates than in the past two decades made debt servicing less burdensome for all country groups: interest payments in 2017 were significantly below the long-term average (4.3% versus 6.7%). In periphery and cohesion countries, the shift in public spending composition was particularly significant. In 2017, capital spending as a share of total expenditure was below the long-term average in both groups, with a much higher share in current spending (Figure 12). As explained in EIB (2017), many political, cyclical and structural factors can explain these trends.

<sup>7</sup> For a discussion of this shift in the structure of public spending see Chapter 1 and Chapter 2 in EIB (2017).

**Figure 11**  
**Change in composition of public expenditure**  
(difference between 2017 and 1995–2016 average in p.p. of GDP)



Source: Eurostat.

Note: This chart reports the changes in shares of public expenditure by country group between 2017 and the long-term average (1995–2016).

**A more growth-friendly composition of public spending was observed in 2017 (Box A).** This is the case for all country groups, and for periphery countries in particular. In 2017, capital expenditure in Europe increased by 0.4 p.p. as a share of total expenditure, compared with the previous year. However, the share of current expenditure declined by 0.2 p.p. Interest spending declined further to 4.3% of total expenditure (-0.2 p.p. compared with 2016). Periphery countries made the biggest contribution to this change. Capital spending in these countries increased, on average, by 0.8 p.p., while current expenditure declined by 0.5 p.p. The marginal increase in public investment and in growth-friendly recomposition observed in 2017 is consistent with budgetary plans outlined in the Member States' 2017 Stability and Convergence Programmes.

**The EU's country-specific recommendations in 2017 and 2018 call for an improvement in the composition of public expenditure to create room for public infrastructure investment.** This was the case for 2017 in Belgium (improve the composition of public spending), Germany<sup>8</sup> (increase public investment levels), Ireland<sup>9</sup> (prioritise public investment), the Netherlands and Spain (increase investment in R&D). In all the countries concerned, recommendations were reiterated in 2018<sup>10</sup>.

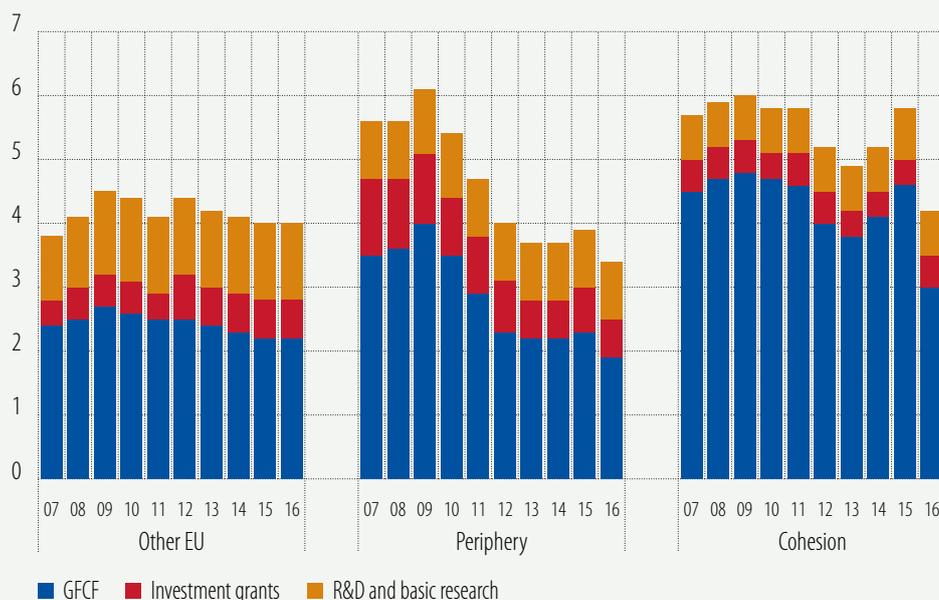
8 Recommendations were to "use fiscal and structural policies to... achieve a sustained upward trend in investment. Accelerate public investment at all levels of government, especially in education, research and innovation, and address capacity and planning constraints for infrastructure investments".

9 Recommendations were to "better target government expenditure, by prioritising public investment in transport, water services, and innovation in particular in support of SMEs. Enhance social infrastructure, including social housing and quality childcare".

10 In the assessment of 2017 country-specific recommendations, the Commission concluded that "limited" progress was made to address these recommendations by Belgium and Spain and "some" progress was made by the Netherlands, Ireland and Germany (notably with the operational start of the agency for municipal investment "Partnerschaft Deutschland – Berater der öffentlichen Hand GmbH"). In Germany, one of the recommendations in 2018 was to increase public investment at the municipal and regional levels in particular.

**Box A****Growth-enhancing expenditure and tax incentives**

Beyond public investment, the public sector has a role in enhancing potential growth by supporting research and innovation. Governments can either adopt a model of direct intervention or provide incentives to private sector R&D, as well as supporting productive investment that has been hindered by market failures. To assess the magnitude of productive public spending, an indicator of growth-enhancing public expenditure is computed. It summarises government outlays classified as gross fixed capital formation, plus investment grants and total expenditure for R&D and basic research.<sup>11</sup> As shown in Figure A.1, growth-enhancing expenditure increased from 3.9% of GDP in 2007 to 4.5% in 2009, before declining slowly to about 4% of GDP until 2016. In the other EU countries, an increase in spending on investment grants and research offsets the decline of government GFCF. In periphery countries, growth-enhancing expenditure also increased until 2009, before declining by almost 3 p.p. of GDP, driven by the contraction of both gross fixed capital formation and investment grants. In cohesion countries, growth-enhancing expenditure suffered a steep contraction in 2016, driven by lower GFCF.

**Figure A.1****Growth-enhancing expenditure 2007-16 (% of GDP)**

Source: Eurostat.

Public expenditure on basic research and R&D increased only in the other EU countries; the gap in public R&D expenditure of more developed EU countries and of the rest of the EU widened over the last decade. This poses some questions on the quality of government spending to support the upgrade of technology and business sophistication in less developed countries, particularly with regard to the large gap between R&D investment and EU-wide objectives (see Chapter 3).

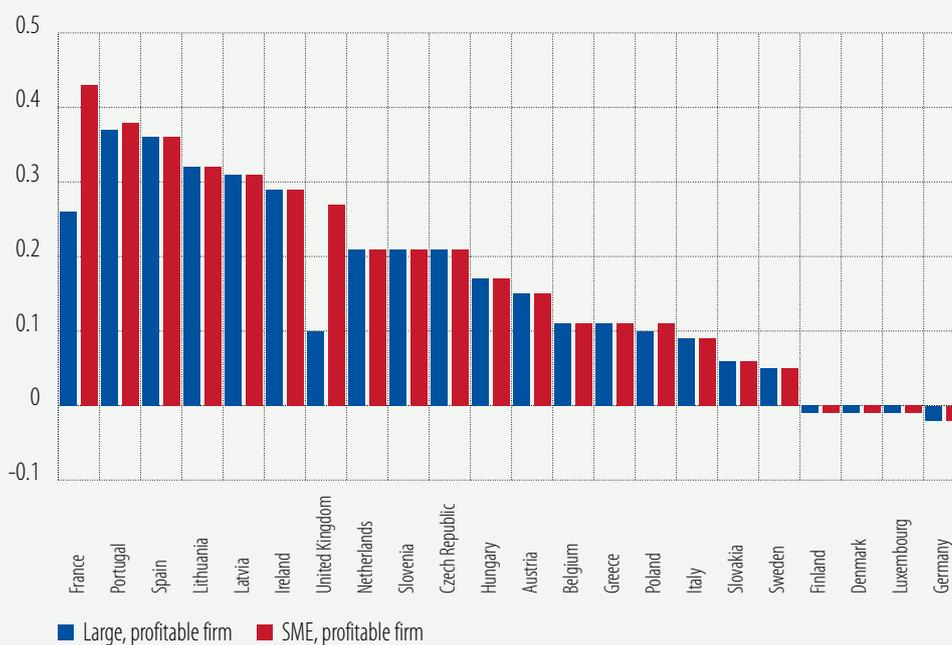
On the revenue side, tax incentives are crucial for investment decisions in the private sector, together with tax certainty and the administrative efficiency of the tax system. Over the last few years,

<sup>11</sup> To avoid double counting, gross fixed capital formation and investment grants in R&D and basic research are excluded.

governments have introduced tax incentives to give preferential treatment to firms investing in R&D (see Chapter 3 of EIB, 2017). Overall, in 2017, 25 Member States were using fiscal incentives for innovation support. In particular, 15 Member States had accelerated depreciation or enhanced allowance schemes in place (European Commission, 2017).

As shown in Figure A.2, the subsidy rate is the highest for SMEs in France, Portugal and Spain, while in Finland, Germany, Luxembourg and Denmark the tax subsidy rate is negative.<sup>12</sup>

**Figure A.2**  
**Implied tax subsidy rate on R&D expenditures**



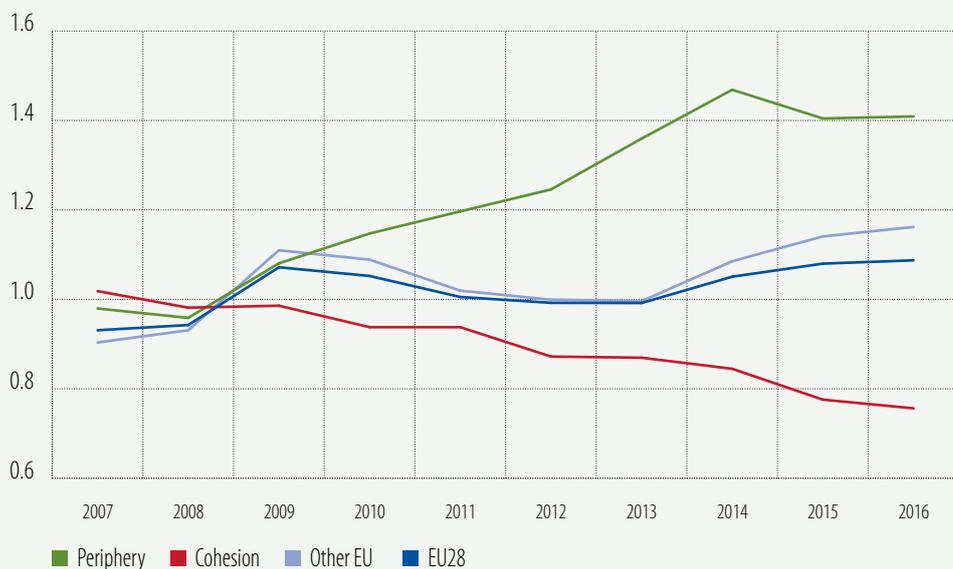
Source: OECD.

Some countries, such as Italy and France, have made large use of tax incentives for the deployment of digital technologies and equipment in firms. In France, in particular, payable tax credits (those above tax liability) to firms are the largest of the few countries reporting this indicator and are equivalent to around 1% of GDP. Non-payable tax credits (those below the liability of taxpayers) are recorded in national accounts as subsidies, which include many other forms of subsidies to influence levels of production, the prices of products or the remuneration of the factors of production<sup>13</sup>. In national accounts, it is not possible to disentangle the “tax incentive” component within subsidies from the traditional “transfer” component for remuneration of producers, nor to understand why a subsidy is in place (e.g. public goods, market failures). In Europe as a whole, subsidies have picked up, as a share of GDP, over the last few years (Figure A.3). While this component of public spending declined steadily in cohesion countries, it increased significantly in periphery countries, from about 1.0% of GDP in 2008 to 1.4% in 2016.

<sup>12</sup> The tax subsidy rate is calculated by the OECD as 1 minus the *B*-index, a measure of the before-tax income needed to break even on USD 1 of R&D outlays, measuring the marginal cost of R&D to users. In some countries, the *B*-index can be larger than 1, leading to negative tax subsidy rates on R&D expenditures.

<sup>13</sup> Together with: over-compensation of VAT; training schemes of companies; subsidies to reduce pollution; grants for interest rate relief; subsidies on products (per product or service produced); “deliberate” losses of public corporations (economic policy choices); support for payroll of disadvantaged employees (e.g. hiring of long-term unemployed).

**Figure A.3**  
Subsidies in selected COFOG categories, 2007–16 (% of GDP)



Source: Eurostat.

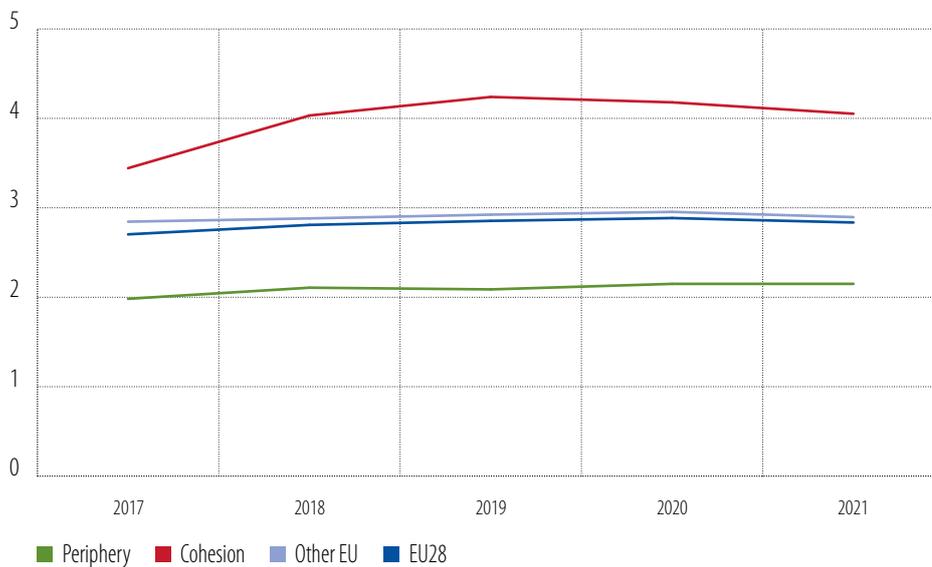
Note: The chart reports total subsidies in the sectors of economic activities, environmental protection, housing, health and education.

In the EU, subsidies are mainly targeted towards transport (25% of total), economic activities (25%) and fuel and energy (18%). If well designed, subsidies can support the redistribution of income and market efficiency at the same time. However, subsidies can also be detrimental to equity, efficiency and growth. Overall, subsidies have become larger items in public budgets (especially in countries that have reduced growth-enhancing expenditure the most). The crucial factors to make subsidies efficient are the capacity to identify target groups and market failures and to design tailored tax incentives.

## Medium-term fiscal plans

**Medium-term budgetary plans released in 2018 during the European Semester are slightly more optimistic than last year's, but public investment in Europe will remain below its long-term average.** Compared with 2017, Stability and Convergence Programmes submitted in 2018 show a slightly better outlook for public investment in the medium term. In 2017, budgetary documents forecasted the stabilisation of public investment at around 2.8% of GDP over 2018-20 and an increase of public GFCF relative to total expenditure. In 2018, budgetary plans submitted over the European Semester report an aggregate public investment equal to around 2.9% of GDP in Europe in 2019-20. This is broadly in line with the latest EC forecasts, yet below the long-term average of 3.2% of GDP. Gross fixed capital formation by the governments of all Member States will represent a higher share of total spending, reaching 6.5% of total expenditure in 2020.

**Figure 12**  
**Gross fixed capital formation of the general government in 2018 Stability and Convergence Programmes (% of GDP)**



Source: 2018 Convergence and Stability Programmes of EU Member States.  
Note: Greece not included.

**Public investment should increase, particularly in cohesion countries.** In this group, according to budgetary plans, it will reach 4.2% of GDP in 2019–20 (Figure 12). Several 2018 budgetary plans forecast significant shifts compared with the previous year. The governments of Hungary, Latvia, the Netherlands, Luxembourg, Malta, the UK, France and Portugal report greater public investment to GDP in the medium term. The opposite is observed in Romania, Cyprus, Lithuania and Croatia.

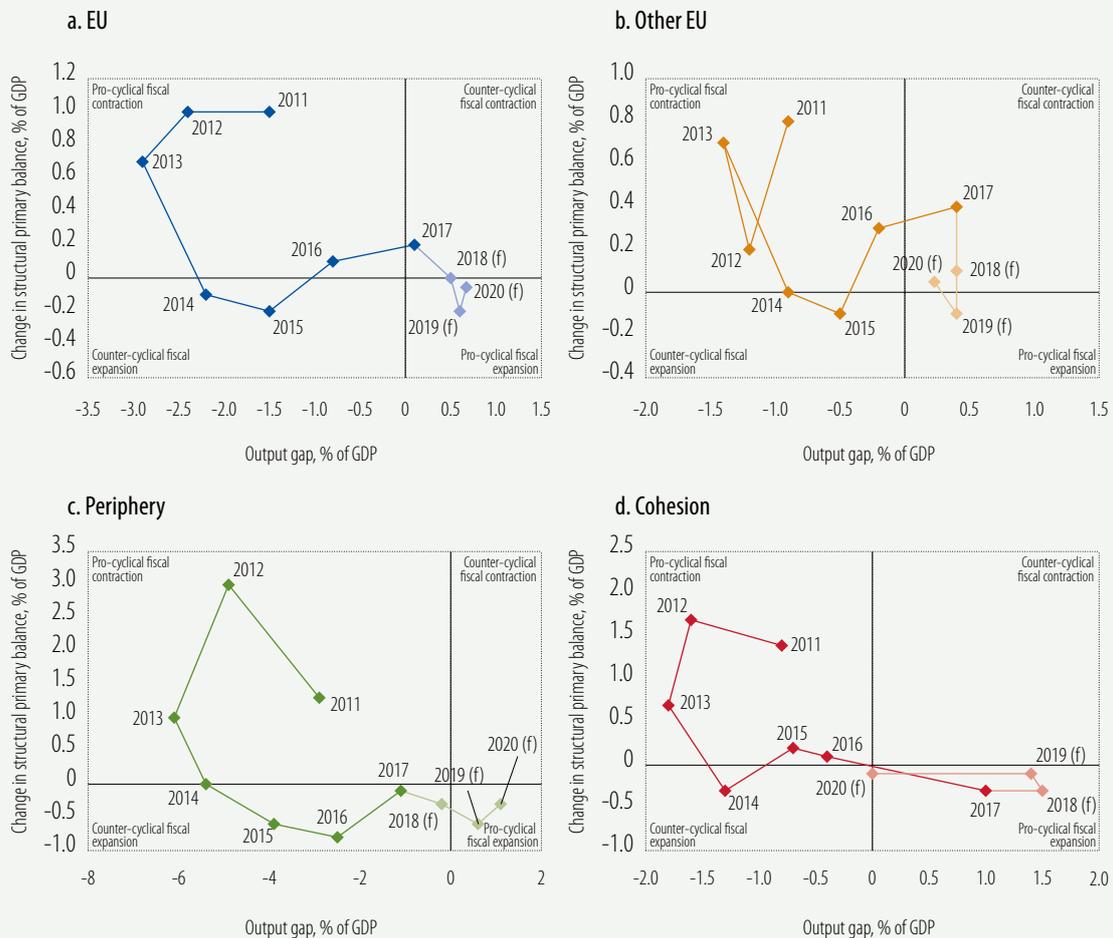
### Box B

#### Fiscal stance and composition of public expenditure

After the considerable fiscal contraction of 2011–13, the fiscal stance of the EU has been broadly neutral, with marginal changes of the structural primary balance in 2014–16. In 2017, the structural primary surplus increased by 0.2 p.p. to 1% of GDP, which amounted to a mild fiscal contraction.

In recent years, country groups have not always been consistent in terms of their fiscal stance. However, the EU, particularly the euro area, is currently benefiting from more homogeneous cyclical conditions, favouring a convergent fiscal policy orientation (European Commission, 2018c).

The structural primary surplus is projected to remain unchanged at 1% of GDP in 2018, according to EC forecasts, and to decline to 0.8% of GDP in 2019, with a fiscal expansion equal to 0.2% of GDP. The euro area will keep a neutral stance in 2018, in line with the recommendations of the European Fiscal Board (2017). For the first time in many years, the EU economy grew at potential in 2017 and is projected to grow above potential in 2018–20. As a consequence, the EU’s fiscal stance will be almost neutral, in pro-cyclical territory, following two years of fiscal contraction (Figure B.1). As shown in panels b–d in Figure B.1, cohesion countries already had a mild pro-cyclical expansionary fiscal stance in 2017, and are expected to be followed by periphery and other EU countries in 2019.

**Figure B.1**  
**Fiscal stance in the EU**

Source: ECON calculations, AMECO data.

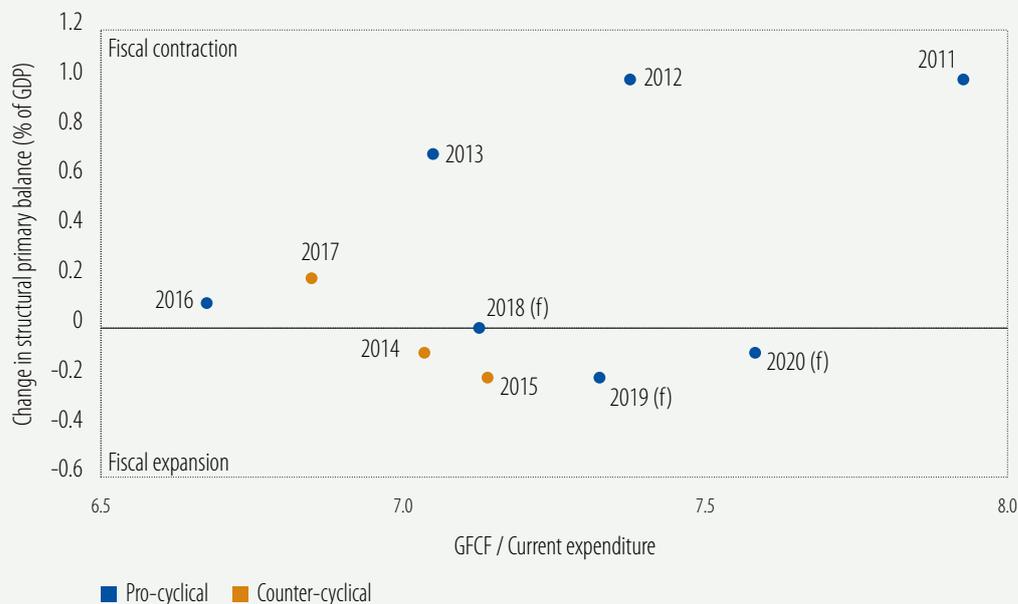
As mentioned in the text, capital spending declined when compared to total public expenditure in Europe. As shown in Figure B.2 (reporting the ratio of public investment and current expenditure to the corresponding fiscal stance by year since 2011), a significant decline of public investment is observed in 2011–13, years of significant fiscal contractions. This trend was interrupted in 2014 and 2015 (two years of neutral fiscal stance), before the decline in 2016. In 2017, public expenditure started to be more investment-oriented, a trend set to continue in 2018–20.

Since 2011, a fiscal contraction has been associated with less investment-oriented public expenditure in almost two out of three cases of fiscal contraction.<sup>14</sup> Fiscal expansions, on the other hand, are more often associated with a pro-investment shift in public spending (63% of cases), rather than with an increase of current expenditure (Figure B.3).<sup>15</sup>

<sup>14</sup> Out of these episodes, 83% were pro-cyclical, as they took place during bad economic times (when the output gap was negative).

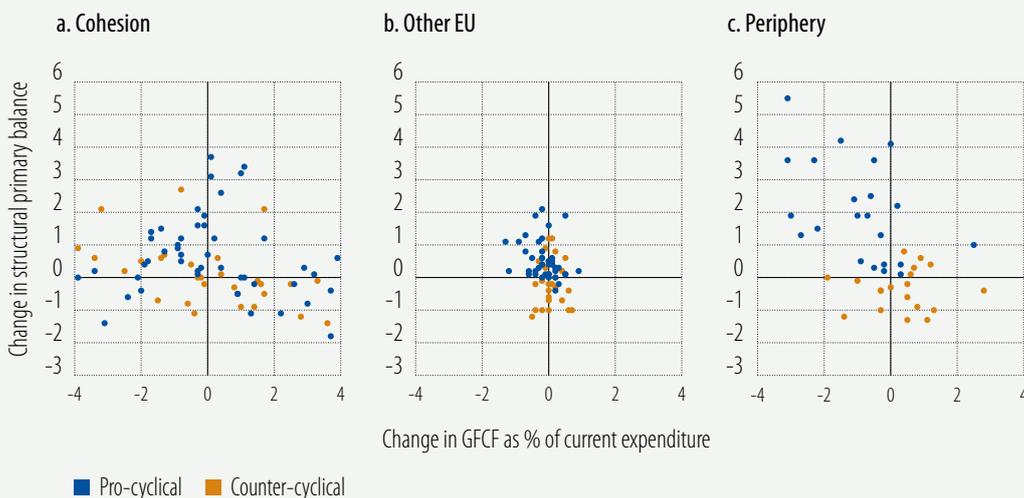
<sup>15</sup> Out of these, 64% took place during bad economic times, thus being counter-cyclical.

**Figure B.2**  
**Annual change in fiscal stance and composition of public expenditure in the EU**



Source: ECON calculations, AMECO data.

**Figure B.3**  
**Annual change in fiscal stance and public expenditure composition, 2011–17**



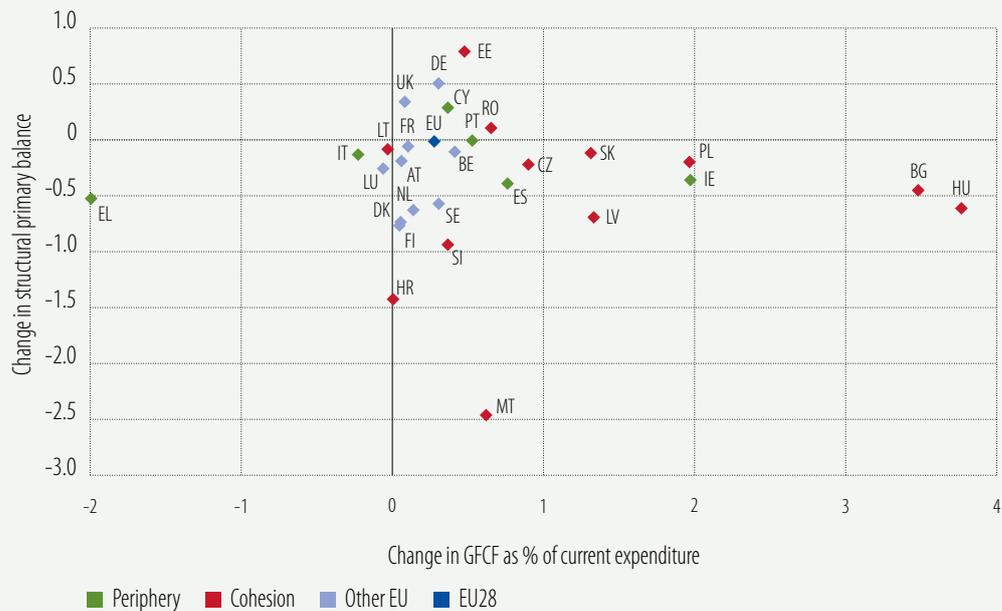
Source: ECON calculations, AMECO data.

Most European countries are expected to carry out a pro-cyclical fiscal expansion in 2018. One relevant question is whether the fiscal expansion will be used as an opportunity to increase public investment, which would be desirable given the public investment gap observed in most European countries following years of under-investment (European Commission, 2018). As shown in Figure B.4, several cohesion and periphery countries are expected to carry out an investment-oriented fiscal

expansion, while most other EU countries will keep the balance between investment and current expenditures almost constant. The fiscal stance is expected to become slightly expansionary in 2019. However, a few countries are expected to register a sizeable structural deficit, with the need for a significant adjustment (European Commission, 2018d).

**Figure B.4**

**Change in structural primary balance (% of GDP) and change of government expenditure composition (%), 2017-18**



Source: ECON calculations, AMECO data.

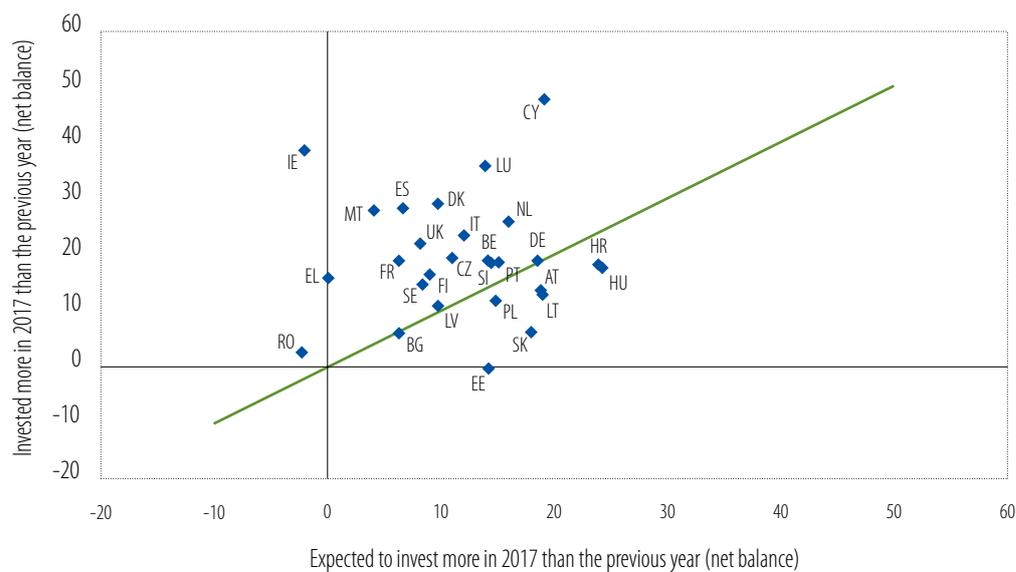
## Corporate investment

### Corporate investment in 2017 and outlook for 2018

**Real investment from the corporate sector in the periphery and other EU countries continued to increase in 2017.** The investment rate in the periphery exceeded the long-term pre-crisis average by more than 1 p.p. This was entirely due to a high investment rate in machinery and equipment. Investment in other buildings and structures, both corporate and government, remains 2.3 p.p. below its historical, pre-crisis average. Corporate investment in the other EU countries was close to the historical average.

**The investment increase in most countries exceeded the expectations of corporates from the previous year.** Every year, the EIB Investment Survey (EIBIS) asks non-financial corporations about their realised investment in the previous year and their expectations about investment in the current year. In 2017, realised investment turned out largely better than anticipated in most EU Member States (Figure 13).<sup>16</sup>

**Figure 13**  
**Correlation of expected vs realised investment (%)**



Source: EIBIS 17 and EIBIS 18.

Base: All firms.

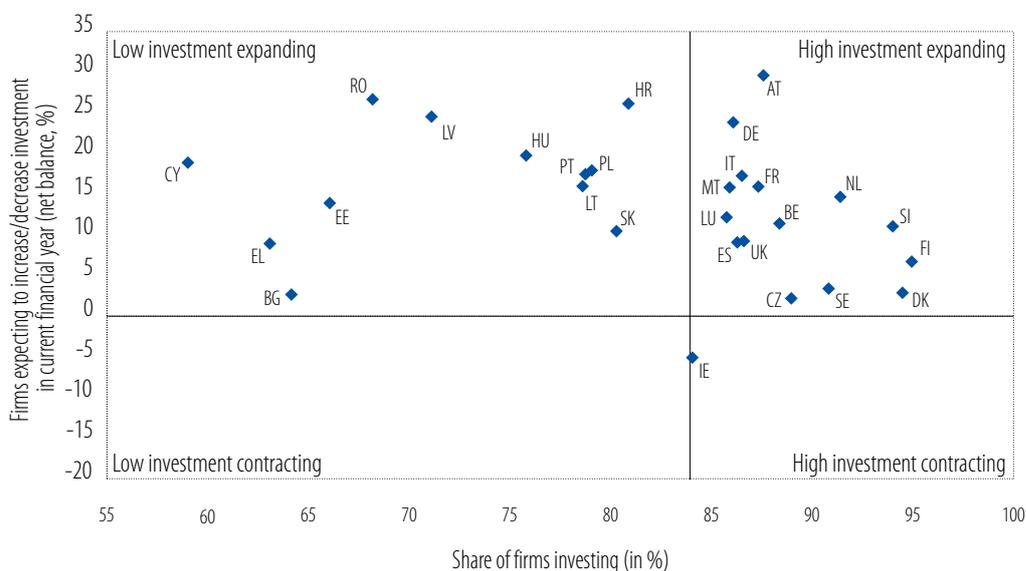
Question: Expectations are derived from two questions: firms that had invested in the last financial year were asked if they expected to invest more, around the same amount or less than last year; firms that had not invested in the last financial year were asked if they expected to invest in the current financial year. Realised investment is derived from the following question: overall was this more, less or about the same amount of investment as in the previous year?

<sup>16</sup> Data for Slovakia are preliminary.

**Firms remain largely optimistic for 2018.** The new wave of EIBIS data places most EU countries in the upper half of the investment cycle (Figure 14). This means that more firms expect an expansion of investment activities than a reduction going forward. Most of northern and central Europe and Spain are already experiencing a relatively broad-based investment upswing and expect a further increase in their investment (Figure 14, upper right area of the panel).<sup>17</sup>

**Optimism for investment in 2018 notwithstanding, in most cohesion countries investment levels remain low (Figure 14, upper left area of the panel).** The real GFCF of non-financial corporations is well below pre-crisis levels in most of these countries. In addition, the share of investment in value added is below the 20-year average levels in all cohesion countries, where data exists. This is partly due to a base effect: corporate investment in cohesion countries was very high in the 1990s and early 2000s as these economies were integrating into the European supply chain. This boom is unlikely to repeat itself.

**Figure 14**  
**Investment cycle**



Source: EIBIS 18.

Base: All firms. Share of firms investing shows the percentage of firms with investment per employee greater than EUR 500. The vertical line on the chart shows the share of investing firms in the first wave of the EIBIS in 2016.

Note: Net balances show the differences between firms expecting to increase investment activities in the current financial year and firms expecting to decrease them.

**Low returns and competitiveness problems, especially in many domestically owned firms, suppress corporate investment in cohesion countries (Box C).** The economic downturn after 2008 had a long-lasting impact on firms' profitability in cohesion countries. Smaller, mostly domestically owned, less competitive firms were affected the most. These were doing relatively well before the financial crisis thanks to booming domestic demand and easy financing conditions. After 2008 the returns of these firms fell significantly (Figure C.1, panel a) and with them the availability of internal financing. At the same time, obtaining external financing became more difficult and costly.<sup>18</sup>

<sup>17</sup> Ireland is the only country in which the share of firms expecting further expansion of investment activities is lower than the share of firms expecting a reduction. This outcome can be interpreted as a normalisation of two consecutive years of stronger-than-expected investment activities. It also reflects the expected impact of Brexit.

<sup>18</sup> Foreign-owned firms rely almost exclusively on intra-group funding and were not very affected by these financial constraints.

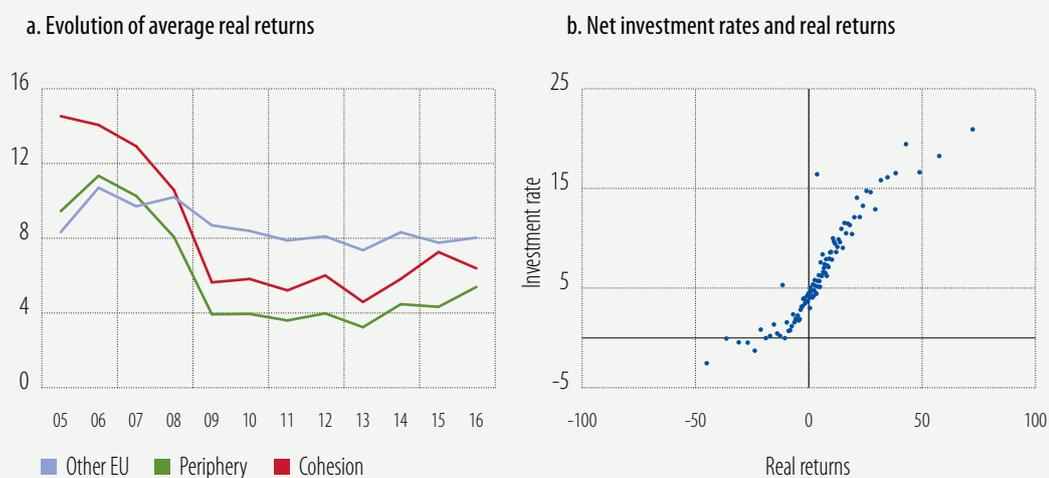
**Box C**

**Corporate returns and investment in the EU**

Corporate returns have not recovered to their early 2000s levels. Average real corporate returns declined significantly in 2008 and have remained below pre-crisis levels since then in most EU countries (Figure C.1, panel a).<sup>19</sup> This decline is closely associated with the decline in corporate investment (Figure C.1, panel b). This relationship survives in a formal statistical model that controls for the weighted average cost of capital, demand effects at very disaggregate level and firm-specific characteristics (see Kolev, 2018).

**Figure C.1**

**Real returns in the non-financial corporate sector in the EU (%)**



Source: Bureau van Dijk ORBIS, EIB staff calculations.

Note: Real returns are computed as the ratio of operating profit plus financial revenue to total assets from each firm's balance sheet and income statement. It is then adjusted for the change in the relative price of capital using the deflator for consumer expenditure and sector-specific investment deflators. The net investment rate is computed as the annual change in fixed assets as a share of fixed assets. Each observation on the plot represents the average real return within each percentile of real returns and the corresponding average net investment rate of the firms in each percentile of real returns.

The decline affected not only average returns but also the spread across the distribution. Consistent with the literature on the efficiency of capital allocation (Gopinath et al., 2017; EIB, 2017), the dispersion of real returns also increased after 2008. The polarisation of returns across firms increased as well: both the share of firms with below-average returns and the share of firms with very high returns increased.<sup>20</sup> The difference between the returns of the top 10% of firms in the return distribution and the median firm also increased, whereas the difference between the bottom 10% of firms and the median firm remained broadly the same before and after 2008. This provides additional evidence of polarisation.

The decrease in the weighted average cost of capital was much smaller. Chapter 5 of this report shows the dramatic decline in the borrowing costs of non-financial corporates in the euro area since 2009. The cost of equity increased after the financial crisis in 2008 and then returned to pre-crisis levels.

<sup>19</sup> Real returns are computed as the ratio of capital remuneration (operating profit and financial revenue) to total assets, adjusted for the sector-specific relative price of capital, depreciation and changes in the sector-specific prices of assets.

<sup>20</sup> In technical terms, the skewness of the distribution increased. This is also consistent with the recent literature demonstrating that the difference between very successful firms and the rest has increased (see Andrews et al., 2015).

Thus, the overall weighted average cost of capital declined somewhat, but much less than borrowing costs in some countries, especially in the periphery and cohesion groups.

Small and underdeveloped equity markets in most European countries cannot dismiss the relevance of the cost of equity to investment decisions of European firms. In imperfect markets and for a short period, it might be reasonable to approximate the cost of funds with borrowing costs. The argument breaks down when one looks at longer periods. Equity owners, even of non-listed companies, will not be willing to accept returns that are consistently lower than the market return and to continue to support new investments in their companies. In addition, lenders will refuse to finance new investments beyond a certain leverage threshold, which is a function of returns. Even if they are willing to lend, owners of leveraged firms would rather forgo some investments with a positive net present value because of a debt overhang problem (Myers, 1977).

The significant decline in corporate returns and investment after 2008 was mostly due to falling returns of smaller, older or less sophisticated firms.<sup>21</sup> Based on the first two waves of the EIB Investment Survey, the likelihood that a firm has declining returns in all years after 2008 decreases with the size of the firm, the share of intangible assets in its total assets, the share of its state-of-the-art machinery and equipment and its level of total factor productivity. Firms with declining returns in the period after 2008 are more likely to see demand as a constraint to investment and are more likely to assess their past investment as insufficient. The likelihood of having declining returns before 2008 was much less associated with productivity, size and the share of intangible assets.

The polarisation of the distribution of returns and the continuing existence of unprofitable firms has negative implications for the efficiency of resource allocation in the EU and consequently for aggregate productivity and potential GDP. This adds to the list of structural problems that policymakers should address to raise the potential growth rate of European economies.

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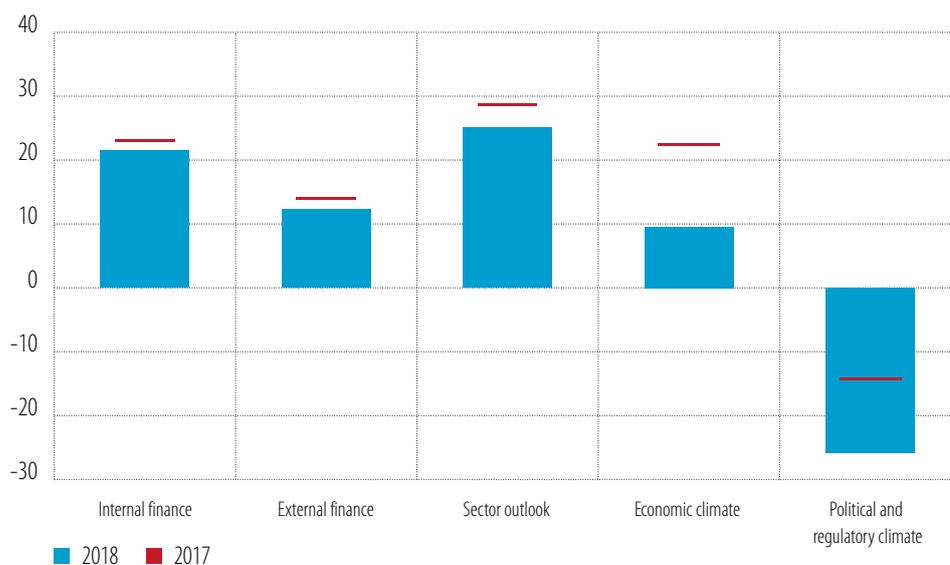
21 See Kolev (2018) for details.

## Business environment and obstacles to investment

The positive investment outlook is supported by an optimistic business outlook and by expectations of further easing of financing conditions (Figure 15). Firms continue to be very positive about their sector-specific business outlook for the next 12 months, with a net balance of about 25% of firms, particularly in the construction sector and the infrastructure sector, expecting an improvement. Expectations of internal financing capacity and access to external finance are also improving, with firms in the periphery countries being the most upbeat about an improvement in their funding situation.

Despite a positive macroeconomic outlook, expectations about the political and regulatory environment have deteriorated since the last round of the EIBIS (Figure 15). In 2017, net 14% of firms expected that the political environment would worsen over the following 12 months. This share has now increased to more than 25%. The deterioration in the political and regulatory outlook is particularly pronounced among firms active in manufacturing and larger firms. From a cross-country perspective, firms active in the UK (-43%), Poland (-43%), Germany (-34%) and the Netherlands (-32%) are most concerned about imminent adverse changes to the political and regulatory environment.

**Figure 15**  
Firms expecting improvement vs worsening (net balance)



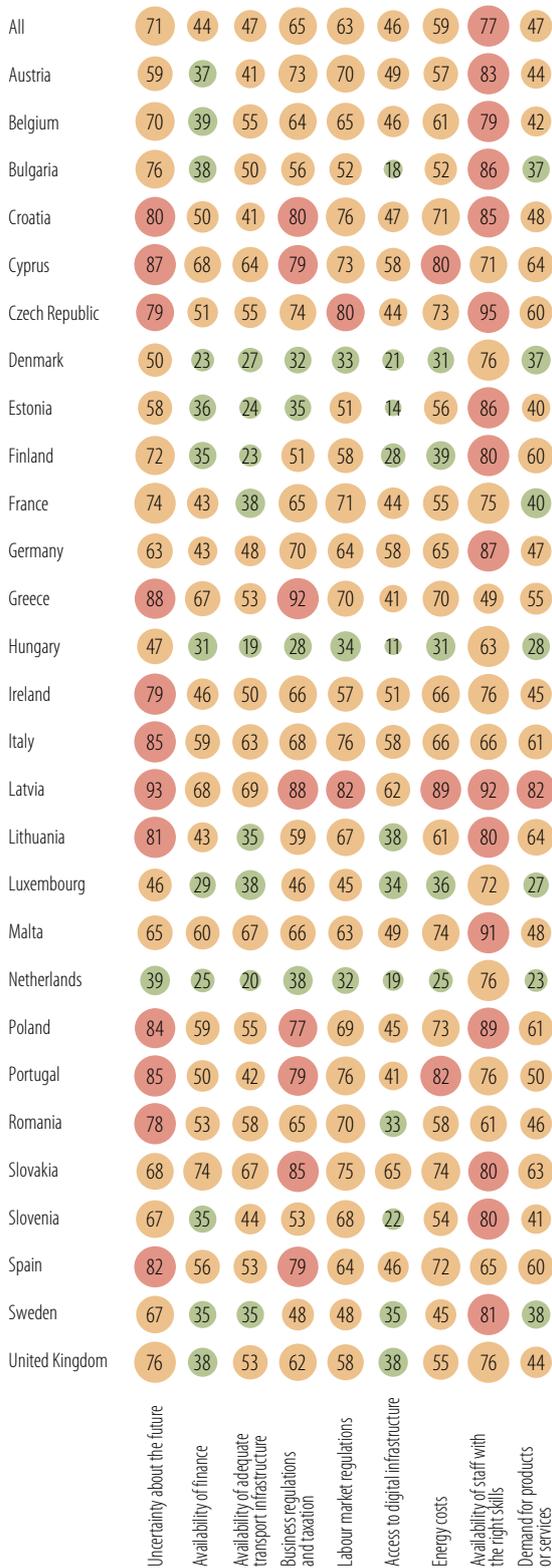
Source: EIBIS 17 and EIBIS 18.

Base: All firms.

Question: Do you think that each of the following will improve, stay the same or get worse over the next 12 months?

### A lack of staff with the right skills is the most frequently cited obstacle to investment in the EU.

The EIBIS asks firms about obstacles to investment in their countries of operation. Nearly eight out of ten firms cited “lack of staff with the right skills” as a barrier to their investment activities. The highest shares of mentions, with more than nine out of ten firms reporting “lack of staff with the right skills” as an obstacle to investment, are recorded in the Czech Republic, Latvia and Malta. The share of firms reporting skill shortages as obstacles increased by 6 p.p. compared with 2017 and by 11 p.p. relative to 2016. The largest increases were in Germany (up from 77% to 87%), Finland (up from 73% to 80%) and Croatia (up from 76% to 85%).

**Figure 16**  
**Obstacles to investment by country**

**A lack of staff with the right skills predominantly reflects difficulties in hiring new staff, whereas overall firms are satisfied with their current staff.** Firms consider 93% of their current staff to be fully proficient in their job. There are few differences between countries, with no country dropping below 85% for this metric. The share of staff considered proficient for higher-level occupations, including managers or professionals, is slightly higher than that for lower-level occupations. These high levels of satisfaction suggest that firms' concerns about lack of staff with the right skills do not reflect a negative assessment of their current staff, but rather reflect difficulties in finding new staff with the right skills.

**Difficulties in finding staff with the right skills are an obstacle to firms gaining a technological advantage (Figure 17).** Across sectors, the lack of skilled staff is most often perceived as a barrier by firms with a medium level of machinery and equipment that is "cutting-edge" or "state-of-the-art", suggesting that the "lack of staff with the right skills" constitutes an obstacle to firms moving up the quality ladder.

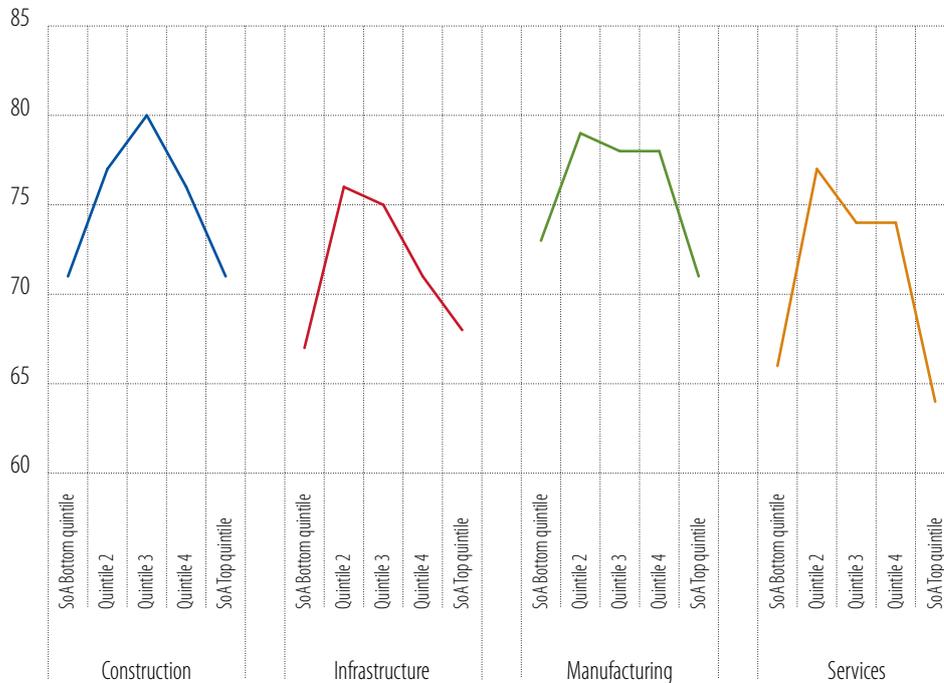
Source: EIBIS 18.

Base: All firms.

Questions: Thinking about your investment activities in your country, to what extent is each of the following an obstacle? Is it a major obstacle, a minor obstacle or not an obstacle at all?

Note: A red circle means that the share of mentions of a particular obstacle is in the top quartile; a green circle means that it is in the bottom quartile; an orange circle that it is between the two. The size of the circle and the number inside indicate the share of firms mentioning an area (as either a minor or major obstacle).

**Figure 17**  
**Lack of skilled staff and firm capital profile**



Source: EIBIS 18.

Base: All firms.

Questions: Thinking about your investment activities in your country, to what extent is “lack of staff with the right skills” an obstacle? Is it a major obstacle, a minor obstacle or not an obstacle at all? What proportion, if any, of your machinery and equipment including ICT, would you say is state-of-the-art (SoA)?

Note: Quintiles are defined within country and are based on the proportion of state-of-the-art machinery and equipment.

**The “peak pattern” across capital profiles is also present across staff profiles.** The difference is that the peak of when staff with the right skills matters the most comes earlier for firms that predominantly employ staff in lower-level occupations (second quintile) than for firms that primarily employ staff in higher-level occupations (third and fourth quintiles).

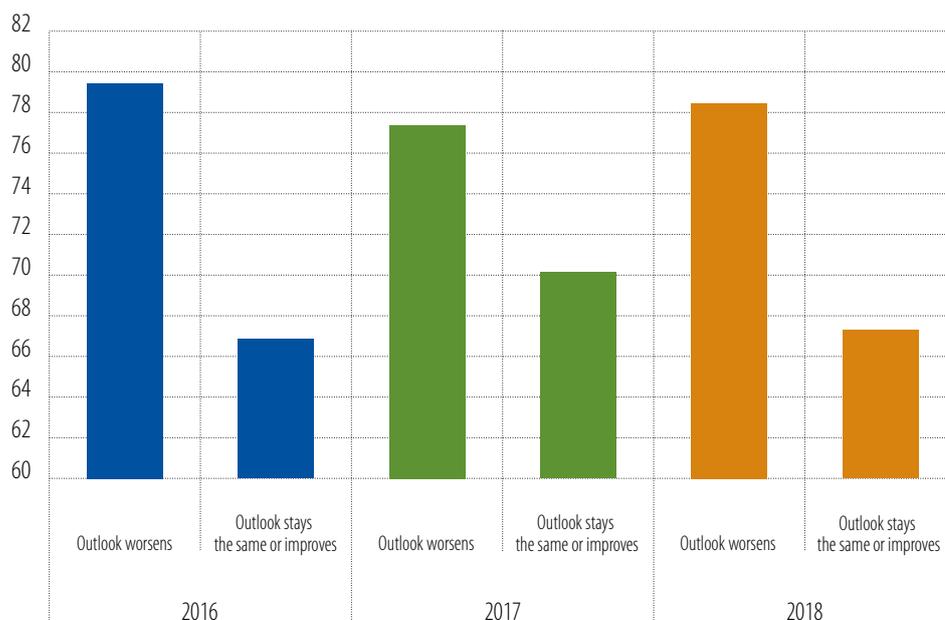
**“Uncertainty”, “business regulation” and “labour market regulation” follow “lack of staff with the right skills” as the most frequently cited barriers to investment.** Uncertainty is reported by 71% of firms, business regulation by 66% and labour market regulation by 63%. Across all areas, the frequency with which these issues are reported has increased over the past year. This may be due, at least to some extent, to the fact that a larger share of firms are engaging in investment activities.

**Sustained high levels of uncertainty are due to the worsening of the political and regulatory environment.** While the most mentions of “uncertainty” are recorded in periphery countries, the gap with the rest of the Member States is narrowing progressively. As the macroeconomic situation strengthens in these countries, the share of firms reporting “uncertainty” as an obstacle to investment starts to come down: by 4 p.p. in Greece since the last wave, 3 p.p. in Spain and 5 p.p. in Portugal. The only exception is Ireland, where Brexit considerations have most certainly affected “uncertainty” levels negatively.

**Uncertainty due to the political and regulatory environment holds across years, sectors and size classes.** Firms that are worried about a deterioration of the political and regulatory environment tend to report significantly higher levels of “uncertainty”. This is illustrated in Figure 18 and holds across years, sectors and size classes. Given the marked deterioration in the outlook of the political and regulatory

environment seen earlier, it is very likely that this has, at least to some extent, counter-balanced the positive effect of an improved macroeconomic environment on “uncertainty”.

**Figure 18**  
**The share of firms that report uncertainty by expectations about the political and regulatory environment (%)**



Source: EIBIS 17 and EIBIS 18.

Base: All firms.

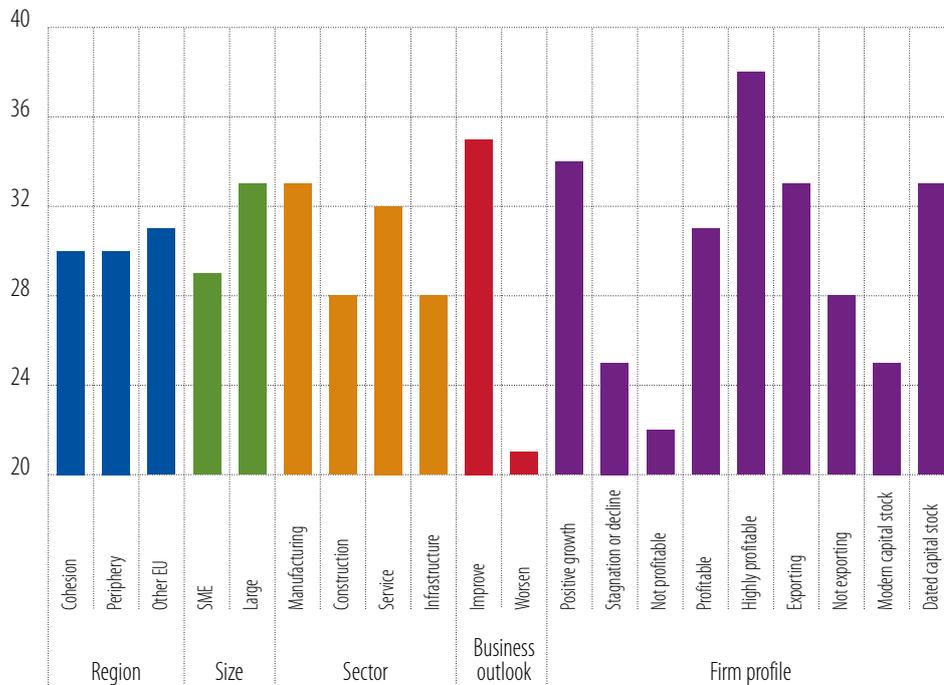
Questions: Thinking about your investment activities in your country, to what extent is “uncertainty” an obstacle? Is it a major obstacle, a minor obstacle or not an obstacle at all? Do you think that each of the following will improve, stay the same or get worse over the next 12 months?

## Investment purpose

**Replacement continues to dominate firms’ investment activities.** 47% of firms’ investment in the last financial year was spent on the replacement of existing buildings, machinery, equipment and IT. Investment in capacity expansion and on innovation accounted for 30% and 15% of firms’ investment spent, respectively – an increase compared with two years ago.

**Capacity expansion activities are driven by more competitive firms, in manufacturing and services, with positive business opportunities.** The share of investment expenditures allocated to capacity expansion activities is relatively evenly distributed across countries, but less so across sectors and types of firms. The sectors that invest most in capacity expansion are manufacturing and services. From a firm perspective, we find that growing firms, profitable firms and those with a greater share of machinery and equipment that is “state-of-the-art” (“modern capital stock”) tend to invest more in capacity than other firms. The same is true for exporting firms (Figure 19).

**Figure 19**  
**Share of investment allocated towards capacity expansion activities by region, sector and firm type (%)**



Source: EIBIS 18.

Base: All firms that invested in the last financial year.

Question: What proportion of total investment was for (a) replacing existing buildings, machinery, equipment, IT, (b) expanding capacity for existing products/services, (c) developing or introducing new products, processes, services?

Note: Firms with positive growth are those that state positive employment growth over the previous three years (in 2017); highly profitable firms are those with an EBIT/turnover ratio above 10%; firms' capital profile is defined as the top and bottom quintile of machinery and equipment that is state of the art (with quintiles defined within countries).

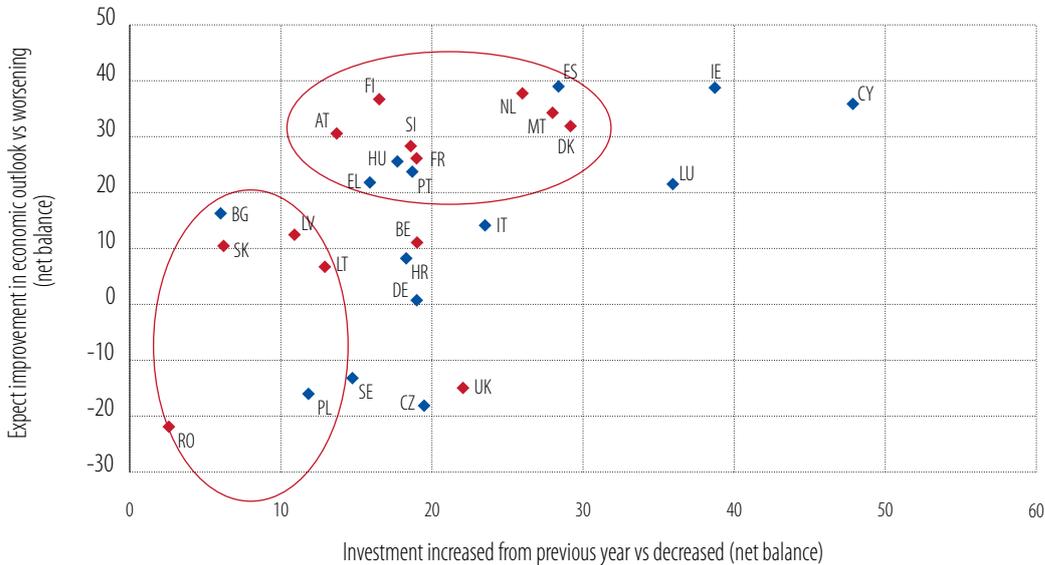
## Perceived investment gaps in the corporate sector

**Despite the positive investment activities in the last two financial years, about 16% of firms consider their past investment to have been insufficient.** Looking back at their investment activities in the past three years, these firms state that their investment activities did not meet their needs. The corresponding share was 15% last year and also the year before. The biggest perceived investment gaps are recorded in cohesion countries.

**Relative to 2017, investment gaps increased most in countries with moderate investment activities and a very optimistic economic outlook (Figure 20).** The position of these countries in the figure (highlighted by the upper ellipse) suggests that the widening gap they experienced is driven not by weak investment activities, but rather by a reassessment of investment needs in the light of an improved economic situation. A second, smaller group of countries with widening investment gaps is characterised by instances in which firms' investment activities over the last year were relatively poor and the economic outlook moderate. In this group, it is likely that perceived gaps increased primarily because of lacklustre investment rather than changes in needs. A rigorous econometric framework using firm-level data confirms this interpretation.<sup>22</sup>

<sup>22</sup> We regress whether firms report an investment gap on past investment activities and their economic outlook plus a series of control variables as reported in EIB, 2017.

**Figure 20**  
**Change in investment activities and economic outlook for countries with widening investment gap (red) and others (blue)**



Source: EIBIS 18.

Base: All firms.

Questions: Looking back at your investment over the last three years, was it too much, too little or about the right amount to ensure the success of your business going forward? For the current financial year, do you expect your total investment spend to be more, less or the same as last year? Do you think that the overall economic climate will improve, stay the same or get worse over the next 12 months?

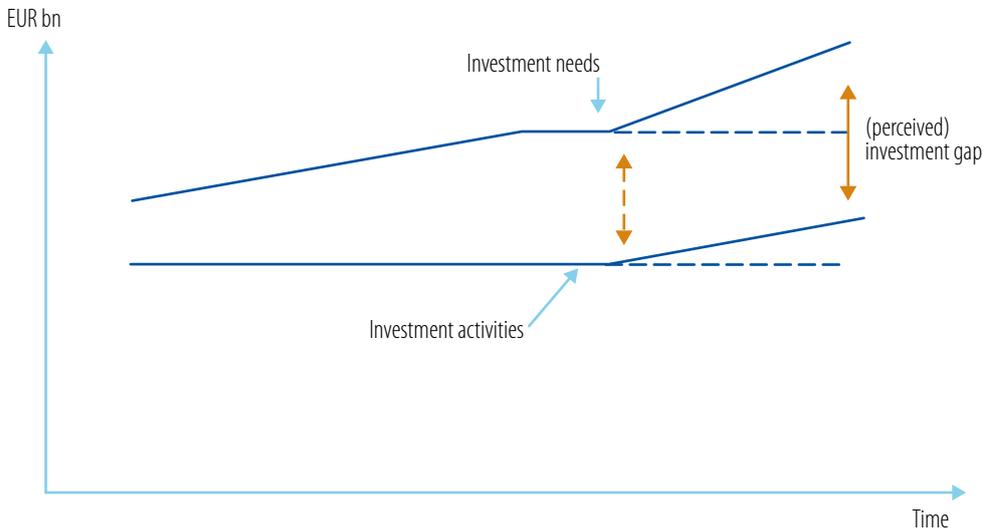
Note: The red diamonds highlight the countries in which investment gaps increased by more than 2 p.p. The blue diamonds show all other cases.

**The increase in perceived investment gaps is driven by an upward revision of investment “needs”.** Investment gaps are the difference between investment needs and investment activities. Provided that the firms’ assessment of needs is constant, an increase in investment activities leads to a narrowing of perceived gaps. On the other hand, if firms increase their assessment of investment needs by more than they increase investment, perceived gaps will widen.

**Perceived investment gaps in Europe widened in recent years mostly because firms’ actual investment could not catch up with the changes in their assessment of investment needs.** As the economic recovery stabilised, many firms realised that the pessimism they adopted during the crisis was largely exaggerated and this led to an under-statement of their true needs. As these firms now revise their investment needs upwards, perceived investment gaps remain stable or even widen, despite a positive investment performance overall (Figure 21).

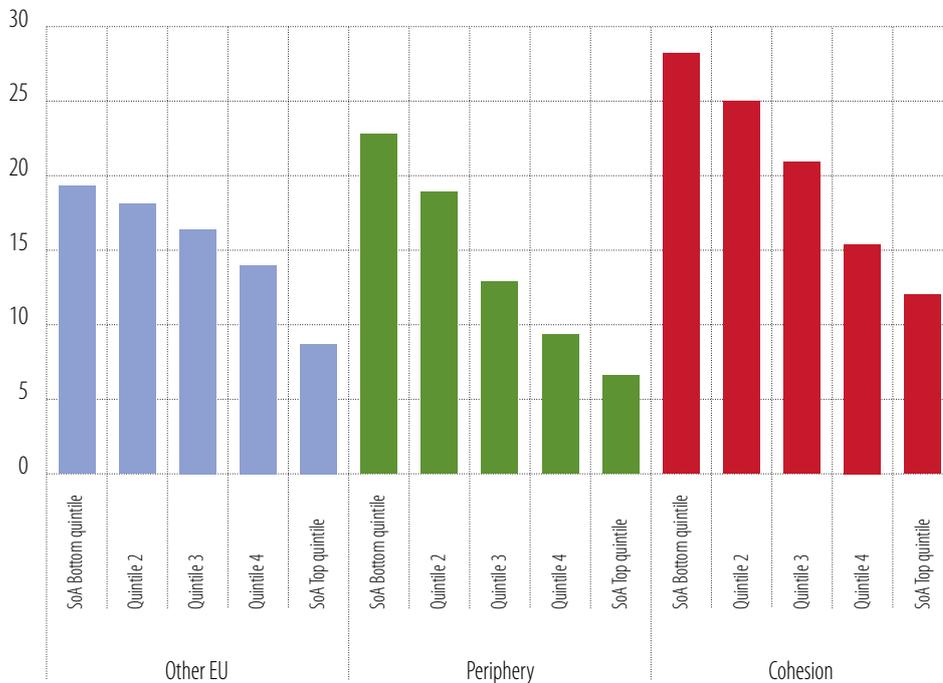
**Increasing investment needs reflect firms’ concerns that outdated technology reduces their competitiveness.** As shown in previous work, despite the recent pick-up in capacity expansion activities, perceived investment gaps are largely unrelated to measures of “insufficient capacity” (see e.g. EIB, 2017). Instead, perceived investment gaps continue to be closely associated with firms’ assessment of the quality of their capital stock (Figure 22).

**Figure 21**  
**Schema of changes in perceived investment gaps**



Source: ECON.

**Figure 22**  
**Investment gaps and quality of firms' capital stock (% net)**



Source: EIBIS 18.

Base: All firms.

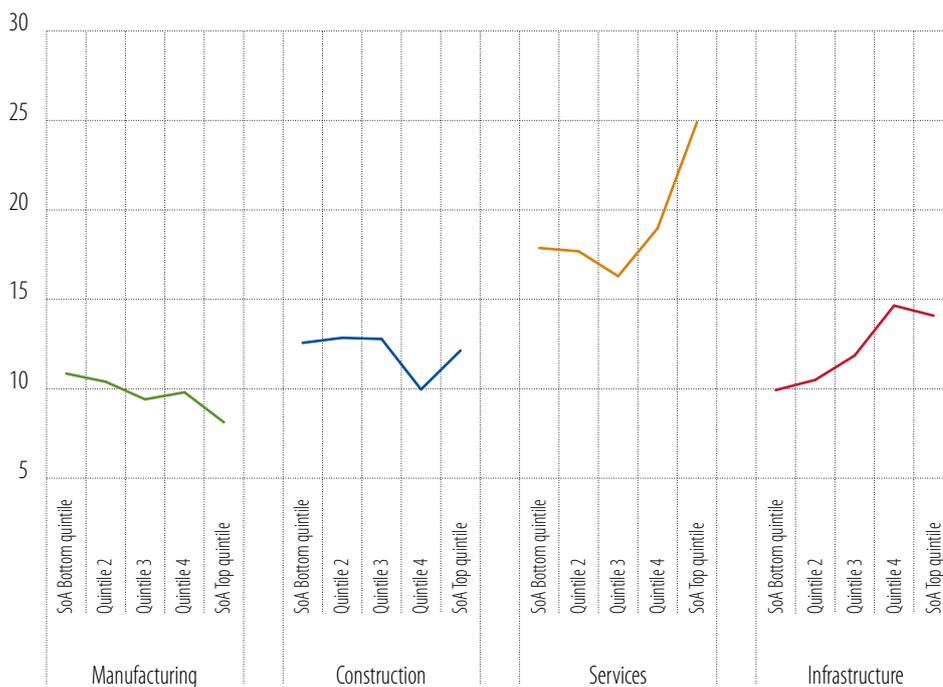
Questions: Looking back at your investment over the last three years, was it too much, too little or about the right amount to ensure the success of your business going forward? What proportion, if any, of your machinery and equipment, including ICT, would you say is state-of-the-art (SoA)?

Note: Quintiles are defined within country.

**Further analyses show that technological upgrades imply a move towards ever more digital content in firms' capital stock, particularly in the services and infrastructure sectors.** The more modern a firm's equipment is, the more important the investment in digital assets becomes (Figure 23). In the infrastructure sector, which includes the information and communication sector, the share of investment allocated to digital for a firm with a poor-quality capital stock is 9%, while for a frontier firm it is 15%.<sup>23</sup> The contrast is even more striking for service sector firms: companies with a poor-quality capital stock allocate about 18% of their investment to digital assets, whereas leading service sector firms allocate more than 25% to digital assets.

**There is no such upward slope in the construction and manufacturing sectors.** This does not mean that technological upgrade implies less digitalisation in these sectors. Rather, in these cases digital assets are often embodied in tangible assets such as "smart" machines and equipment that firms are likely to report as investments in "machinery and equipment" instead of software, data, ICT networks and website activities, thus blurring the picture. Indeed, in Chapter 8, we show that in the manufacturing sector up to 30% of investment in machinery and equipment can be linked to digital content. In the services sector this share is 20%.

**Figure 23**  
Share of investment allocated to digital assets by firm capital profile (%)



Source: EIBIS 18.

Base: All firms.

Questions: In the last financial year, how much did your business invest in software, data, IT networks and website activities with the intention of maintaining or increasing your company's future earnings? What proportion, if any, of your machinery and equipment including ICT, would you say is state-of-the-art?

Note: Quintiles are defined within country. Capital profile refers to the share of own equipment that is assessed by firms as state-of-the-art (SoA).

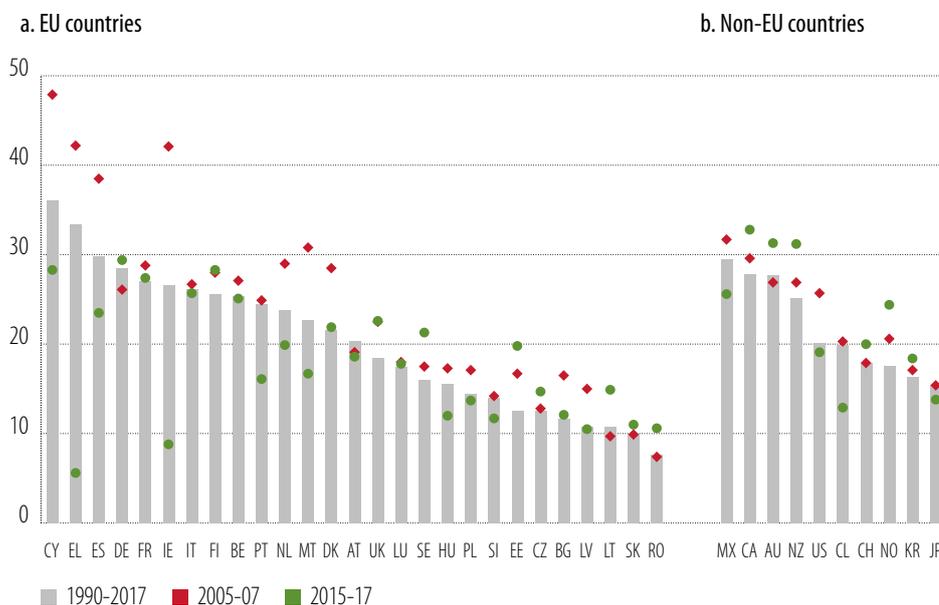
<sup>23</sup> The increased share of investment allocated to digital assets in infrastructure is driven by the information and communication sector. Note that the "infrastructure" category comprises all firms falling into the NACE classifications typically associated with infrastructure (information and communication, transport, electricity, water supply and sewerage), not just utilities.

## Residential investment trends in the European Union<sup>24</sup>

### Longer-term trends

**Residential investment accounted on average for 20% of total investment in EU countries in 1990–2017.** That is, the construction of new dwellings and expansion or improvements of existing ones accounted on average for 4.5% of GDP (Figure 24 a, bars). By comparison, machinery and equipment accounted on average for 36%, other buildings and structures for 31% and intellectual property rights for 13% of total investment over this period. In major non-EU economies, the long-term share of residential investment was on average higher, around 24% of total investment (Figure 24, panel b).

**Figure 24**  
**Residential investment as a share of total investment (%)**



Source: National data; BIS; author's calculations.

Note: Countries ordered by average share of residential in total investment 1990–2017.

In many EU countries residential investment was lower as a share of GDP in the past three years than the three years preceding the 2008–9 crisis (red diamonds vs green dots in Figure 24). This is not the general pattern. In Germany, Finland, Sweden, the UK and several cohesion countries, residential investment shares were higher in 2015–17 than in 2005–7. Like a number of non-EU economies (Figure 24, panel b), these EU countries either have not been strongly affected by the crisis or have rebounded from it quickly.

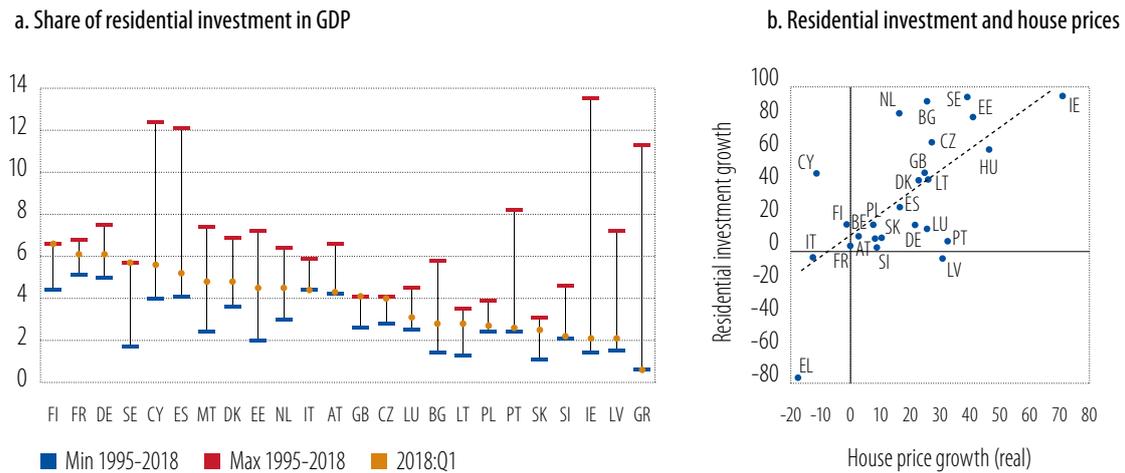
Comparing current levels of residential investment with the longer-term range of variation provides additional insights (Figure 25, panel a). First, current levels (dots) are at or close to historical peaks of residential investment (red dashes) in the Czech Republic, Finland, Sweden and the UK. Second, in the largest continental economies – France, Germany and Italy – residential investment is currently well within the long-term range of variation, though Italy is close to the bottom of that range (blue dash), given relatively subdued macroeconomic conditions. This suggests that residential investment in large economies has been more or less synchronised with other components of aggregate demand, and less

<sup>24</sup> Prepared by Emanuel Kohlscheen, Aaron Mehrotra and Dubravko Mihaljek from the Bank for International Settlements (BIS). The views expressed are those of the authors and not necessarily those of the BIS.

affected by record low interest rates. Third, in all countries where residential investment was above 8% of GDP before the crisis, its current levels are close to the bottom of the historical range. An overhang in residential investment has clearly depressed housing starts and expansions of existing units for a protracted period.

**Figure 25**

**Residential investment: GDP shares and growth versus house prices (%)**



Source: National data; BIS; author's calculations.

Note: The vertical axis in panel b plots the increase in real house prices over the last 20 quarters, in %.  
The horizontal axis in panel b plots the increase in residential investment over the last 20 quarters, in %.

## Recent developments

Since early 2013, roughly two-thirds of EU countries have seen cumulative growth in residential investment of 20% or more (Figure 25 b, vertical scale). In Bulgaria, Estonia, Ireland, the Netherlands and Sweden, dwelling construction has expanded by more than 80%, or 12% per year on average over this period. Significant expansions have also taken place in the Czech Republic, Denmark, Hungary, Germany, Spain and the UK. However, the pick-up has not yet reached Austria, France, Italy, Slovenia and several other countries.

The recent revival in residential investment has gone hand-in-hand with a rebound in house prices (Figure 25 b, horizontal scale). This is not surprising, as rising prices or expectations of future house price gains drive up returns to housing investment. While the dispersion among countries remains significant, the median cumulative increase in real house prices over the last 20 quarters was 16%, or roughly 3% per year. The largest increases were recorded in Ireland (over 70%) as well as Estonia, Hungary and Sweden (40–50%). By comparison, real gains in house prices since 2013 amounted to 22% in Germany and to 16% in Spain.

## Main drivers

The above trends suggest that residential investment evolves more or less in line with the overall business cycle. Indeed, its key determinants – income growth, demographic variables, house prices and nominal interest rates – are unsurprising. For instance, all else being equal, a 1% increase in per capita GDP is associated with a 2.6% cumulative increase in residential investment after five quarters, while a 1% increase in real house prices is associated with a 1% increase in new dwellings (Table 1, last column). Similarly, a 100 basis-point increase in the short-term interest rate slows down residential investment

by about 1.1% after five quarters. The size of these coefficients is similar to estimates for other major economies outside the EU.<sup>25</sup>

**The importance of GDP per capita as a driver of residential investment can be explained by strong synergies between income growth and construction activity.** Changes in aggregate value added, employment, and wages tend to generate strong income effects and hence demand for housing. At the same time, housing construction has large multiplier effects and generates strong spillovers to other sectors. Thus, while not particularly high relative to GDP, residential investment is often cyclically the most pronounced component of GDP. This makes it quite important for the dynamics of overall investment and GDP growth. For instance, the EU-wide drop in residential investment in 2008 accounted for nearly 70% of the slowdown in overall GDP growth that year.

Two other features of residential investment are worth noting. First, turns in the residential investment cycle typically predate turns in the business cycle. Second, the dynamics of residential investment in terms of prices and quantities (i.e. new dwellings constructed) is asymmetric across the cycle: during housing booms, prices rise much more than dwelling construction, while during housing busts the bulk of adjustment takes place through a slump in dwelling construction rather than prices (see Kohlscheen et al., 2018).

**Table 1**  
**Drivers of residential investment growth in the EU**

Variable	t+1	t+2	t+3	t+4	t+5
PPI inflation	0.0035 (0.084)	0.0043 (0.093)	-0.2640 (0.206)	-0.1150 (0.150)	-0.3010 (0.191)
Real house price growth	0.274*** (0.040)	0.410*** (0.130)	0.598*** (0.141)	0.876*** (0.162)	1.047*** (0.187)
Interest rate change	-0.504* (0.248)	-0.654** (0.279)	-0.797** (0.322)	-0.843** (0.304)	-1.100** (0.424)
Population density change	0.0119*** (0.001)	0.0244*** (0.002)	0.0393*** (0.004)	0.0562*** (0.005)	0.0718*** (0.007)
Net migration rate change	0.0394*** (0.012)	0.0776*** (0.025)	0.1140*** (0.038)	0.1410*** (0.047)	0.1620*** (0.057)
Housing stock/GDP	0.0027 (0.004)	0.0037 (0.008)	0.0038 (0.012)	-0.0021 (0.015)	-0.0080 (0.019)
GDP per capita change	0.517** (0.220)	1.249** (0.490)	1.849*** (0.589)	1.971*** (0.658)	2.637*** (0.725)
Unemployment rate	-0.0633 (0.072)	-0.0806 (0.149)	-0.0735 (0.232)	0.0390 (0.300)	0.1420 (0.375)
Number of observations	2 829	2 804	2 779	2 754	2 729
R <sup>2</sup>	0.059	0.123	0.170	0.191	0.225

*Note:* The dependent variable is growth in real residential investment (difference of the log of real residential investment) between  $t+h$  and  $t$ , where  $h$  corresponds to column  $h$  in the table. The estimation period covers 1970:Q1 to 2017:Q4, but varies by country: for most EU15 countries, data for residential investment are available from 1970 onwards, and for many other economies from 1995 onwards. All models include country fixed effects. In parentheses we show robust standard errors clustered by country; \*, \*\* and \*\*\* denote statistical significance at the 10%, 5% and 1% confidence levels, respectively. For details on the methodology see Kohlscheen et al. (2018).

25 See Kohlscheen et al. (2018).

## Conclusion and policy implications

**The surge in the EU economy in the past few years has been accompanied by a large and unexpectedly quick (by historical standards) recovery in labour markets.** Today, the employment rate in the EU as a whole is at a record high, and rates of unemployment are at or near a 20-year low in most Member States.

**Improving labour markets increased the disposable incomes of households and fuelled private demand, after years of retrenchment and deleveraging.** Consumer and business sentiments are close to historical maxima, and there is a sense of returning to normal after so many years of economic malaise.

**This is a false perception, however. While economic developments have been positive, potential growth in the EU has remained at dismal levels since 2008, as reflected in low corporate returns.** Significant backlogs of postponed or completely written-off investments remain unaddressed, especially in the periphery countries. Structural weaknesses remain in a number of EU economies despite numerous reforms.

Policymakers will have to focus on making EU economies more dynamic by further addressing labour market rigidities, reducing regulation on markets for services and lowering barriers to entry and exit of firms. Such changes should push up returns, spur investment and ultimately lift the potential growth rates of European economies.

**The new gap with US investment in machinery and equipment that has opened since 2009 requires urgent attention by policymakers.** Similar developments in the 1990s led to significant gains in competitiveness by US firms relative to their European peers. This increased the gap between US and EU aggregate productivity.

The ongoing economic expansion and very low interest rates should encourage governments to engage in a decisive reduction of the significant backlogs of government investment formed during the years of fiscal retrenchment after the sovereign debt crisis in the euro area.

**While recent growth in residential investment in the EU as a whole has been healthy, developments in a few economies may warrant close monitoring.** For instance, where the expansion has been very fast, the contribution of residential investment to aggregate demand nears record highs or financial institutions' exposures to the property sector have risen sharply, it might be prudent to consider the use of counter-cyclical policies, including macroprudential tools, to alleviate macroeconomic and financial stability concerns. Large variability in residential investment across countries and time might also be relevant for the EU's economic and social cohesion policies, given that they aim for convergence in living standards across the Union.

**Box D****Consumption of fixed capital in the European System of National and Regional Accounts<sup>26</sup>****Consumption of fixed capital (depreciation)**

Depreciation – the reduction in the value of an asset over time – is a term used in both business accounts and national accounts. In the specific context of national accounts, the term consumption of fixed capital (CFC) can also be used: in national accounts CFC is dependent on the current value of the asset, while in business accounts the term depreciation is usually used in the context of writing off historic costs. CFC is the specific way of referring to depreciation when referring to national accounts. Therefore, for national accounts, the two terms can be used interchangeably.

The European System of National and Regional Accounts (ESA 2010, § 3.139) manual defines CFC as follows:

*“the decline in value of fixed assets owned, as a result of normal wear and tear and obsolescence. The estimate of decline in value includes a provision for losses of fixed assets as a result of accidental damage which can be insured against.”*

ESA (2010, § 3.141) also gives some broad guidance on how to estimate it:

*“CFC is estimated on the basis of the stock of fixed assets and the expected average economic life of the different categories of those goods. For the calculation of the stock of fixed assets, the perpetual inventory method (PIM) is applied whenever direct information on the stock of fixed assets is missing. The stock of fixed assets is valued at the purchasers’ prices of the current period.”*

All European countries use the PIM, which is the most widely used approach to measuring stocks and flows of fixed assets. The PIM is based on the simple idea that stocks constitute cumulated flows of investment, corrected for retirement and efficiency loss; it is calculated by type of assets, thus differentiating (at least) by categories such as dwellings, buildings, infrastructures, machineries, equipment, weapons and intellectual property products. The application of the PIM crucially depends on a number of assumptions, including estimations on the useful lifetime of assets and depreciation functions to be used.

The service life of an asset is the period during which it remains in use, or ready to be used, in a productive process. Of course, service life varies considerably between different categories of assets.

To depreciate an asset, straight-line or geometric depreciation functions are chosen on the basis of both the category of the assets considered and practical issues (including the availability – or not – of information at a sufficiently detailed level).

Straight-line depreciation diminishes the value of an asset by a fixed amount each year, while geometric depreciation reduces the value of an asset by a fixed percentage of its value in the previous year.

The straight-line method fully exhausts the value of the asset by the end of year  $X$ , where  $X$  is the expected service life in years, while with geometric depreciation the decline in asset values is asymptotic and the annual capital consumption amounts calculated will never sum to the full value of the asset.

<sup>26</sup> This box is written by Filippo Gregorini from Eurostat, the European Commission. The information and views set out in this box are those of the author and do not necessarily reflect the official opinion of the European Commission. Neither the European Commission nor any person acting on its behalf may be held responsible for any use of the information contained therein.

**Depreciation rates in Europe 2000-15**

As discussed above, the calculation of CFC crucially depends on both the composition of the stocks of fixed assets and the assumptions made under the PIM. National data available on the stocks of fixed assets by industry (see Table 20 of the ESA2010 Transmission Programme of Data) show CFC heterogeneity across European Member States in terms of both levels and dynamics.

**CASE 1****High vs low depreciation rates**

France and Estonia showed constant depreciation rates in the period 2000–15, but at different levels: between 15% and 16% in France and around 7.5% in Estonia (Figure D.1). The composition of the stock of fixed assets and assumptions on different assets can help to explain these differences.

In France, a relatively short service life (25–30 years) for asset category “buildings other than dwellings” – which is part of the “other buildings and structures” asset category (henceforth “buildings”) – is assumed, compared with the observed practice in the EU, which is around 50 years. In Estonia, the service life for buildings other than dwellings is in line with the EU observed practice. Moreover, in France “buildings” has constantly accounted for a 32–35% maximum of total assets in the period from 2000 to 2015, whereas in Estonia its weight was 45% of total assets in 2000, rising to 52% in 2015. “Buildings” is usually the asset category with the longest service life and most weight of the total fixed assets. Therefore, the combination of an assumed short service life and low weight for this asset category – as recorded in France – implies higher depreciation rates, all else being equal.

Additional insight can be derived from the observation of the asset category for intellectual property products (IPP), which typically have a service life of around ten years. In France IPP assets made up a large fraction of total fixed assets – around 25% in the period 2000 to 2015. On the other hand, in Estonia this is tiny – ranging from 2% in 2000 to 5% in 2015. It is reasonable to assume that a higher share of IPP assets implies a higher depreciation rate due to their short average service life.

**CASE 2****Increasing vs decreasing depreciation rates**

Belgium and Portugal showed divergent depreciation rate paths in the period 2000–15: the depreciation rate increased in Belgium by more than 2 p.p. from 8% in 2000; in Portugal, on the other hand, the depreciation rate decreased from almost 9% to 7% in the same period (Figure D.1). The composition of fixed assets can help to explain these differences.

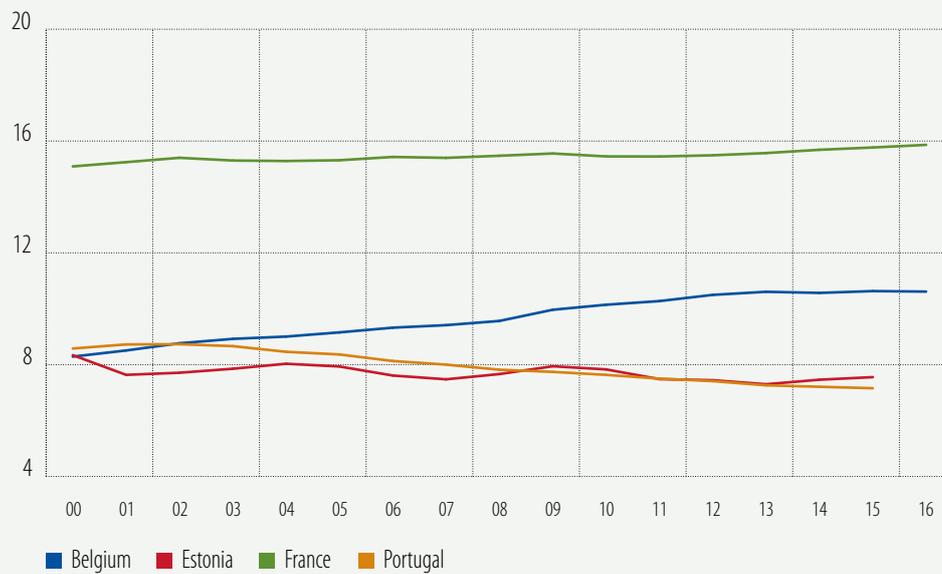
Data for Belgium show a very substantial increase in IPP assets in both relative and absolute terms, also including the asset category “computer software and databases”, with an exceptionally short service life: three years in Belgium compared with around five years in the EU. In 2000 IPP assets formed less than 6% of total Belgian fixed assets; in 2015 their weight was above 9%. For comparison, in Portugal IPP assets have increased, but still remain a very tiny share of total fixed assets: 3% in 2000 and less than 5% in 2015.

It is also worth focusing on the weight of assets with a long service life in total fixed assets – “buildings”: in Belgium this category represented 53% of total fixed assets in 2000, decreasing to 48% in 2015, while in Portugal “buildings” represented 69% of total fixed assets in 2000, increasing to 78% of the total in 2015. Among countries with complete data available, 78% is the highest share for “buildings” in the total fixed assets for 2015: the second highest value is Lithuania at 68%, 10 p.p. lower than Portugal.

In order to determine the reasons for the decreased depreciation rate in Portugal conclusively, a very detailed record of all the assets would be needed. However, based on data available in Table 20 of the ESA2010 Transmission Programme, and assuming that straight-line depreciation is used, numerical simulations show that the very high and increased share of “buildings” in total fixed assets recorded in Portugal in the period 2000–15 is compatible with the decreasing depreciation rate path observed.

In summary, drawing on the cases described above, we can conclude that different asset compositions, as well as different assumptions, can result in the different depreciation rates observed across countries. As asset compositions and assumptions change over time, so do average depreciation rates. Countries with a large share of assets with low service lives (high average depreciation rates) will need to invest more to maintain the same level of capital stock than countries with smaller shares of such assets.

**Figure D.1**  
**Average depreciation rate in selected EU Member States (%)**



Source: Eurostat, *National accounts aggregates by industry [nama\_10\_a64]* and *Cross-classification of fixed assets by industry and by asset [nama\_10\_nfa\_st]*.

Note: The average depreciation rate is computed as the ratio of consumption of fixed capital to net capital stock. Not all assets and industries are selected. Here, assets include N112N, N11MN, N115N and N117N (according to ESA2010 Table 20 classification); industries include NACE Rev.2 categories A–J, M and N. This selection provides a crude approximation of investment by non-financial corporations.

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## Chapter 2

### Investment in infrastructure

**Infrastructure investment continued its downward trend in 2016, and preliminary data suggest that this trend did not reverse markedly in 2017.** The government sector accounts for about 80% of the fall in total infrastructure investment over the past decade. The public-private partnership (PPP) market continued to contract. Corporate infrastructure investment activities kept up slightly better.

**The fall in infrastructure investment activities was not due to a saturation effect:** one in three large municipalities in Europe said that infrastructure investment was below needs; infrastructure investment fell most in regions with an already poor infrastructure quality; and additional infrastructure investment continued to generate substantial spillovers in terms of firm growth.

**Fiscal constraints, low financial returns in the corporate sector and less political support for PPPs undermine infrastructure investment in Europe.** Many governments shifted outlays from investment towards current expenditures, partly reflecting political choices and short-term spending pressures. Fiscal constraints were particularly binding for disadvantaged regions with already poor infrastructure quality. Corporate infrastructure investment suffered from falling returns, in part due to tighter regulation.

**A focus on long-term needs, strong institutions and sound project preparation are key to addressing Europe's infrastructure gaps.** Careful project selection and implementation is essential at all levels of government, including at the EU level, not least to overcome the fragmentation of the single market. To address the backlog of infrastructure investment, the local context must be taken into account, and a balanced policy mix is required. This should include lending instruments, well-tailored blending and technical assistance where needed. Reassessing all the pros and cons of PPPs will ensure their effective use.

## Introduction

**The need to invest more in Europe's infrastructure is being exhaustively discussed in the context of the EU's post-2020 Multiannual Financial Framework.** And rightly so – the longer-term economic performance of the EU and the global economy critically depends on the availability of adequate and state-of-the-art infrastructure (European Commission, 2018; Calderon and Serven, 2014). Addressing infrastructure gaps is also critical to promote economic, territorial and social convergence and to achieve many of the UN Sustainable Development Goals (United Nations, 2016).

**A push for more infrastructure investment requires action across all types of promoters of infrastructure projects.** Infrastructure investment has been weak in recent years across the three main promoters of infrastructure projects: central and subnational governments, infrastructure corporates and special purpose vehicles (e.g. in the context of public-private partnerships (PPPs)).

**The role of subnational governments in providing infrastructure and the impediments they face in addressing gaps are the focus of this chapter.** Subnational governments play an important role in infrastructure provision, accounting for more than half of investments in the EU. Subnational governments also contributed disproportionately to the decline in overall infrastructure investment, 80% of which can be attributed to the government sector. This decline in infrastructure investment at the subnational level may undermine convergence in infrastructure quality, with possibly far-reaching economic and social implications.

**This chapter is divided into three sections.** Section 1 provides a review of recent infrastructure investment activities in Europe by institutional sector (government, corporates and investments implemented by means of special purpose vehicles (SPVs)). Section 2 sheds some more light on infrastructure quality disparities and constraints at the subnational level. Section 3 presents policy implications.

## Recent trends in infrastructure investment in Europe

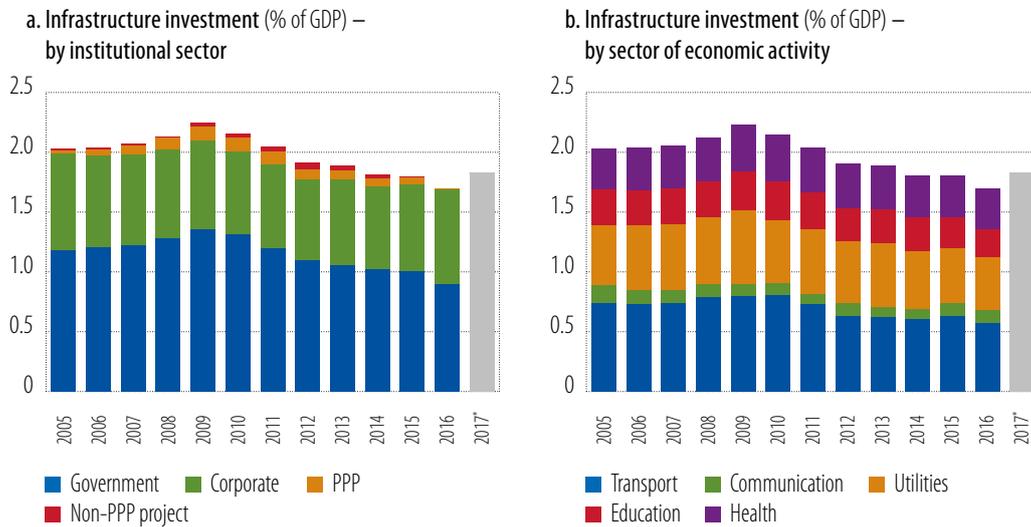
### Overall infrastructure investment

**Infrastructure investment continued its downward trend in 2016, and preliminary data suggest that there was not a marked reversal of this trend in 2017.** Using our preferred measure of infrastructure investment,<sup>1</sup> we find a continuation of the downward trend for 2016 that began with the global financial crisis. At 1.7% of GDP, overall infrastructure investment now stands at about 75% of its pre-crisis level (Figure 1). For 2017, preliminary data<sup>2</sup> suggest at best a modest pick-up in investment activities.

1 We proxy infrastructure investment as gross fixed capital formation in other buildings and structures in the infrastructure sectors (Revoltella et al., 2015).

2 Final data on gross fixed capital formation by sector and asset class in 2017 is expected to be published only in spring 2019.

**Figure 1**  
**Infrastructure investment by sector and promoter**



Source: Eurostat, Projectware, EPEC.

Note: Based on EIB Infrastructure Database. Data are missing for Belgium, Croatia, Lithuania, Poland, Romania and the UK. PPP: public-private partnership.

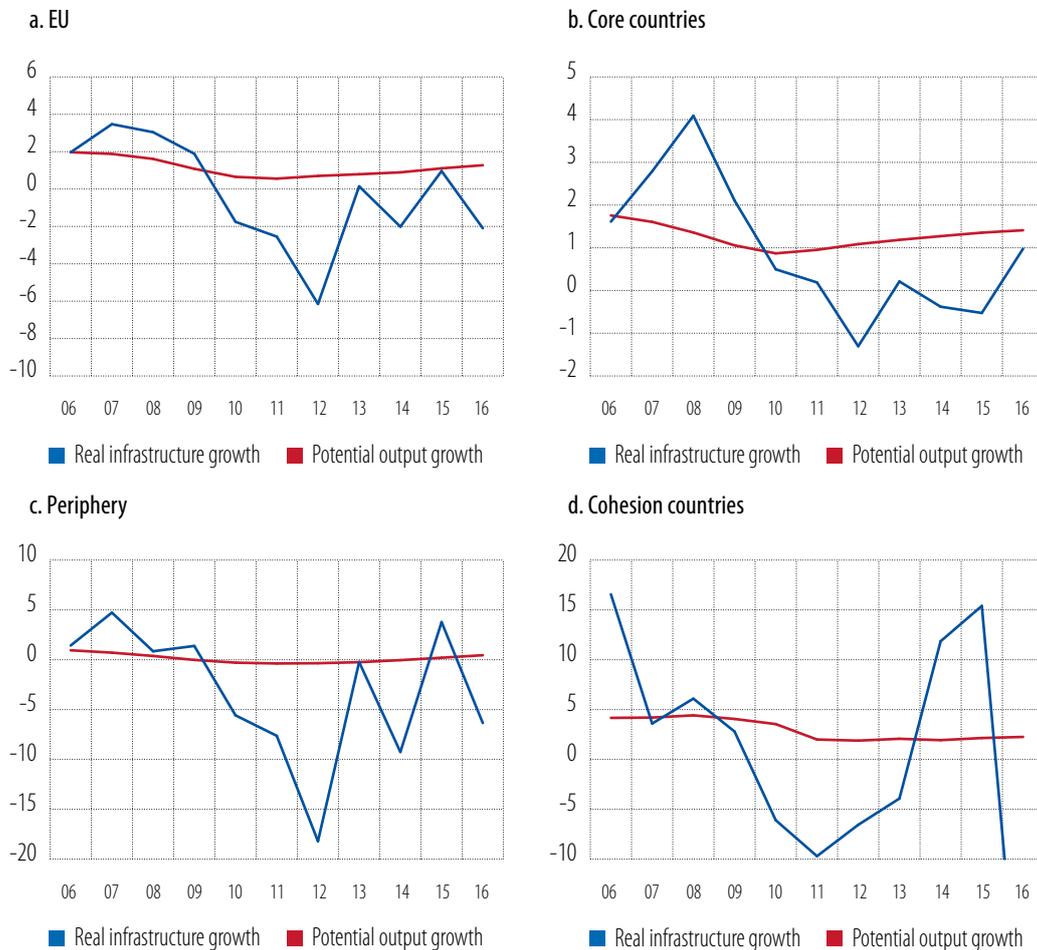
\*Data for 2017 is a projection based on preliminary data.

**Weak infrastructure investment activities in recent years have lagged potential GDP.** The decline in infrastructure investment as a share of GDP (in Figure 1) paints a more benign picture of the fall in infrastructure investment than is possibly merited. This is because GDP growth was relatively weak in the past decade. An arguably better benchmark may be “potential GDP” – the economy’s productive capacity – which abstracts from cyclical changes. Infrastructure investment growth was below potential GDP growth in six out of the past eight years<sup>3</sup> (Figure 2). Accumulated, infrastructure investment has fallen short of potential GDP by 1.4% since 2005.<sup>4</sup> At 3%, the accumulated gap is most pronounced in the periphery region. The sectors most negatively affected by sluggish infrastructure investment are information and communication technology (ICT) and transport.

3 We estimate potential GDP using a multivariate Kalman filter following Alichii et al. (2017) and Havik et al. (2014).

4 Results expressed in 2005 values. The values are not supposed to represent “investment gaps” but are just a measure of the fall in infrastructure investment.

**Figure 2**  
**Real infrastructure investment vs potential GDP growth (in %)**

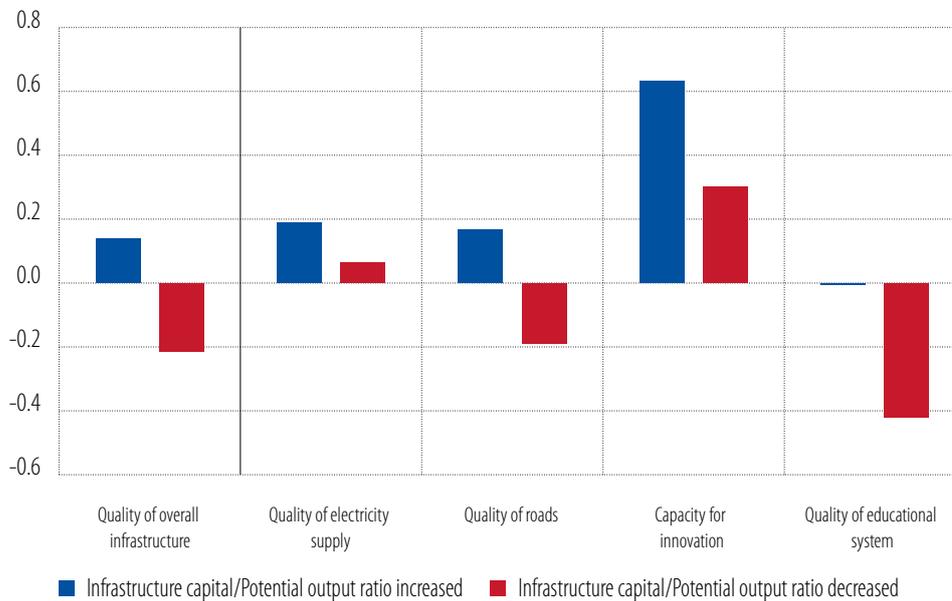


Source: Eurostat, Projectware, EPEC (for infrastructure investment) and EIB estimation (for potential growth).

**The investment slowdown goes hand in hand with a deterioration in the perceived “quality of infrastructure”.** If we compare how the perception of the quality of European infrastructure changed between the pre-crisis and post-crisis periods with how the infrastructure stock changed over this same period, we find a positive correlation. That is, the (perceived) quality of infrastructure evolved less favourably in countries in which poor investment led to a drop in the capital-to-(potential)-output ratio and *vice versa* (see Figure 3).<sup>5</sup>

<sup>5</sup> Note that the correlation is not perfect, as other factors are likely to influence our outcome variables. The capacity for innovation, for example, increases with the availability of fast internet; however, the broader innovation environment and the corporate sector’s readiness to innovate also play an important role.

**Figure 3**  
**Change in infrastructure stock and perceived infrastructure quality**



Source: Eurostat Capital Stock data and World Economic Forum Competitiveness data. Comparison 2016 vs 2008.

**The negative development in infrastructure investment led to a backlog of investment, putting at risk Europe’s capacity to reach its policy goals.** The EU has imposed policy goals it wants to achieve by 2030 in various areas, e.g. climate and energy<sup>6</sup> and broadband penetration. A bottom-up estimation suggests that to achieve the goals related to infrastructure, additional investments of EUR 155 billion per annum will be necessary (see Box A for details). If dynamics in infrastructure investment do not reverse, this target will become ever harder to achieve.

**The sluggish infrastructure investment performance also risks undermining the productive capacity of the EU economy more generally.** After all, capital devoted to infrastructure purposes is complementary to non-infrastructure capital in the production of goods and services: crowded highways mean slower transportation of goods from factory to market; dated power plants raise the cost of energy and of running machinery and equipment; and slow internet connections limit the speed at which firms can process information. In other words, poor infrastructure risks making non-infrastructure capital less productive and undermining the EU economies’ productive potential (see, for example, Qiang et al., 2009; Meltzer, 2014; Revoltella et al., 2015).

**The (forgone) gains of more infrastructure investment are measurable: firms grow less in regions with poor infrastructure.** Figure 4 shows what happens to firms’ value added growth if the industry in which they are active is subject to a positive growth shock depending on the quality of the infrastructure in the region in which they are located.<sup>7</sup> Specifically, it shows firms’ responsiveness to growth opportunities in their sector,<sup>8</sup> for two periods and two groups of firms: period one spans the years 2006–9, period two: 2010–15. Group one consists of firms that are located in regions that saw no change in their infrastructure between the two periods, and group two consists of firms located in regions that saw a significant improvement in infrastructure.

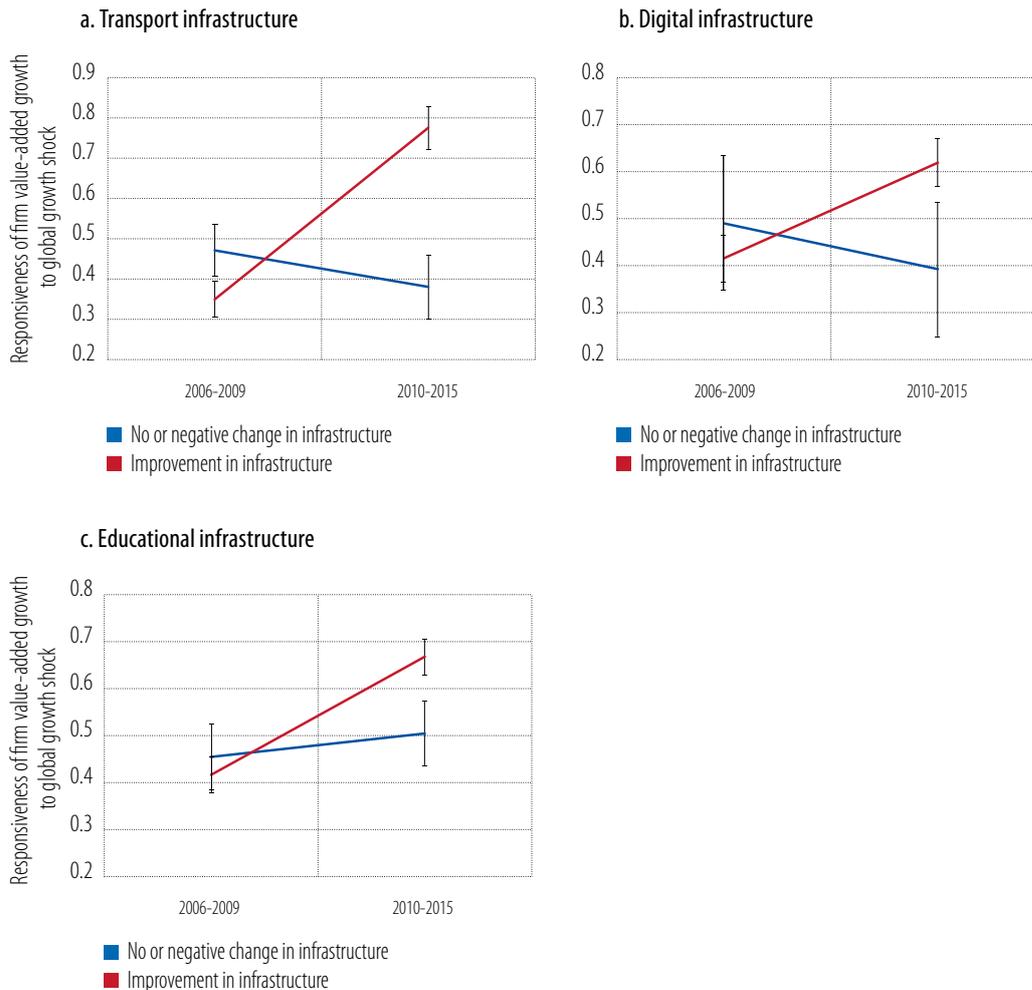
6 For an extensive discussion of the EU 2030 targets related to energy, see Chapter 3.

7 Specifically, we use data on US industry output growth to proxy global growth shocks. This variable is strongly correlated with firms’ value added growth in our sample: an increase in US industry growth by 10% is associated with an increase in real value added by European firms of about 4%.

8 See Rajan and Zingales (1998).

The figure shows that firms' responsiveness to sectorial growth opportunities increased (more) in regions that saw an improvement in their infrastructure stock. This suggests a positive effect of infrastructure quality and firms' capacity to exploit exogenous growth opportunities. Our result holds across all the main infrastructure sectors and is robust to the inclusion of a wide series of control variables.

**Figure 4**  
**Infrastructure stock and efficient allocation of resources in the light of global growth shocks**



**Source:** We combine (i) firm-level data from Bureau van Dijk's ORBIS database, comprising about 100 000 firms per year in 236 European regions (NUTS-2) in the years 2005-15; (ii) Eurostat data on the level of infrastructure in the same 236 European regions (which we proxy using the share of population with broadband access; number of hospital beds per 100 000 inhabitants; percentage of population with tertiary education; kilometres of railway plus kilometres of motorway per square kilometre); US industry growth data at NACE2 two-digit level coming from the EU KLEMS database.

**Note:** We use firms' real value added growth as their growth variable. Where data at NUTS-2 level is not available, we use data at NUTS-1 level. To proxy global growth shocks, we use – in line with a large body of literature including Rajan and Zingales (1998) and Fisman and Love (2007) – the data on US industry output growth. All regressions control for country, sector, size, and year fixed effects and also the non-interacted infrastructure variables.

**Box A**

**Infrastructure gaps in Europe**

The annual “investment gap” is defined as the difference between investment needs and current investment levels. The annual infrastructure investment gap for the EU27 (i.e. all Member States except the UK) until 2030 is estimated at roughly EUR 155 billion. This corresponds to 1.2% of the current EU27 GDP and 5.8% of Gross Fixed Capital Formation (Table B1.1). The infrastructure investment gap of EUR 155 billion per year is only one part of the estimated overall investment gap of EUR 403 billion, as investment needs in innovation and energy efficiency are also substantial.

**Table A.1**

**Annual infrastructure investment gaps for EU27**

	EUR billion	% of GDP	% of GFCF
ICT (broadband and digitalisation)	50	0.38	1.86
Energy generation and grids	17	0.13	0.63
Water and waste	7	0.05	0.26
Social and affordable housing	6	0.05	0.22
Education	8	0.06	0.30
Health	17	0.13	0.63
Mobility	50	0.38	1.86
<b>Total</b>	<b>155</b>	<b>1.19</b>	<b>5.77</b>

Source: Estimates by the EIB Projects Department.

Note: GDP and Gross Fixed Capital Formation (GFCF) refer to 2017. All numbers refer to EU27, i.e. all Member States except the UK.

Estimates of infrastructure investment gaps are based on EU policy targets and EIB expert judgements. Notably, EU policy targets for broadband (European Gigabit Society targets), energy (EU 2030 climate and energy targets) and water and sanitation (compliance with EU Directives) are considered. For mobility and social infrastructure, investment needs reflect past investment backlogs combined with higher future needs to accommodate demographic trends, migration and other megatrends.

**An important link between firm growth and infrastructure is firms’ dependence on the right resources, in particular people to realise their growth potential.** The EIB Investment Survey of firms (EIBIS) suggests that the most important barrier to investment for the corporate sector in Europe is a lack of staff with the right skills. As reported in Chapter 1, this refers primarily to finding “new people” with the right skills, and, as reported in Chapter 8, predominantly affects firms aiming to pursue new business activities.

The link between “lack of staff with the right skills” (as well as other production process input factors) and infrastructure is that, in order to quickly and effectively respond to positive opportunities, firms need to be able to draw on the necessary resources, for which efficient and well-functioning infrastructure is a key “enabling factor”.

Indeed, if we match firms’ survey responses with a measure of the quality of the infrastructure in the region in which they are located, we find that in regions with a poor (within-country)<sup>9</sup> infrastructure quality firms are more likely to report “lack of staff with the right skills” as an issue for their investment activities than firms elsewhere (see Figure 5).<sup>10</sup>

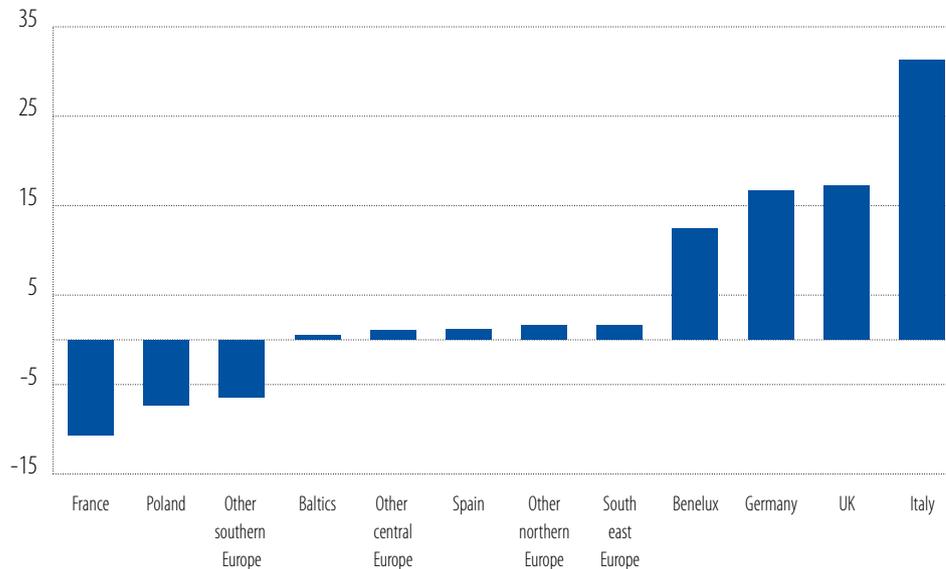
9 We define poor infrastructure quality relative to the country median. This is to control for cross-country differences.

10 For a more detailed study of the link between infrastructure and skills see Heuermann and Schmieder (2018).

**Figure 5**

**Where firms miss skills more: a look at municipal differences**

(Difference in pp. between firms in regions with low and high infrastructure quality, respectively)



Source: Matched dataset EIBIS firms and municipalities.

Note: Difference between mean shares of firms naming availability of skills as an impediment to investment in municipalities with low and high quality infrastructure. Positive values indicate skills missed relatively more in the first group (in percentage points, based on 2017 responses). Combines responses for skills as a major and minor investment impediment.

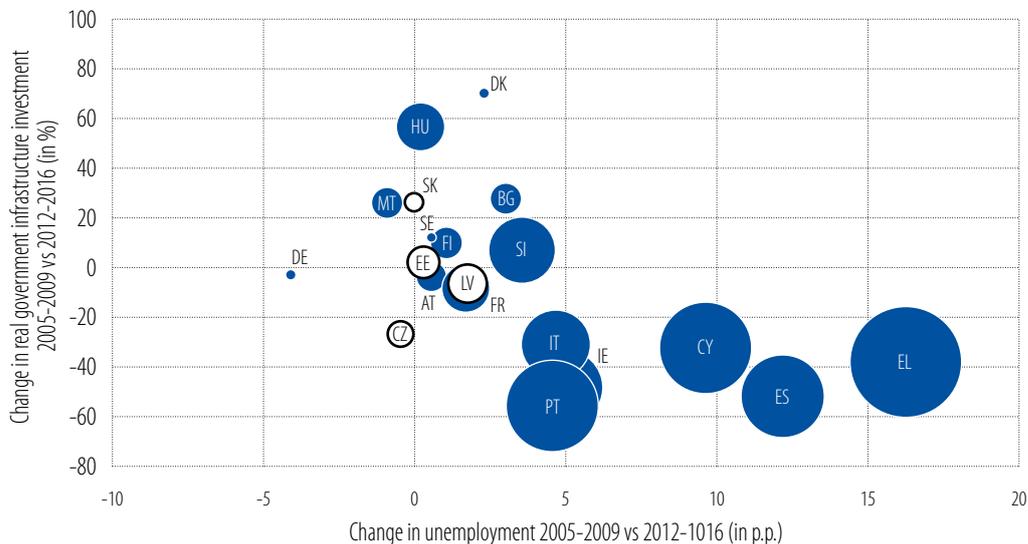
## Government infrastructure investment

**Government infrastructure investment accounts for about 80% of the overall fall in infrastructure investment.** The government component of aggregate infrastructure investment declined by 0.45 percentage points (p.p.) of GDP between 2009 and 2016. This is compared with 0.1 p.p. for the non-government sector.

**The fall in government infrastructure investment was most pronounced in countries subject to strong adverse economic conditions and high fiscal pressure.** Figure 6 illustrates this point. It plots the change in government infrastructure investment (y-axis) against the change in unemployment (x-axis) and the change in sovereign rating (size of the bubbles) between 2009 and 2016. It shows that the largest fall in government infrastructure investment occurred in countries that experienced a strong adverse shock to their economic activity (further to the right in the figure), as well as countries that were subject to high fiscal pressure (reflected in a deteriorating sovereign rating score, illustrated by a larger bubble size in Figure 6).

Chapter 1 shows that the need to tighten budgets translated, for most countries, into a lower overall government budget, as well as a strong shift within the remaining budget from gross fixed capital formation – i.e. investment – towards current expenditures. For government infrastructure investment this meant a “double shock” of lower overall government spending and a smaller share of it allocated to infrastructure investment activities.

**Figure 6**  
**Changes in real government infrastructure investment and economic conditions**



Source: Eurostat, Projectware, EPEC for government infrastructure investment, Eurostat for unemployment figures and EIB for rating changes.

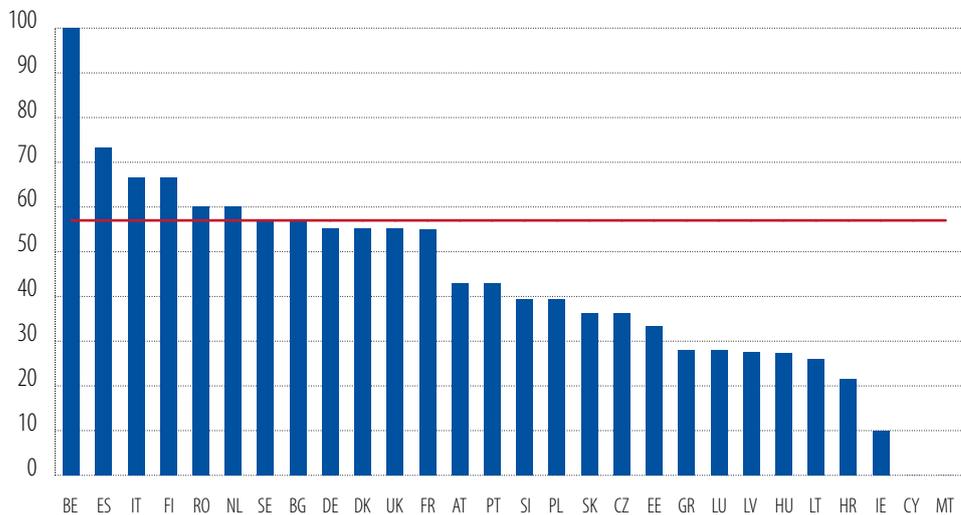
Note: The larger the bubble size, the greater the downgrade in sovereign rating. The black circles indicate rating upgrades. To calculate rating scores, sovereign ratings from S&P, Moody's and Fitch were used and converted into numerical values using an EIB methodology.

**Improving economic conditions and loosening fiscal pressure helped to slowly reverse the negative trend in government infrastructure investment, but the near-term investment outlook remains modest.** Government budgetary plans announced in the 2018 stability and convergence programmes report a slight increase in public investment in 2018 (2.8% of GDP) and 2019 (2.9%). This increase is more pronounced in cohesion countries (from 3.4% of GDP in 2017 to 4.0% in 2018 and 4.2% in 2019). However, public investment levels in all country groups are expected to remain below their long-term averages, especially in the periphery (by about 1 p.p. of GDP) and in cohesion countries (by 0.4 p.p.). According to the European Commission's 2018 Autumn Forecast, public investment will exceed long-term averages (2003–16) in 2018 only in ten countries: Austria, Belgium, Denmark, Estonia, Finland, Germany, Hungary, Latvia, Poland and Sweden.

**Subnational governments cut investment disproportionately.** Subnational investment accounts for more than half of overall government infrastructure investment (see Figure 7). We find a positive correlation between overall government infrastructure investment and the subnational investment share between the pre- and post-crisis periods: that is, when overall government investment decreased, so did the share of investment accounted for by subnational governments. When overall government investment stayed the same or increased, so did the share of subnational governments.

This suggests that changes in overall government infrastructure investment often came with disproportionate changes at the subnational level in the same direction (Figure 8, panel a).

**Figure 7**  
**Subnational infrastructure investment share (in %)**

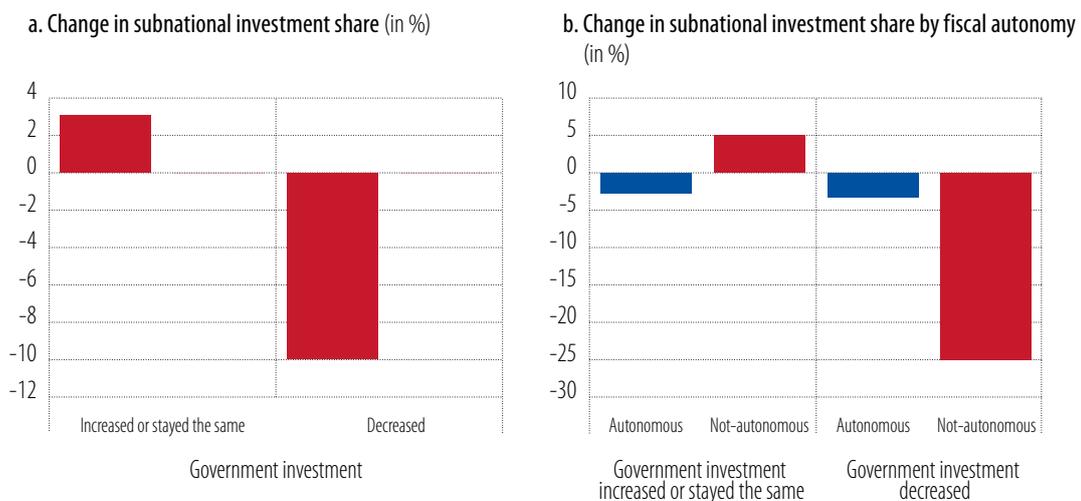


Source: Eurostat.

Note: The data shows subnational investment in the infrastructure sectors over total government investment in these sectors based on COFOG gross fixed capital formation data in economic affairs, education, environment and health. Since the data does not make it possible to distinguish between gross fixed capital formation in total assets and "other buildings and structures", we base the calculation of investment shares on information on gross fixed capital formation across all asset types.

**Cuts in transfers from the central government can explain part of the pro-cyclicality of the subnational investment share.** Simple correlations confirm that in countries with a low level of fiscal autonomy the pro-cyclicality of subnational investment tended to be substantially more pronounced (see Figure 8b). This suggests that in centralised countries central governments have passed on fiscal pressure (disproportionately) to subnational governments through cuts in transfers.

**Figure 8**  
**Change in subnational investment share by overall government investment trend**

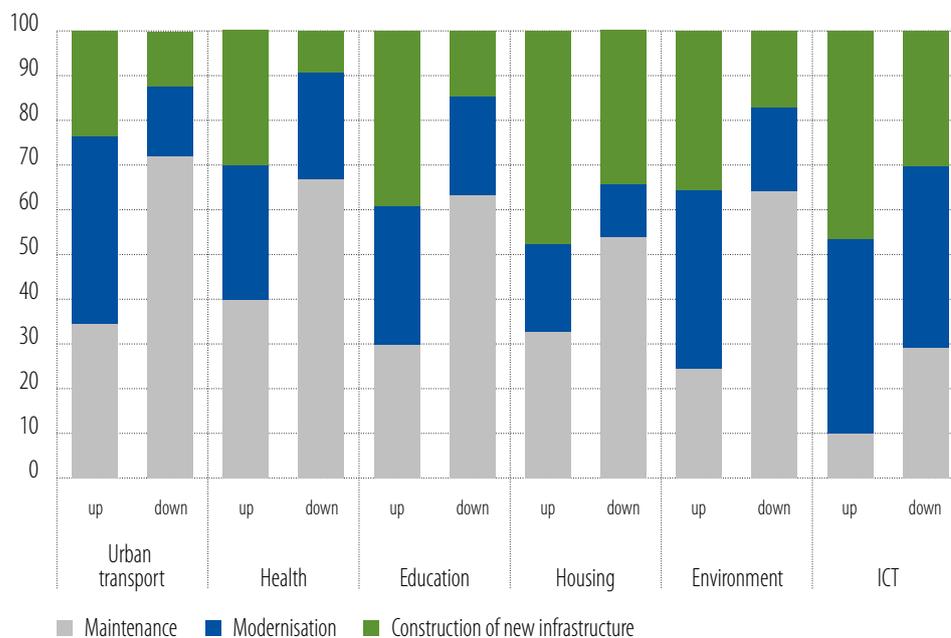


Source: Eurostat, Projectware, EPEC (for infrastructure investment) and Eurostat for subnational government investment in infrastructure sectors. Fiscal autonomy data comes from Hooghe et al. (2018). Blue bars in Panel b refer to countries in which regions have relatively high fiscal autonomy, red bars to countries in which fiscal autonomy is relatively low. The change in subnational investment share by fiscal autonomy is based on a relatively small number of observations and should therefore be taken as indicative.

The recent change in subnational infrastructure investment is likely to have come with a change not only in volumes but also in the “type of investment” carried out. Figure 9 shows the share of investment that subnational governments allocate to capacity expansion, modernisation of existing infrastructure and maintenance for regions that cut their infrastructure spending in the past few years and regions that increased them.

The figure shows that – across all sectors – investment cuts went hand in hand with a significant decrease in investment spending allocated to capacity expansion and/or modernisation activities. The disproportionate cuts to infrastructure investment activities in recent years therefore seem to have led to a shift in investment activity towards “maintaining the status quo”, instead of investing into new/better infrastructure.

**Figure 9**  
**Investment spent by investment purpose for municipalities that saw infrastructure investment activities go “up” and “down”, respectively (in %)**



Source: EIB Municipality Survey 2017.

Note: The figure shows the share of investment that municipalities allocate to different investment purposes for municipalities that saw their infrastructure investment activities in recent years increase (i.e. go “up”) and decrease (i.e. go “down”), respectively.

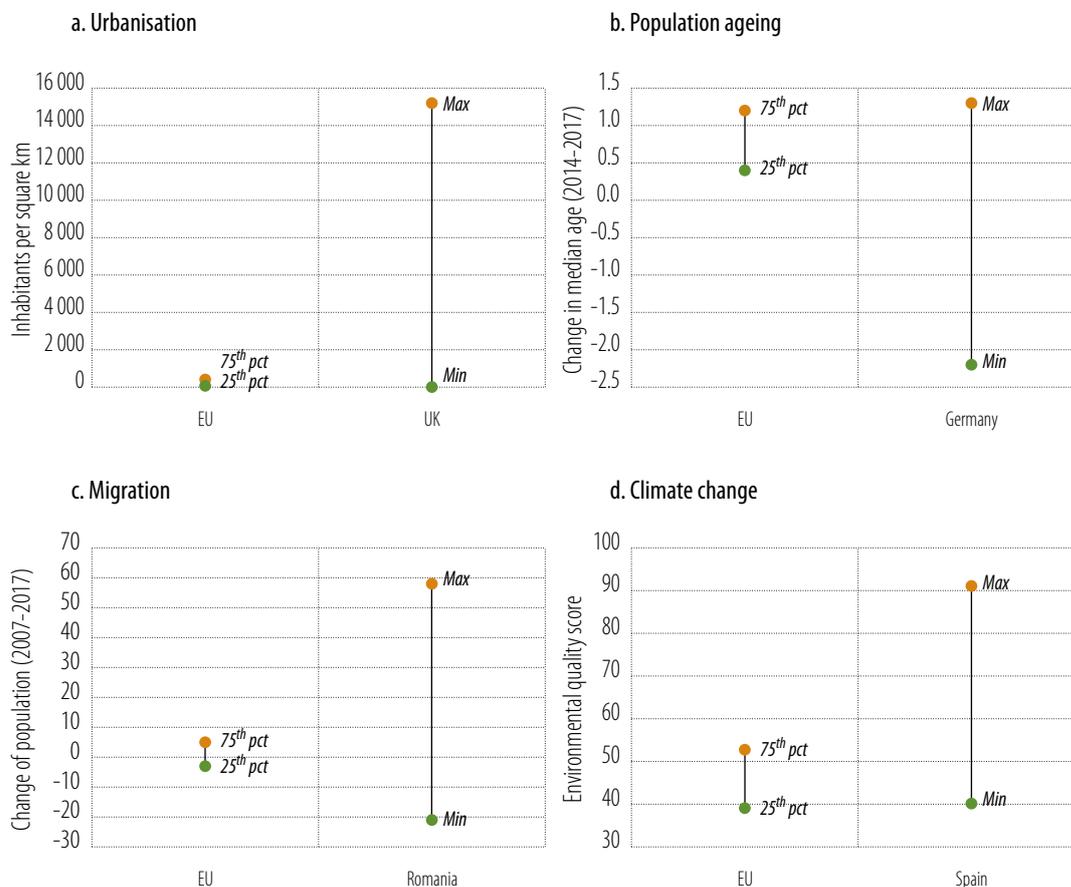
**Less investment flexibility at the subnational level is an issue, particularly in the light of growing urbanisation, demographic ageing, migration and climate change.** All four megatrends tend to come with substantial investment needs in new/better infrastructure at the local level (see Collier and Venables, 2016; World Economic Forum, 2017b; Hendel-Blackford et al., 2017).<sup>11</sup> These changing needs

<sup>11</sup> Urbanisation, for example, is expected to increase across all EU countries, but particularly rapidly in Eastern Europe. It will put enormous pressure on existing infrastructure, as it entails not only strong growth of major urban centres, but also the integration of ever more cities and rural areas into urban-rural regions, which involves a shift from mainly rural to urban land use and economic activity (with the corresponding changes in infrastructure needs). Demographic ageing is also likely to affect infrastructure needs substantially: this includes – most obviously – demand for infrastructure for children and teenagers, as well as health care and long-term care for the old. Other areas of infrastructure provision – such as wastewater and sewage – are less obvious candidates but may also need to be adapted to changes in the needs of a shrinking/ageing population. A similar argument can be made for migration and climate change mitigation and adaptation.

often vary substantially across regions (Figure 10), even within the same country. For instance, the difference in the European Commission's measure of climate change exposure between the least and most exposed region in Spain is almost three times as wide as the one between the region at the 25<sup>th</sup> and 75<sup>th</sup> percentile EU wide, illustrating the dramatic differences in exposure within the same country (Figure 10, Panel d). Similar patterns also appear for the other three megatrends. Since subnational governments are most aware of local needs, they have often been bestowed with key responsibilities to address them (Ter-Minassian and Fedelino, 2008; IMF, 2009).<sup>12</sup>

Section 2 of this chapter will delve into more detail as to how, in particular, subnationals with a poor infrastructure quality can be helped to effectively adapt to these (and other) challenges.

**Figure 10**  
**Regional disparities in megatrends**



Source: Eurostat.

Note: The charts illustrate that the four megatrends tend to be distributed very differently across the EU regions, even within the same countries. The charts report Eurostat data of NUTS-3 regions for population density, change in population and ageing. The environmental quality score comes from DG Regio (Social Progress Index) and is reported at the NUTS-2 level. For each megatrend the figure contrasts the 25<sup>th</sup> and 75<sup>th</sup> percentile at the EU level against the minimum and maximum in selected Member States. The purpose of this is to illustrate that within-country variation can often be substantial and exceed the inter-quartile range for the EU overall.

<sup>12</sup> The advantages of decentralised infrastructure investment have to be weighed against risks of local elite capture in regions in which institutions are still developing.

## Corporate infrastructure investment

**Corporate infrastructure investment has remained stronger than government investment in recent years.** Corporate infrastructure investment in 2016 accounted for some 35% of total infrastructure investment in Europe (see Figure 1). In 2016, for the first time, corporate infrastructure investment (as a share of GDP) reached and even slightly exceeded its 2009 level.

**This notwithstanding, there is a link between government and corporate infrastructure investment.** Using a novel dataset of 10 000 infrastructure corporates (see Data Annex for details) we find that in countries in which government infrastructure investment dropped (more) corporate infrastructure investment activities evolved more sluggishly. This is true even if we control for the overall economic performance and firm financials, suggesting negative spillover effects from the government sector to the corporate infrastructure sector (see Table 1).

**Table 1**  
**Investment activities by infrastructure corporates**

Variables	Investment/Total Fixed Assets
Growth of sales	0.828*** -0.0221
Financial leverage	-0.0428 -0.0328
Interaction (growth of sales and financial leverage)	-0.330*** -0.092
Quick ratio	-0.0124*** -0.0028
Growth in government infrastructure investment	0.857* -0.505
GDP growth	0.653 -1.663
Constant	0.536*** -0.0614
Country FE	YES
Observations	31 874
R-squared	0.059
Standard errors in parentheses	
*** p<0.01, ** p<0.05, * p<0.1	

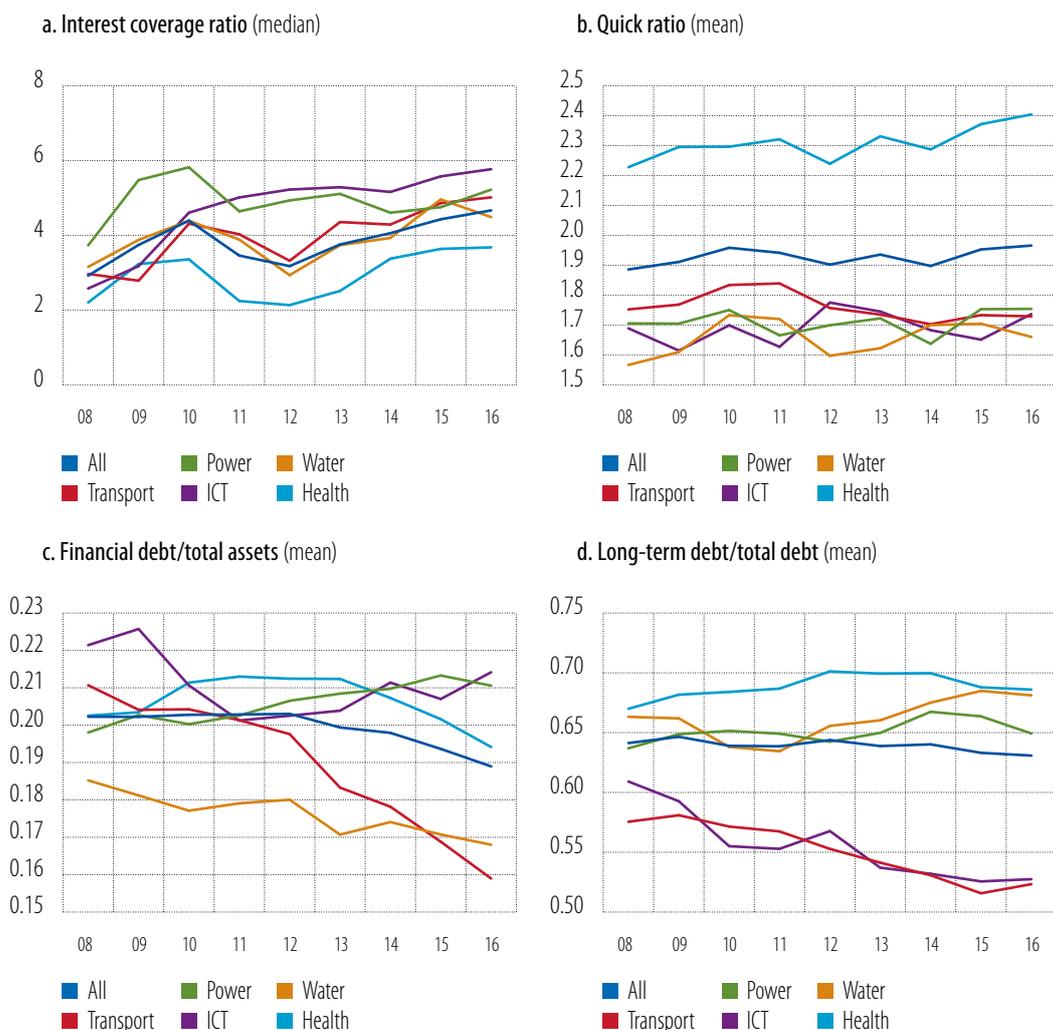
*Source:* EIB infrastructure data base; Bureau van Dijk. EIB calculations.

*Note:* The regression shows the regression of corporate investment (defined as changes in firms' total fixed assets over total fixed assets in  $t - 1$ ) on growth in government infrastructure investment, GDP growth (both at the country level), firm-specific characteristics and country fixed effects.

**Corporate balance sheets have remained stable or even improved in recent years, supporting investment activities in the sector.** Our data show that infrastructure firms have seen improvements in debt service capacity (with increases in interest coverage rates and falling leverage ratios) as well as constant or ameliorating metrics with regard to their liquidity and term structure (Figure 11), supporting the recovery in infrastructure investment in the sector.

Table 1 shows that corporates with a higher leverage respond more sluggishly to changes in demand (proxied by sales). This suggests that the improving situation, notwithstanding debt overhangs in the corporate sector, held back investment in some cases.

**Figure 11**  
**Corporate balance sheet indicators for the infrastructure sector**



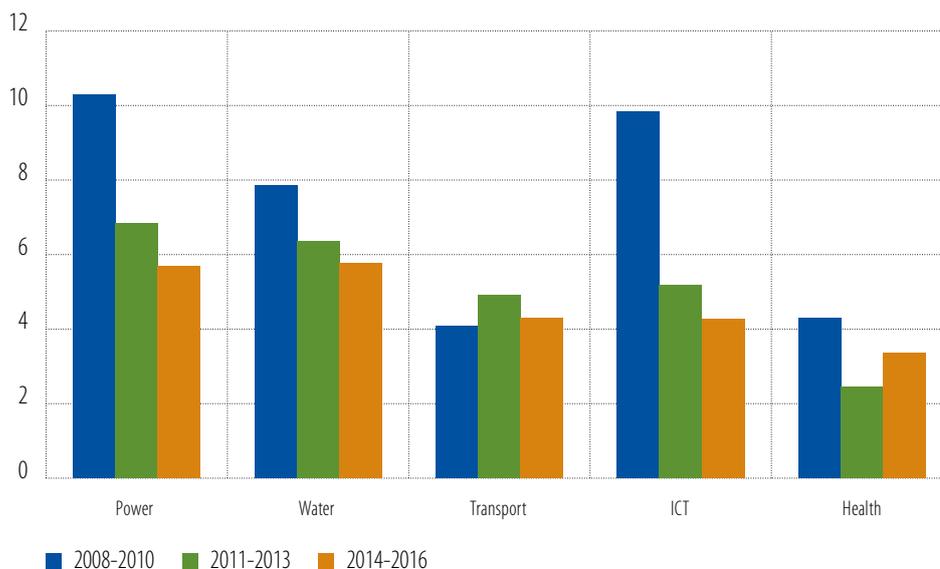
Source: Bureau van Dijk. EIB calculations.

Returns on investment, on the other hand, are on a clear downward trajectory, dampening the incentive to invest (more) in infrastructure. To estimate the return on infrastructure, we consider the entire infrastructure sector as one investment project (see Fama and French, 1999; Wagenvoort and Torfs, 2013).<sup>13</sup> The return on this project is then measured as the internal rate of return that equates the initial value of firms with the present value of their net flows generated over the sample period.<sup>14</sup>

This captures the private commercial returns on investment – a key factor in business investment decisions. (Note that our measure – while central for firm investment decisions – is not equal to the economic rate of return of infrastructure investments, which also takes into account the wider benefits from infrastructure investments such as increases in aggregate productivity or gains in regional or national competitiveness, etc.)

Figure 12 shows that commercial returns on investment clearly declined between the pre- and post-crisis periods, with the most marked drops being in the power and ICT sectors. Transport is the only sector in which returns remained relatively stable over this period.<sup>15</sup>

**Figure 12**  
**Estimated Internal Rate of Return (IRR) by infrastructure sector (in %)**



Source: EIB calculations based on Bureau van Dijk ORBIS data for selected infrastructure firms.

13 We bundle here regulated activities and competitive activities, as the principal aim is to provide an overview of what is happening to returns rather than what is driving the changes.

14 
$$IC_0 = \sum_{t=1}^T \frac{X_t - I_t}{(1 + r_{i,b \rightarrow b})^t} + \sum_{t=1}^T \frac{FSC_t - FBC_t}{(1 + r_{i,b \rightarrow b})^t} + \frac{TC_T}{(1 + r_{i,b \rightarrow b})^T} \quad (1)$$

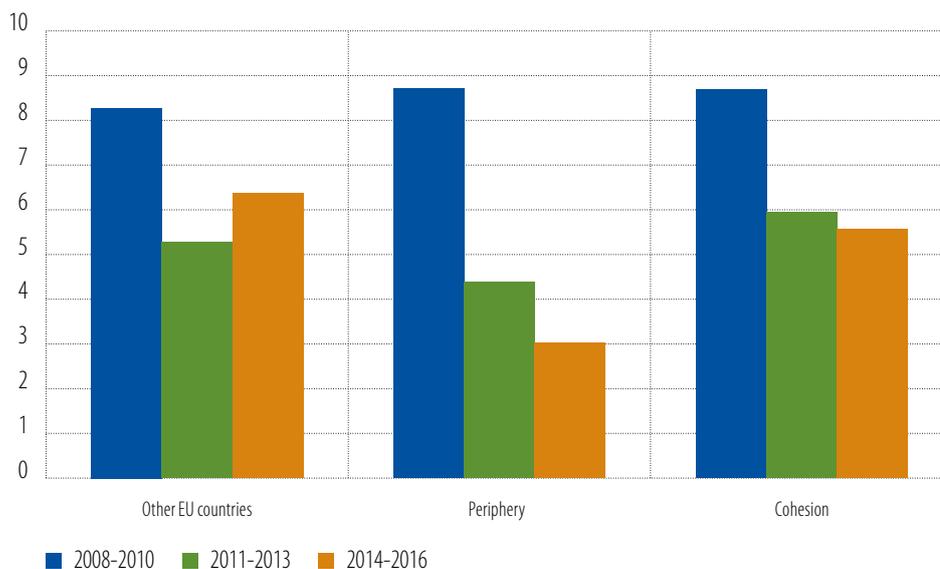
where  $IC_0$  is the aggregate initial book value of firms present in the sample at the beginning of the sample period for project  $i$ ;  $X_t$  is the aggregate after-tax cash earnings before deduction of depreciation, interest costs and dividends in year  $t$  of firms that were present in the sample in year  $t - 1$ ;  $I_t$  is the aggregate gross investment in year  $t$  of firms that were present in the sample in year  $t - 1$ ;  $FSC_t$  is the aggregate book value of firms that leave the sample between  $t - 1$  and  $t$ .  $FBC_t$  is the aggregate book value of firms that enter the sample between  $t - 1$  and  $t$ ;  $TC_T$  is the terminal aggregate book value of firms that remain in the sample in year  $T$ ; and  $r_{i,b \rightarrow b}$  is the operational return on investment. It should be noted that, in contrast to Fama and French (1999), we value all the cash flows at book value. Therefore, our estimates correspond not to the expected returns, but rather to the realised returns on investment.

15 This could not stop overall transport infrastructure investments from falling, as the corporate sector accounts for a relatively small share of investment in this sector.

**Returns have fallen most in the periphery countries (Figure 13).** In particular, the power sector in the region saw a stark decline in returns from 2008–10 to 2014–16. The ICT sector also saw a marked decline in returns, albeit less strong than the power sector. Health is the only sector in the periphery that saw more or less stable returns. In the cohesion and other EU countries returns declined more modestly. Just as in the periphery, the decline in these two regions was most pronounced in the power and ICT sectors. In addition, we find a marked decline in returns in the health sector in the other EU countries.

**Figure 13**

**Estimated IRR for the main infrastructure sectors by region (in %)**



Source: EIB calculations based on Bureau van Dijk ORBIS data for selected infrastructure firms.

**The falling returns mirror those in the non-infrastructure corporate sector.** The similar evolution in the infrastructure and non-infrastructure corporate sector can be explained by a weak(er) macroeconomic environment that directly affected returns in both sectors (see Chapter 1 for a discussion).<sup>16</sup> In addition, as most infrastructure sectors include – at least to some extent – activities for which returns are set by regulators using firms’ cost of capital as a key input, falling interest rates are likely to have fed through to firms’ return profiles.

**Changes in regulation in the infrastructure sector certainly play an important role in falling returns.**

- Regulation may have affected recent returns in the infrastructure sector by putting more emphasis on competition than was the case traditionally. While this move affected most infrastructure sectors, the effect on returns was particularly strong in the ICT and power sectors (see Perrin, 2013). In the ICT sector, the move towards “access regulation” – which imposes on incumbents the requirement to make the last-mile infrastructure available to new entrants – has been beneficial in terms of lowering costs and user penetration, but shown to dampen returns on investment (see Briglauer et al. 2015, 2018; Williamson et al., 2016).

In the power sector, it is, in particular, competition from renewables on the back of strong fiscal incentives that led to downward pressure on returns and what is often called the “missing money” problem for conventional providers of energy in this sector, i.e. wholesale prices below costs (see, for example, European Commission, 2015).

<sup>16</sup> Note that the fall in returns is not a contradiction with recent high stock market valuations insofar as the latter reflect not just the improved profitability situation in recent years (which we also see in our returns data) but also optimistic expectations about future profitability.

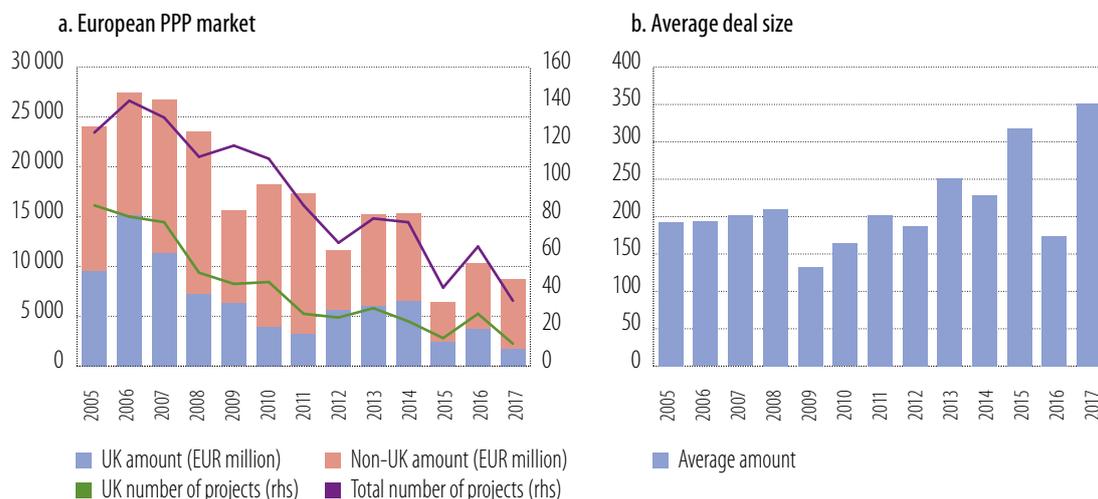
- Political interference had a negative effect on allowed returns in various sectors and countries. A stark example is France, where years of interference in tariff setting for gas eventually led retail suppliers to challenge tariff decisions in court. Other striking examples of recent interference include outright rate cuts in Hungary and Bulgaria (see, for example, Labelle and Georgiev, 2015) and taxation of regulated infrastructure in Spain and Italy, which indirectly reduced the return on investment below the nominal level set by the regulator (see Chapter 3 for more discussion on this).
- Regulation may have affected returns by means of a bias in the estimation of “allowed returns”: where applicable, regulators often estimate “allowed returns” for infrastructure corporates by combining the risk-free rate with an equity risk premium, where sovereign bond yields serve as a proxy for the former and historical equity risk premiums as a proxy for the latter. The problem with this approach is that, as sovereign bond yields fell during the crisis years, regulators tended to adjust allowed returns downward, neglecting the fact that the fall in sovereign yields generally came with an increase in equity risk premiums. The result of this was a downward bias of allowed returns, with the corresponding consequences for investment (see EIB, 2017).

## Public-private partnerships

**The European PPP market almost completely dried up in recent years.** In the light of weak government infrastructure investment and, at best, stable corporate infrastructure investment activities, many observers had high hopes for public-private partnerships to fill the gap with respect to pre-crisis investment rates.

So far, this hope has not materialised, with the PPP market standing at historically low levels (Figure 14): in 2017, it stood at an aggregate volume of EUR 8.7 billion – compared with EUR 30 billion in 2005 – supported by a record low number of (relatively large) deals.

**Figure 14**  
**Evolution of European PPP market over time** (in EUR million)



Source: EPEC.

**The decline in PPPs can be interpreted – to some extent – as an over-reaction to very strong enthusiasm for PPPs before the crisis.** In retrospect, some of the enthusiasm for PPPs prior to the crisis was likely motivated by an excessive belief in the private sector as a generally superior vehicle to promote infrastructure projects and/or a desire on the part of governments to keep what were *de facto* (contingent) government liabilities off their balance sheets.

The post-crisis years brought to light these issues and led to increased opposition to the use of PPPs in a number of markets, as well as a more selective approach to their proposed use: a number of failed PPPs in the periphery countries following the crisis led to government bail-outs (illustrating the *de facto* link between PPPs and government balance sheets in these cases); the UK National Audit office questioned the cost effectiveness of a number of PPPs recently (pressurising the UK government to become more careful in the selection of projects to be promoted using SPVs<sup>17</sup>).

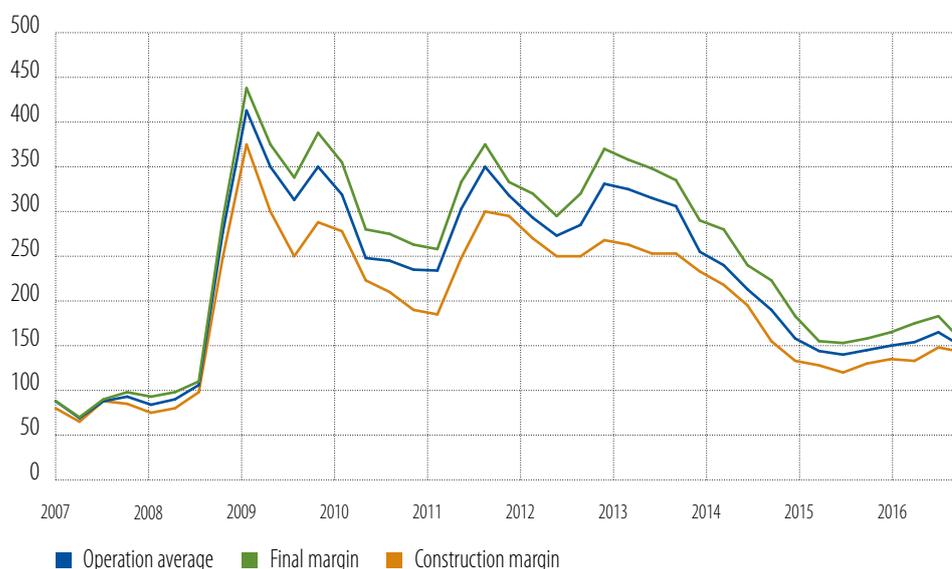
Inadequate framework and regulatory conditions and lack of sufficient technical capacity as well as misaligned incentives have often contributed to disappointed expectations when it comes to what PPPs deliver. (see e.g. Hall (2006) and ECA (2018)).

While this negative experience with PPPs undoubtedly had an effect on governments' willingness to use them to promote infrastructure projects, the reaction that led to the market nearly drying up completely was most certainly too strong. After all, PPPs, when designed well, hold the promise of being an efficient delivery approach that allows public authorities to tap private sector expertise and channel idle savings into productive use. Meanwhile, clearer guidance as to when PPPs can be considered on and off balance sheet have been developed (see EPEC/Eurostat, 2016; Box B).

**Elevated costs of funding, on the other hand, are unlikely to explain the recent weak investment activities.** While financing margins for PPPs increased sharply after the onset of the global financial crisis, in part due to the disappearance of mono-line insurers that played a big role in the pre-crisis market, they have declined ever since (Figure 15). This suggests that regulation-induced or otherwise induced supply constraints on the financing side are not at the heart of the fall in the European PPP market today, but that what is primarily needed to revitalise the market is new interest by governments in PPPs as a vehicle to effectively implement (suitable) infrastructure projects.

**Figure 15**

**Margins for benchmark European PPP projects** (in basis points)



Source: Authors' calculation based on Standard and Poor's.

<sup>17</sup> See National Audit Office, 2018.

**Box B****Infrastructure as an asset class**

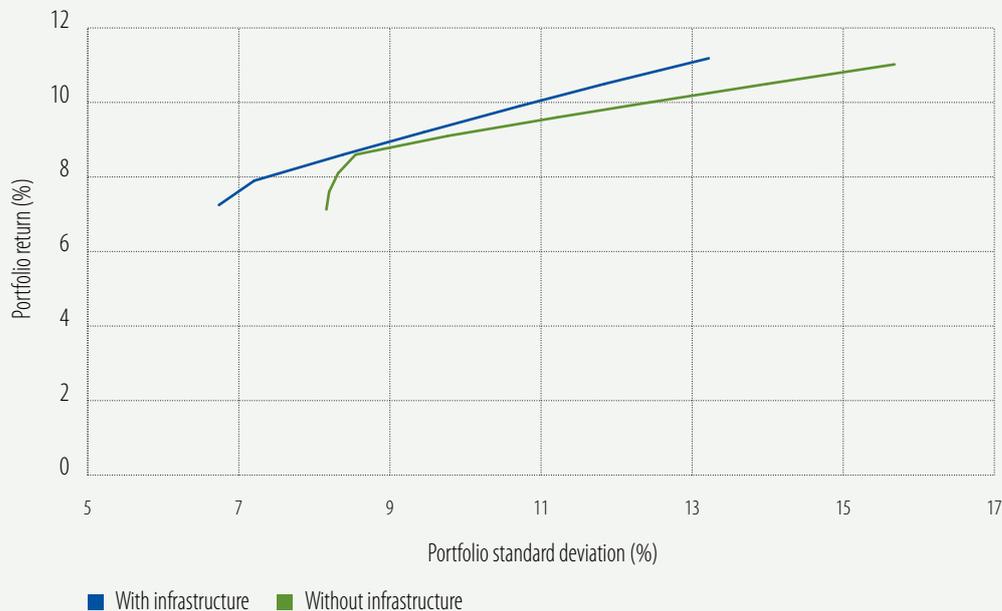
Infrastructure projects are an appealing asset class. Savings accumulation in retirement systems has never been larger than today, underscoring the important role that pension funds and pension reserve funds can play as a source of productive long-term capital. In 2015, pension funds and public pension reserve funds held EUR 24.3 trillion in assets (OECD, 2015), well above pre-crisis levels and a little below the combined GDP of the OECD member countries (EUR 39.3 trillion). With the average allocation to infrastructure investment in the form of unlisted equity and debt at only 1.1% of total assets under management, there is a growing potential for infrastructure investment to gain a share in portfolio allocation. Bridging infrastructure gaps through tax revenues and development assistance alone is insufficient for governments operating under very tight fiscal conditions. Fiscal constraints are the major obstacle to infrastructure investment for 75% of the municipalities that reported infrastructure gaps in the EIBIS (EIB, 2017), revealing that debt overhang is negatively affecting infrastructure investment. In the context of low public sector financing for infrastructure and with banks retrenching due to maturity mismatches in their balance sheet, an emerging idea is to transform infrastructure investment into an asset class. Examples are project bonds, and other forms of insurance/pension fund investment in more or less standardised assets.

Infrastructure investment as an asset class is appealing to investors for several reasons.

- Maturity mismatches between life insurers encourage the use of infrastructure investment as an asset class. Such investment offers better maturity matching of balance sheet assets and liabilities than core money market instruments. In 2017, the European Insurance and Occupational Pensions Authority calculated that the maturity of insurers' liabilities was greater than that of their assets (resulting in a maturity mismatch) by more than ten years for German life insurers and close to five years for French insurers (Van Liebergen et al., 2017). Maturity mismatches challenge firms' solvency, since cash flows from assets are insufficient to meet liabilities as they fall due. Structurally low interest rates due to an ageing population, global saving in excess of investment and decreasing potential growth further aggravated the maturity mismatch. When interest rates decline, the present value of liabilities increases more than the present value of assets for insurers with maturity mismatches.
- Infrastructure's revenue stream is persistent and is often more resistant to cyclical changes in the economy and inflation than other asset classes. Infrastructure typically provides basic services with relatively stable demand. Infrastructure's real returns have been more positive than those of bonds and equities, the assets mostly favoured by portfolio institutional investors wanting to offset the inflationary impact.<sup>18</sup> Real returns remained more positive before and after the global financial crisis.
- When included in a portfolio of other traditional financial assets such as fixed income, stocks, private equity and real estate investment trusts, European infrastructure investment offers a higher expected portfolio return for a defined level of risk. The resulting efficient frontier of optimal portfolios that offers the highest expected return for a defined level of risk is higher when European infrastructure investment is included in a portfolio than when it is not. The shift in the efficient frontier illustrates the significant diversification gains attributed to the low correlation of infrastructure with other portfolio assets when infrastructure is included in an investment portfolio.

<sup>18</sup> On average, large pension funds and public pension reserve funds allocate 57% of their investment portfolios to bonds and 29% to equities. See OECD (2015).

**Figure B.1**  
**Efficient frontier estimation**



Source: Authors' calculation based on Bloomberg.

Note: Daily data were used for European government bonds (IP06TREU Index), stocks (BE500 Index), private equity (LPXEURPI Index), real estate investment trusts (TEREEE Index) and infrastructure investment (DJBGIT Index) spanning 2010-18.

The low number of originated projects and level of standardisation and generally low returns after discounting the risk and cost of project assessments may deter institutional investors from investing in infrastructure. In this setting, only a few funds can make the effort and develop the business, resulting in a lack of intra-EU cross-border risk sharing. EU pension and insurance investors exhibit home bias in their investment allocation, as they prefer to invest more in their home rather than share risk at an intra-EU level. According to the IMF's Coordinated Portfolio Investment Survey, pension funds and other insurance corporations have 47% of their assets in the world invested in other EU (ex-UK) countries versus 15.6% in the periphery and 1.6% in cohesion countries.

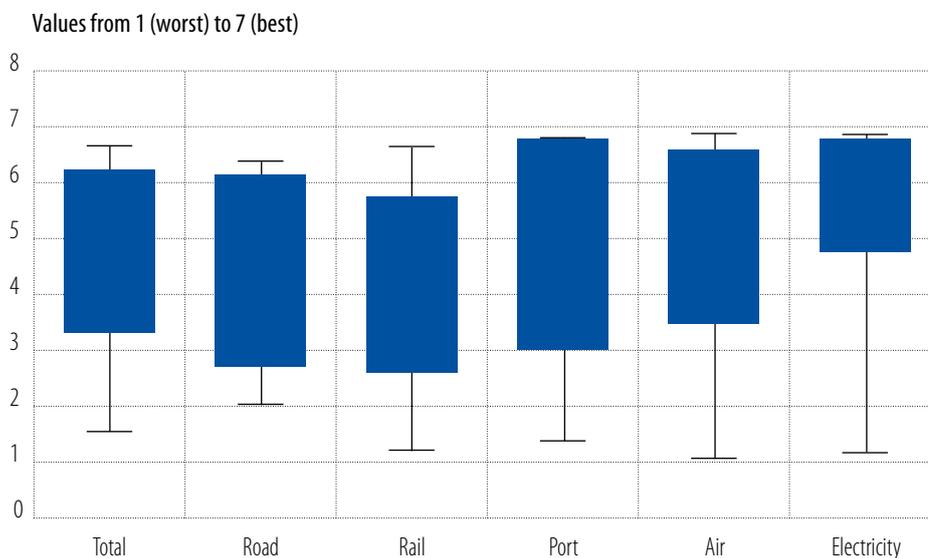
Regulatory barriers to infrastructure investment as an asset class have eased and improved the attractiveness of this option. The delegated regulation adopted by the European Commission on 8 June 2017 is pivotal in that regard, as it reduces by 25% the high capital charge for investments in infrastructure implied by Solvency II for insurers. Additional efforts in promoting infrastructure as an asset class could include developing cross-European investment funds, like the EIB's Marguerite Fund, with the objective of partially addressing investors' home bias. Moreover, smaller projects, for instance at the municipal level, could be pooled, to make those projects more attractive to institutional investors who typically invest fairly large amounts.

## Disparities in infrastructure quality: who are the left-behinds?

**The needs and constraints of municipalities with poor infrastructure quality have received little attention so far, mainly due to a lack of data.** The EIB Municipalities Survey 2017 shed more light on disparities in infrastructure quality across municipalities and its determinants and implications. Matching the municipality data with macroeconomic data at NUTS-3 level allows municipalities with both high and low self-perceived infrastructure quality to be compared across a broad range of dimensions. Funding needs, infrastructure governance capacity and a range of geographical and socioeconomic challenges are of particular interest. This comparison can provide insights into addressing infrastructure gaps and ensuring funds are used effectively. The analysis is based on perceived infrastructure quality at country and municipality level, which represents the best data available for international comparison. Nonetheless, results should be interpreted cautiously, as self-perceptions may be based on different benchmarks across countries and regions.

**While the quality of infrastructure in most EU countries is relatively good in comparison with the rest of the world, dispersion across the EU is substantial.** Perceived infrastructure quality, as reported by the World Economic Forum’s Competitiveness Indicators, in most EU countries is fairly high compared with the rest of the world. Best performers are at the international frontier in most infrastructure sectors. However, the dispersion in infrastructure quality scores across EU countries is substantial, as evidenced by the blue bars in Figure 16. The dispersion in infrastructure quality within the EU is largest for ports and roads and lowest for electricity. An important degree of dispersion across countries can also be found when comparing hard infrastructure network data, such as roads per square kilometre.

**Figure 16**  
Perceived infrastructure quality dispersion at country level

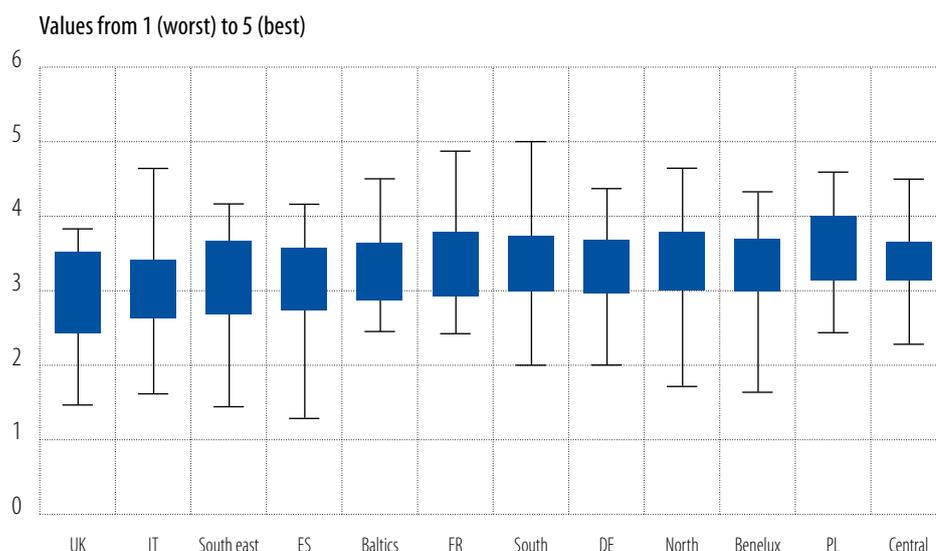


Source: World Economic Forum, Global Competitiveness Index 2017/2018.

Note: Box plots report maximum and minimum infrastructure quality scores of a sample of 137 countries; the bars show the gap between the best and worst performing EU countries.

**The dispersion in infrastructure quality within countries can also be marked.** The EIB Municipalities Survey 2017 ranked 539 municipalities across all EU Member States by their perceived infrastructure quality scores.<sup>19</sup> While cross-country differences in self-assessments have to be interpreted cautiously, dispersion in the overall quality scores reported by municipalities is remarkably heterogeneous within all 12 country groups considered (Figure 17).<sup>20</sup> An important degree of dispersion across regions at NUTS-2 level can also be found when comparing hard infrastructure network data, such as roads per square kilometre.

**Figure 17**  
**Perceived infrastructure quality dispersion within countries**



Source: EIB Municipalities Survey 2017.

Note: Box plots report maximum, minimum, and the 75<sup>th</sup> and 25<sup>th</sup> percentiles of perceived infrastructure quality scores provided by municipalities. Based on overall ranking of 539 municipalities in the EIB Municipalities Survey 2017 using the following question: How would you assess the quality of infrastructure in each of these areas in your municipality on a scale of 1 to 5, where 1 means it is completely outdated and 5 means it is up to latest international standards?

<sup>19</sup> The EIB Municipalities Survey was administered by telephone (in the local language) in 2017. It targeted mayors, treasurers and/or municipalities' chief civil engineers. It took on average (median) 20 minutes to complete. Fieldwork took place between April and August 2017. As part of the survey, 555 municipalities were interviewed in all 28 Member States, split across 12 countries/country groupings covering all EU countries. For more details on the EIB Municipalities Survey 2017, see EIB (2017).

<sup>20</sup> Due to the limited number of observations, smaller countries are merged into groups (EIB, 2017). Overall 12 countries/country groups are considered: France (36 observations), Germany (30), Italy (30), Spain (30), Poland (30), UK (35), Other Northern Europe (92; Austria, Denmark, Finland, Ireland, Sweden), Other Southern Europe (58; Cyprus, Greece, Malta, Portugal), Other Central Europe (67; Czech Republic, Hungary, Slovakia, Slovenia), South East Europe (56; Bulgaria, Croatia, Romania), Baltics (45; Estonia, Latvia, Lithuania), Benelux (46; Belgium, Netherlands, Luxembourg).

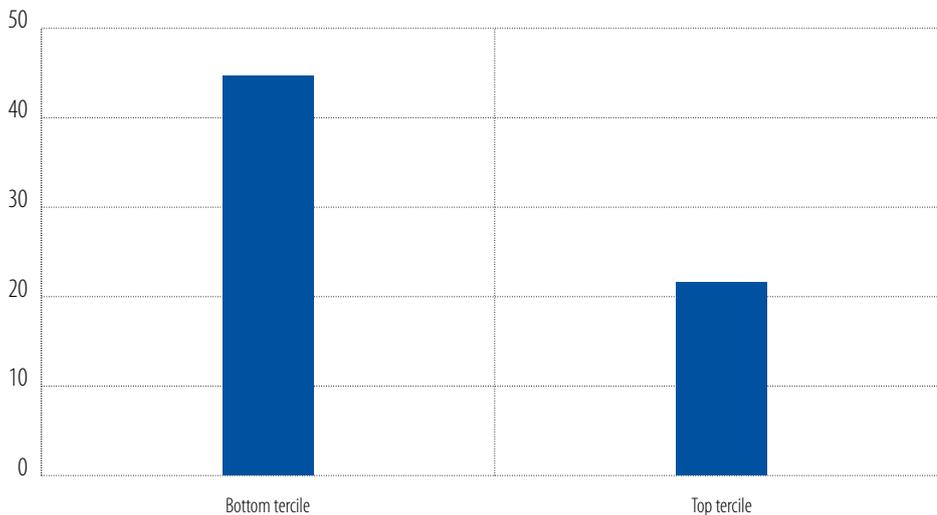
## Municipalities with low infrastructure quality underinvest

**Countries with a low infrastructure quality have cut their infrastructure spending most in recent years.** The decline in infrastructure investment across countries reported in the first part of the chapter is highly correlated with infrastructure quality scores from the World Economic Forum for 2008/9. Specifically, in recent years, infrastructure investment has tended to be low in countries that record the weakest infrastructure quality to start with, undermining the cross-country infrastructure convergence process (EIB, 2017).

**Regions with relatively weak infrastructure quality tend to underinvest more often.** Analysis based on the 2017 EIB Municipalities Survey shows that of the 33% of municipalities reporting the weakest infrastructure quality relative to their country-group average, 45% report underinvestment (Figure 18). This is twice the share observed within the top 33%. Many municipalities therefore seem to be aware of existing infrastructure gaps within their jurisdictions but are unable to boost investment accordingly.

**Figure 18**

**Perceived underinvestment** (% of municipalities with low and high infrastructure quality)



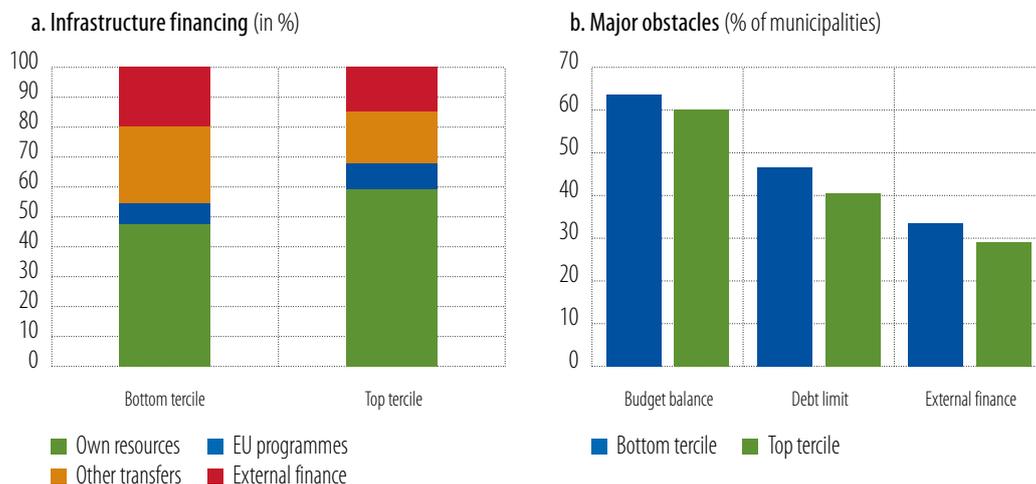
Source: Eurostat; Projectware, EPEC and World Economic Forum.

Note: Low (high) quality refers to the third of municipalities reporting the lowest (highest) average score across infrastructure sectors (weighted by the importance of the sector in terms of subnational gross fixed capital formation) in response to the following question: How would you assess the quality of infrastructure in each of these areas in your municipality on a scale of 1 to 5, where 1 means it is completely outdated and 5 means it is up to latest international standards?

## Municipalities with low infrastructure quality suffer from financing constraints

**Municipalities with low infrastructure quality more often seem constrained in mobilising funding for viable infrastructure projects.** Municipalities with low infrastructure quality fund their infrastructure through transfers and external financing rather than internal sources (Figure 19, Panel a). One possible reason for the limited use of internal funding is that municipalities with low infrastructure quality more often face fiscal constraints, either through tight budgets or legal constraints resulting from the fiscal federal framework. Indeed, low infrastructure quality is associated with a higher perception of the budget balance and debt limits as being an obstacle (Figure 19, Panel b). A strong dependence on transfers and EU funds may limit the willingness of those municipalities to invest in infrastructure on their own accounts. This also matters when deciding about the future allocation of EU funds.

**Figure 19**  
**Infrastructure financing**



Source: EIB Municipalities Survey 2017.

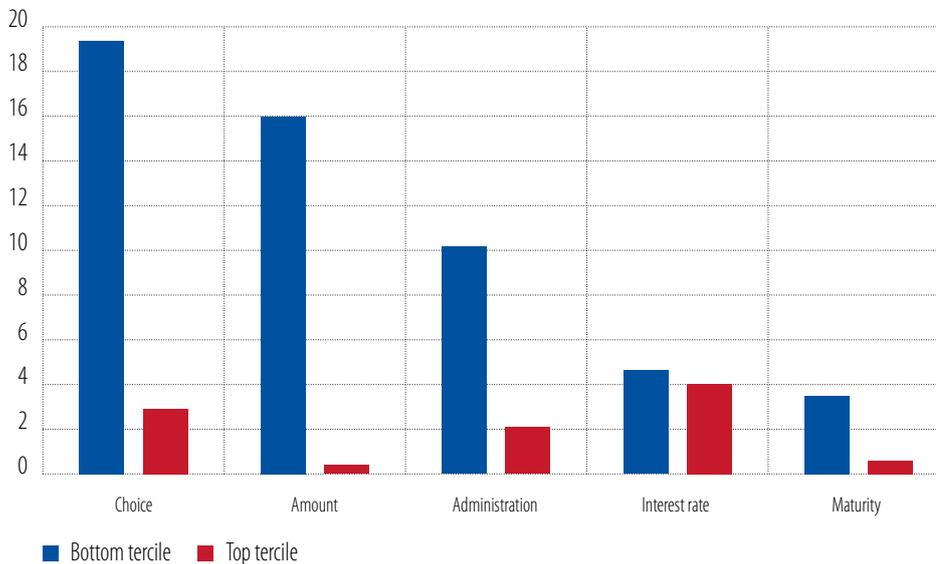
Note: Bottom (top) tercile refers to the third of municipalities reporting the lowest (highest) average infrastructure quality relative to country mean (see also note to Figure 18).

Questions: Can you tell me approximately what proportion of your infrastructure investment activities were financed by each of the following?

Thinking about all of the external finance you used for your infrastructure investment activities, how satisfied or dissatisfied are you with: the number of available external funding sources; amount of external funding available; interest rates offered; maturities available (i.e. the length of time over which the external finance has to be repaid); administration/ documentation requirements associated with the external finance?

**Weak infrastructure quality is associated with constrained access to external financing.** While municipalities with low infrastructure quality do use external financing more often to offset the lack of internal sources, they face a number of obstacles. 33% of municipalities that perceive their infrastructure quality to be low report external financing to implement infrastructure projects as being a major obstacle, compared to 29% of municipalities reporting a comparatively high infrastructure quality relative to the country mean, according to the EIB Municipalities Survey 2017. Notably, municipalities with low infrastructure quality are more often dissatisfied with the amount, maturity, choice and administrative hurdles of external financing options (Figure 20).

**Figure 20**  
**External financing constraints (% of total)**



Source: EIB Municipalities Survey 2017.

Note: Bottom (top) tercile refers to the third of municipalities reporting the lowest (highest) average infrastructure quality relative to country mean (see also note to Figure 18).

Question: Thinking about all of the external finance you used for your infrastructure investment activities in..., how satisfied or dissatisfied are you with: the number of available external funding sources; amount of external funding available; interest rates offered; maturities available (i.e. the length of time over which the external finance has to be repaid); administration/documentation requirements associated with the external finance?

## Infrastructure governance and quality go hand in hand

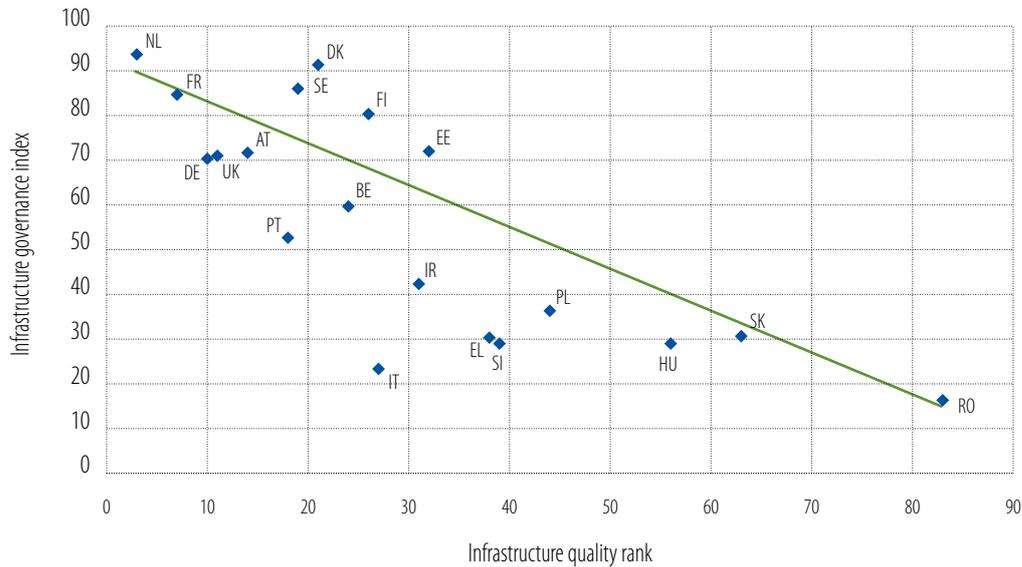
**Countries and municipalities that perceive substantial infrastructure gaps often suffer from technical deficiencies in selecting and implementing complex infrastructure projects.** This is problematic as it suggests that, even if the necessary funding is available, municipalities may have difficulties in using it effectively to address gaps due to limited infrastructure governance.

**Countries that score low on infrastructure quality are also often characterised by weak infrastructure governance (Figure 21).** Infrastructure governance is measured by the Hertie School–OECD Global Expert Survey on Public Infrastructure.<sup>21</sup> This suggests that deficiencies in infrastructure governance undermine the ability of some countries with substantial infrastructure gaps to address them effectively.

**At municipality level, low infrastructure quality is associated with weaknesses in infrastructure governance.** Infrastructure governance is defined here as the technical capacity to select and implement complex projects. 43% of municipalities that report their infrastructure quality to be lower than their within-country peers also report the technical capacity to implement infrastructure projects as being a major obstacle, compared to 30% for within-country peers with high quality infrastructure, according to the EIB Municipalities Survey 2017. Moreover, municipalities with low infrastructure quality conduct independent assessments of different kinds less often before going ahead with an infrastructure project (Figure 22, Panel a). They also consider this kind of information to be important or highly important less often when taking decisions on individual projects (Figure 22, Panel b).

<sup>21</sup> The Hertie School of Governance infrastructure governance indicators developed for the 2016 Governance Report seek to measure governments' readiness to respond to the diverse and complex issues involved in infrastructure decision-making (Oprisor et al. 2015). Drawing on original data from the Hertie School–OECD Global Expert Survey on Public Infrastructure and other data from official sources and surveys, the indicators look at three key dimensions of infrastructure governance: planning, management and outcomes.

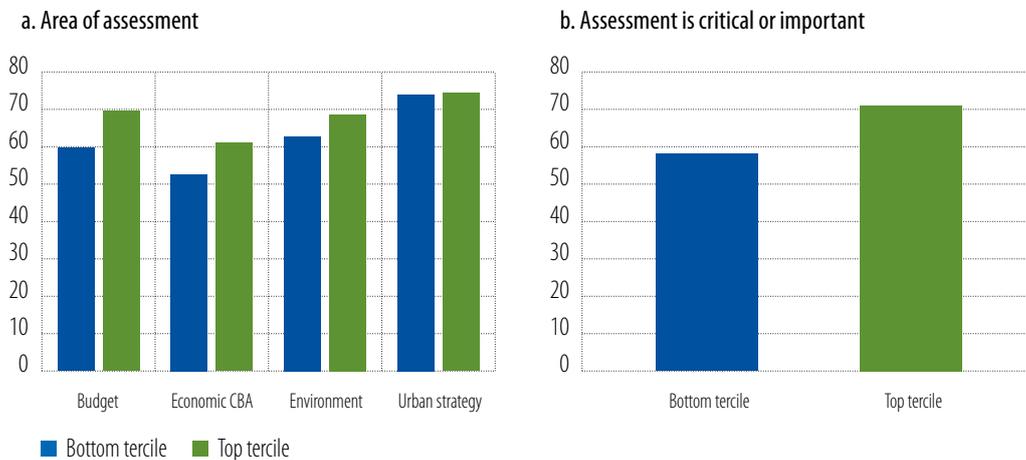
**Figure 21**  
Infrastructure quality and infrastructure governance across countries



Source: World Economic Forum, *Global Competitiveness Indicators (2017)*; Oprisor et al. (2015).

Note: Infrastructure Governance Index: high values indicate strong infrastructure governance capacity. Infrastructure Quality rank is from 1 (best) to 137 (poorest), based on the WEF Global Competitiveness Index.

**Figure 22**  
Independent assessment of projects and infrastructure quality (% of municipalities)



Source: EIB Municipalities Survey 2017.

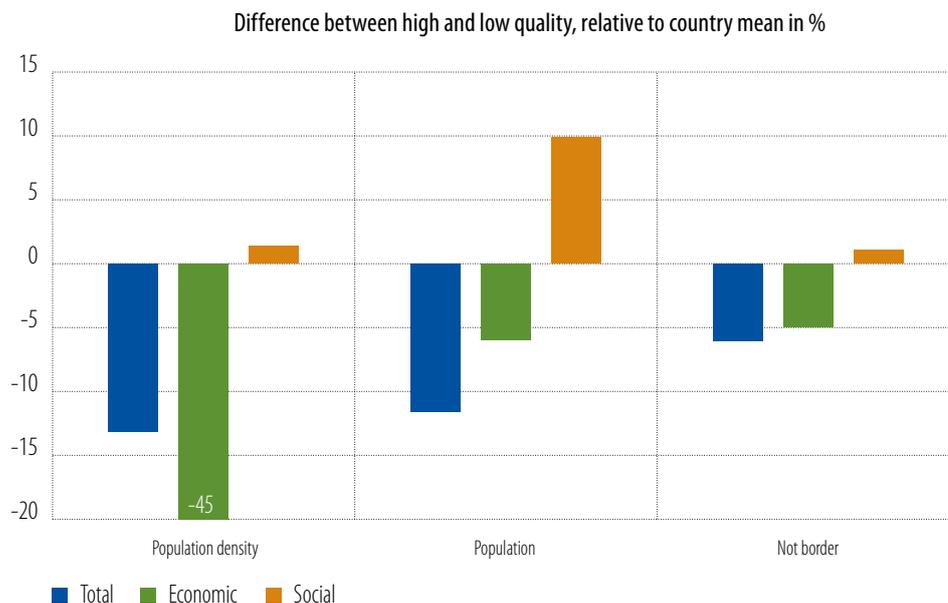
Note: Bottom (top) tercile refers to the third of municipalities reporting the lowest (highest) average infrastructure quality relative to the country mean (see also note to Figure 18). Panel a reports the share of municipalities that respond "always" or "frequently" to the question "Before going ahead with an infrastructure project, do you carry out an independent assessment of ...?". Panel b reports the share of municipalities that respond "critical" or "important" to the question "And how important would you say are the results of the independent assessment/s when deciding whether or not to go ahead with a project?"

## Geographical and socioeconomic challenges are associated with weak infrastructure quality

**Municipalities’ difficulties in building up technical capacity and funding infrastructure must be assessed in the context of their other challenges.** Notably, geographical and socioeconomic obstacles can create spending pressures, hampering municipalities’ ability to invest in technical capacity and infrastructure. While economic returns on infrastructure projects in such disadvantaged regions may be low, most lagging areas have economic potential (Barca et al., 2012). Moreover, neglecting territorial inequalities may entail substantial social and political costs (Rodríguez Pose, 2018). In any case, to ensure the efficient use of available funds, a comprehensive assessment of all socioeconomic costs and benefits is key.

**Low infrastructure quality is associated with geographical challenges constraining the ability to upgrade infrastructure (Figure 23).** Municipalities with low infrastructure quality tend to be more often characterised by a small population, a lower population density and are situated in border areas. These geographical challenges seem to be more pronounced in municipalities that report poor economic infrastructure quality, including transport, ICT and environment than in municipalities that report poor social infrastructure quality, including housing, education and health. Such geographical disadvantages may create greater infrastructure investment needs per inhabitant. At the same time, tax revenues tend to be lower in rural areas, aggravating fiscal constraints.

**Figure 23**  
**Geographical characteristics and infrastructure quality**

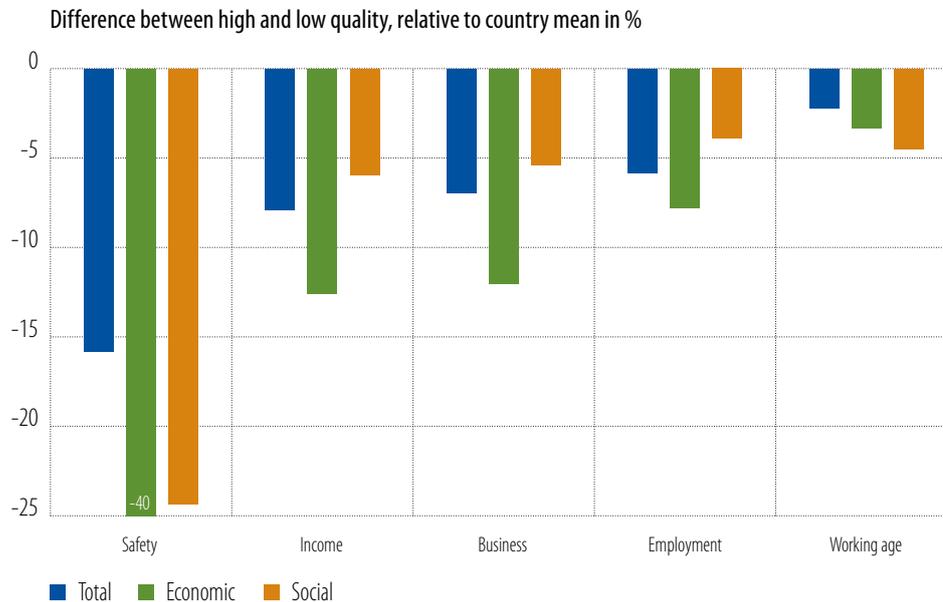


Source: EIB Municipalities Survey 2017; Eurostat.

Note: Within-country difference between municipalities reporting high and low infrastructure quality (see note to Figure 18). Outcomes are also expressed as deviation to their country mean and normalised by the country mean. National accounts data refer to NUTS-3 for 2014, to ensure full coverage. The definition of border regions refers to the European Commission’s territorial typology used in its fifth Cohesion Report. As a dummy variable, it is not expressed as deviation from the country mean.

**Municipalities that assess the quality of their infrastructure to be low also face socioeconomic challenges more often (Figure 24).** They suffer more often from weaker safety conditions, lower income per capita, a lower share of fast-growing firms and employment ratios. These socioeconomic problems seem to be particularly pronounced in relation to deficiencies in economic infrastructure, including transport, ICT and the environment.

**Figure 24**  
**Socioeconomic characteristics and infrastructure quality**



Source: EIB Municipalities Survey 2017; Eurostat.

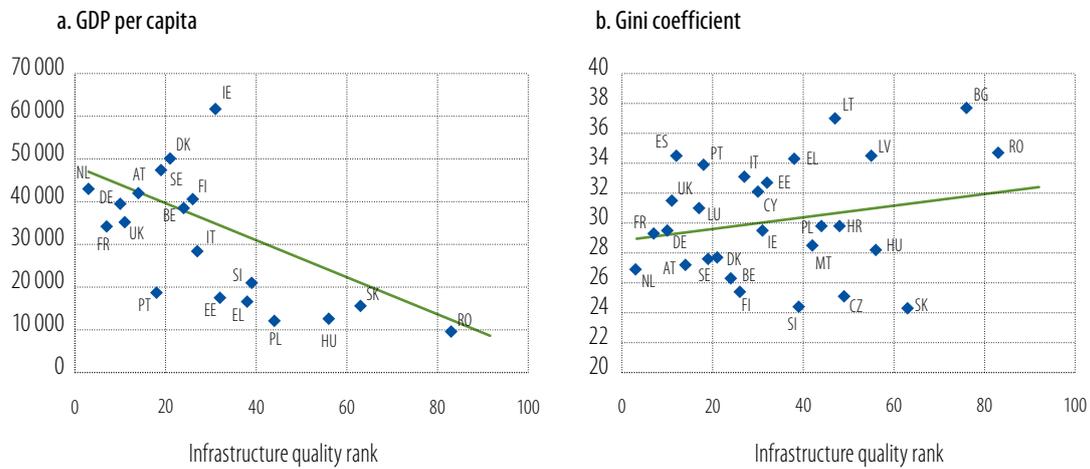
Note: Within-country difference between municipalities reporting high and low infrastructure quality (see note to Figure 18). Outcomes are also expressed as deviation to their country mean and normalised by the country mean. National accounts data refer to the NUTS-3 and 2014, to ensure full coverage. Safety is measured as the inverse of burglaries of private residential premises per capita in 2010 (the latest year available). Income is measured as GDP per capita.

**The difficult economic environment in municipalities with low infrastructure quality is also reflected in firms' assessment of their investment environment.** Firms' perception of the investment environment as reported in EIBIS can be matched with responses from the EIB Municipalities Survey 2017 at the NUTS-3 level. This unique combination of firm-level and municipality data shows that corporates located in municipalities with relatively poor quality infrastructure name skills as an investment impediment more frequently (see also Section 1.1). However, skills gaps often are not the only problem. Notably, firms in municipalities with relatively poor infrastructure more often report weak demand, poor transport infrastructure and energy as constraints.

**Deficiencies in quality often accompany socioeconomic challenges at country level.** Countries that score poorly in infrastructure quality in the World Economic Forum's Competitiveness Index tend to also be characterised by low GDP per capita (Figure 25, Panel a). Moreover, infrastructure quality seems to be positively associated with income equality (Figure 25, Panel b).

**Unfavourable socioeconomic characteristics can create additional social spending pressure, constraining municipalities' investment activities (EIB, 2017; KfW Research, 2017).** In most countries, federal legislation can impose tasks on lower levels of government, possibly without providing an adequate financial endowment. In addition, fiscal federal frameworks in many countries constrain municipalities' autonomy to take on debt. Unfavourable socioeconomic trends may then force them to reduce their infrastructure activities as one of the few adjustment variables at their disposal (European Commission, 2017a).

**Figure 25**  
**Infrastructure quality and socioeconomic outcomes across countries**



Source: Eurostat, World Economic Forum, Global Competitiveness Indicators, 2017; Oprisor et al. (2015).

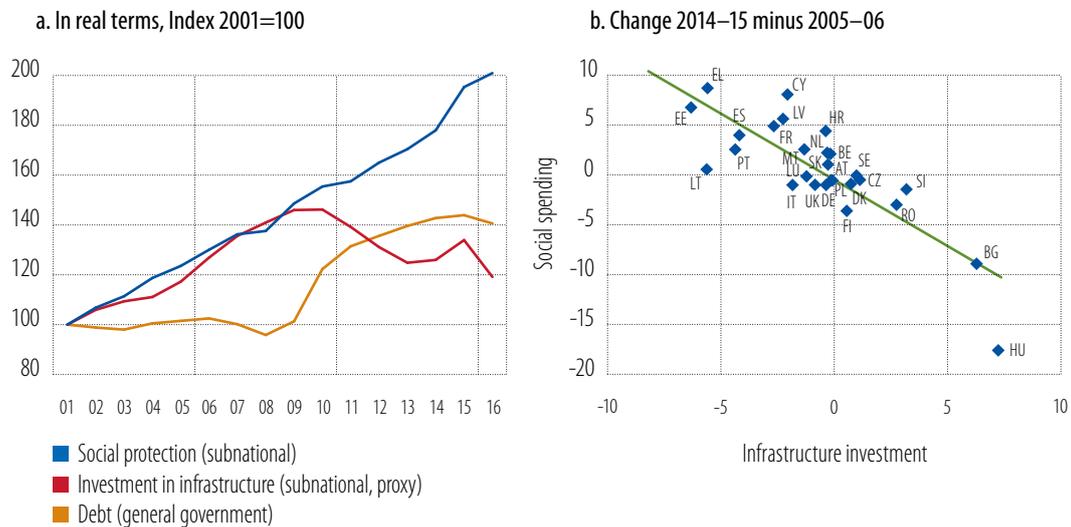
Note: GDP per capita in EUR, 2017. Infrastructure Quality rank is from 1 (best) to 137 (poorest), based on the WEF Global Competitiveness Index. A higher Gini coefficient indicates greater income inequality.

**Social spending pressure may squeeze subnational infrastructure investment particularly during economic downturns (Holtz-Eakin and Schwartz, 1995; Solé-Ollé and Sorribas-Navarro, 2012).** This may have been the case in the EU after the recent financial and economic crisis. A rise in public debt and subnational social spending was associated with a decline in subnational infrastructure investment in real terms (Figure 26, Panel a).<sup>22</sup> This was not the case before 2009, when national debt levels remained stable. The association between changes in subnational spending on social matters and infrastructure also appears when looking at spending shares (Figure 26, Panel b). Moreover, dynamic panel data regression analysis based on these data confirms that this link is statistically significant, even if controlled for budget deficits and cyclical factors.<sup>23</sup> This suggests that spending pressure, coupled with tightening fiscal constraints, can adversely affect infrastructure investment by municipalities.

22 A similar pattern emerges for the share of subnational spending on compensation of employees. This is another important component of subnational government expenditure which is difficult to adjust in the short term.

23 The regressions are based on the Corrected Least Squares Dummy Variable (LSDVC) estimator, which has recently been discussed in the literature on estimating dynamic panel data models (Bruno, 2005). The coefficient of subnational social spending, which includes social affairs and compensation of employees, as a share of total subnational expenditure is negative and significant at the 1% level. The explanatory variable is subnational gross fixed capital formation in economic affairs, environment education and health. Control variables include the lag of the dependent variable, capital transfers, a measure of the business cycle based on a smooth transition function and the subnational fiscal balance in per cent of GDP.

**Figure 26**  
**Subnational infrastructure investment and social spending**



Source: Eurostat, EIB calculations.

Note: On Panel a:

Spending on social protection by subnational governments is deflated by the GDP deflator. Investment in infrastructure is deflated by the GFCF deflator. Debt is expressed in per cent of GDP. Infrastructure investment refers to gross fixed capital formation in other buildings and infrastructure for economic affairs, health, education and environment by local and state governments.

On Panel b:

Infrastructure investment refers to total GFCF for economic affairs, health, education and environment by local and state governments. Social spending refers to the sum of compensation of employees and spending on social benefits other than social transfers in by local and state governments. Both variables are expressed as a percentage of total subnational government spending.

**Our analysis suggests that municipalities and countries with poor infrastructure face a range of challenges that undermine their ability to catch up.** Notably, municipalities with poor infrastructure quality relative to their within-country peers more often report: underinvestment; funding constraints; limited infrastructure governance capacity; and additional geographical and socioeconomic challenges. The combination of challenges that disadvantaged regions face calls for policy solutions that ensure that planning, governance and funding go hand in hand.

## Conclusion and policy implications

**Infrastructure investment has declined in recent years.** Aggregate infrastructure investment has been on a steady downward trend since 2009, lagging potential output growth in six out of the past eight years.

**Our analysis shows that this sluggish investment performance cannot be explained by saturation effects, and rather reflects underinvestment.** Notably, spillovers to new infrastructure investment for the business sector continue to remain high (as shown by our analysis in Section 1). Moreover, one in three municipalities state that recent investment volumes have been below their needs. In some parts of Europe (particularly in weaker regions), this share is even higher.

**Our analysis shows that the retreat of the government sector accounted for about 80% of the overall decline in infrastructure investment.** Where government infrastructure investment decreased, this fell primarily on subnational governments. Given their important role in addressing the (often highly geographically dispersed) effects of the four megatrends – urbanisation, demographic ageing, migration and climate change – this is a worrying development.

**To ensure that the recovery in corporate infrastructure investment continues, policymakers should keep an eye on returns on investment in the sector.** Corporate infrastructure investment performed better than government infrastructure investment in 2017. However, if returns continue to fall, investment activities by infrastructure corporates risk being adversely affected. Policymakers and regulators need to find the right balance between high (cost) efficiency and incentives to invest.

**Investment activities by PPPs require a new, more balanced narrative of the pros and cons of using SPVs to promote infrastructure projects.** To avoid PPPs disappearing altogether from the infrastructure mix, a renewed effort is needed to carefully assess their costs and benefits (compared with other delivery modes) at the micro level. This analysis can then feed into a nuanced narrative at the macro level that could help to overcome the generally negative perception of PPPs.

**Municipalities reporting poor infrastructure quality face a number of additional challenges.** Municipalities with comparatively low infrastructure quality compared to their within-country peers more often report underinvestment, according to the EIB Municipality Survey 2017. This undermines their ability to catch up in terms of infrastructure quality. However, weak infrastructure quality is also often associated with other challenges, notably funding constraints, limited infrastructure governance and other geographical and socioeconomic challenges. This suggests that, to address underinvestment in infrastructure, understanding the local context matters. Moreover, fiscal federal rules are important determinants of income disparities within countries and the ability of regions to raise funds for infrastructure investment.

**The combination of poor infrastructure quality, funding constraints, governance deficiencies and weak social outcomes can create a vicious circle.** Ultimately, this may undermine economic and social cohesion in Europe, with far-reaching economic and social implications (European Commission, 2017b). Evidence suggests that support for Brexit and the election of US President Donald Trump was strongest in poor regions that had suffered long periods of decline, reflecting dissatisfaction with neglected territorial inequalities (Rodríguez Pose, 2018). Economic returns on infrastructure projects may be low in disadvantaged regions. Nonetheless, most lagging and declining areas have economic potential. Many once-lagging areas are now leading regions, while former leaders have sometimes declined (Barca et al., 2012).

**Sound project selection, preparation and implementation is key to addressing infrastructure gaps, in disadvantaged and leading regions.** Evidence suggests that infrastructure investment can be hampered by limited implementation and planning capacity even in countries with ample financing capabilities (Oprisor et al., 2015). To ensure the efficient use of available funds, sound infrastructure governance is key. A comprehensive analysis of all economic and social costs and benefits should be conducted before starting any infrastructure project in the EU (Kline and Moretti, 2014). Application procedures for EU funds can be used to promote the comprehensive use of cost-benefit analysis.

**Tackling infrastructure gaps, in disadvantaged and leading regions, requires a mix of complementary policies, adapted to the local context.** Notably, three components may be required, depending on the project-specific context:

- **Lending instruments** that effectively support regions in addressing key infrastructure gaps.
- **Advisory services** to support capacity building and ensure available funds are used most effectively so that the many challenges faced by municipalities with poor infrastructure quality are addressed in a comprehensive way.
- **Blending** to overcome excessive funding constraints of disadvantaged regions or market failures. Blended financing could be provided, conditional on reform efforts to address other social and economic challenges and promote capacity building.

**The analysis in this chapter suggests that the EU's upcoming Multiannual Financial Framework provides an opportunity to address the identified infrastructure gaps through a coherent policy mix.** The first proposal of the European Commission includes important steps in this direction (European Commission, 2018). Notably a countercyclical investment support scheme is envisaged, to avoid a lasting decline in infrastructure investment after economic downturns. Moreover, the EC proposal aims to strengthen the link between EU funding and respect for the rule of law. It also includes proposals to expand the Reform Support Programme, which offers technical and financial support for reforms. Such initiatives can ensure that infrastructure planning, governance and funding go hand in hand. The EIB has traditionally worked towards delivering such coherent policy solutions. Notably, the EIB combines the financing of projects with high socioeconomic returns, including those with high risks, with technical assistance solutions.

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## Chapter 3

### Investment in innovation and intangible assets

**The global innovation landscape is changing rapidly.** The importance of the digital sector and the intangible economy is rising. China has become one of the top three global players for research and development (R&D) expenditures, together with the United States and the European Union. While remaining in the top league, the EU is spending less on R&D, as a percentage of GDP, than other major economies. The EU is not on track to reach the Europe 2020 strategy target of 3% of GDP invested in R&D by 2020. The gap in R&D intensity for Europe is largely driven by business R&D investment.

**Global R&D expenditures are concentrated among a few hundred firms that account for the majority of R&D spending.** The EU does not create many new large R&D companies. Several European companies are among the global leaders in the automotive and biopharma sectors, but the EU is less present in the fast-growing technological, electronics and digital sectors. Because of path dependency in innovation, this may create challenges for the long-term competitiveness of Europe.

**The share of leading innovators – firms that introduce products that are new to their market and make significant investments in R&D – is lower in the EU than in the US.** At the same time, leading innovators are more finance-constrained when they seek external finance, especially in less developed EU regions.

**To catch up with peers, the EU will need to create better framework conditions – at the EU level, but also at national and regional levels.** Policy action should consider a wide range of intangible investments (including software and databases or organisational and business processes improvements) and should not only concentrate on supporting R&D because of important complementarities between intangible and tangible assets. Access to finance for firms that invest in intangibles cannot be tackled in isolation: it should be embedded into an environment that addresses the other barriers to innovation (such as access to skills) and provides the right incentives to support investment by fast-growing small and young innovative firms in the EU.

## Introduction

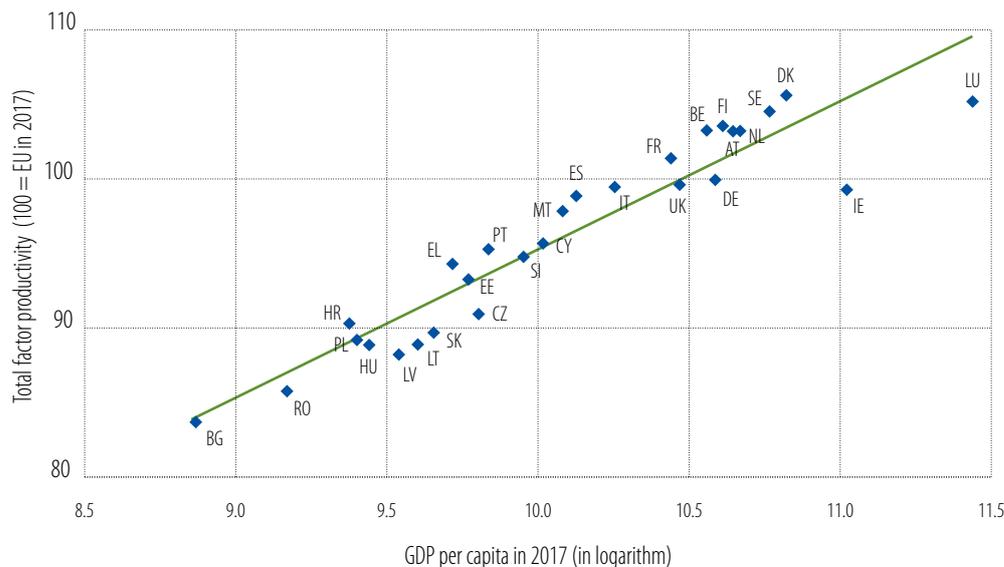
**The global innovation landscape is changing rapidly.** The importance of the digital sector and the intangible economy is rising. China has become one of the top three global players in R&D expenditures, together with the United States and the European Union. While remaining in the top league, the EU is spending less on R&D, as a percentage of GDP, than other major economies. The EU is not on track to reach the Europe 2020 strategy target of 3% of GDP invested in R&D by 2020. The gap in R&D intensity for Europe is largely driven by business R&D investment.

**This chapter provides an overview of recent trends in global R&D expenditures and the investment activities of large innovative companies.** It also discusses the characteristics of innovative firms that invest in intangible assets (such as R&D, but also software and databases or organisational and business processes) and the constraints they face in different EU regions. It highlights the importance of developing effective public policies to better support investment in innovation at the EU level, but also at national and regional levels.

## Productivity and innovation

**Investment in innovation is recognised as the main driver of productivity, long-term prosperity and economic growth for advanced economies, such as those of the European Union and the United States.** A substantial part of the differences in income per capita across countries in the EU is due to differences in firm-level productivity (Figure 1). When considering a large set of countries, including both developing and advanced economies, total factor productivity accounts for more than 60% of the variation in GDP per capita across countries (Jones, 2016). Economic output can increase with investment in physical and human capital. However, in the long term, income per capita rises with innovations that make physical and human capital more productive (Cirera and Maloney, 2017).

**Figure 1**  
**GDP per capita in 2017 and average firm productivity, EU Member States**



Source: EIB calculations based on Eurostat and EIB Investment Survey (EIBIS).

Note: Data on all firms are pooled from the three waves of EIBIS (waves 2016, 2017 and 2018) to construct an average of total factor productivity for each country. Firms in EIBIS are weighted with value added.

**Innovation can help to address pressing policy and social challenges – including an ageing population, climate change, and numerous health and environmental issues.** New products, services and processes have to be developed, creating growth opportunities for firms as well as new skill needs and job opportunities for workers (OECD, 2016). By innovating, entrepreneurs challenge existing firms through a process of Schumpeterian creative destruction, regarded as one of the engines of economic progress (Schumpeter, 1939).

**Innovation is risky and costly.** Innovation activities are the result of costly and risky processes requiring systematic investment in research and experimental development activities. R&D activities “comprise creative and systematic work undertaken in order to increase the stock of knowledge – including knowledge of humankind, culture and society – and to devise new applications of available knowledge” (OECD 2015, p. 45). According to the 2015 OECD *Frascati Manual*, R&D activities refer to activities that are:

- novel – aimed at new findings;
- creative – based on original concepts and hypotheses;
- uncertain – with a high risk of failure;
- systematic – planned and budgeted;
- transferable or reproducible.

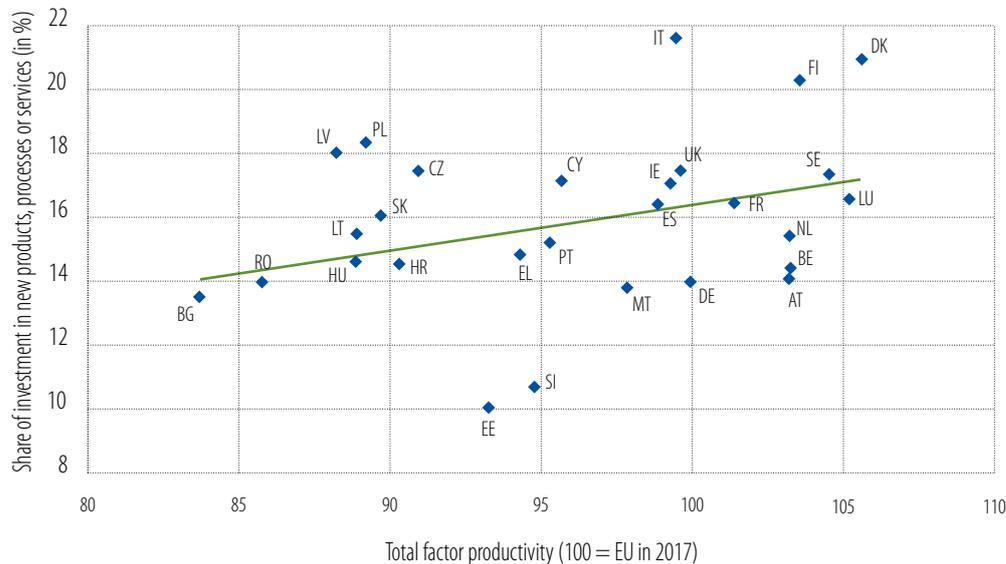
**Innovation activities are difficult to measure.** Statistics on R&D expenditures are often used to compare investment in innovation across countries and firms. Because of the capitalisation as gross fixed capital formation in national accounts, data on R&D expenditures are widely available across countries but they may only capture a small part of investment in innovation.<sup>1</sup> In addition to R&D, it is important to also explore investment in other intangible assets (such as software and databases, organisational capital and employee training), as well as intellectual property rights, such as patents, as they are associated with innovation activities in advanced economies.

**More innovative firms are based in more productive economies.** Firm productivity is associated with innovation activities but the correlation at the country level is weaker than that with GDP per capita (Figure 2). This suggests that there are critical elements in the institutional environment that can affect the success and performance of innovative firms. These include factors such as product and labour market regulations, the protection of intellectual property, the development of capital markets to finance innovation and the nature of the complementarities between investments in physical capital (such as machinery and equipment) and intangible assets (such as R&D, software and databases, organisation and business process improvements). Average firm productivity in the economy grows when:

- resources, such as capital and labour, are allocated to firms that perform better – improvements *between* firms (Syverson, 2011; Restuccia and Rogerson, 2017); or
- firms become more efficient and improve the quality of their products, processes and services – improvements *within* firms (Bartel et al., 2007; Bernard et al., 2010).

<sup>1</sup> For instance, large US companies in the services sector, such as Goldman Sachs or Walmart, report zero R&D in their corporate filings (Jones, 2016). In addition, until recently, accounting and fiscal regulations across many European countries did not require firms to report R&D expenditures, even for publicly listed firms. The UK is a notable exception, with an explicit recommendation of accounting practices that encourage firms to disclose their R&D expenditures since 1989 (Hall et al., 2007).

**Figure 2**  
**Firm productivity and average share of investment in new products, processes and services (in %), EU Member States**



Source: EIB calculations based on EIB Investment Survey (EIBIS).

Note: Data on all firms are pooled from the three waves of EIBIS (waves 2016, 2017 and 2018) to construct an average of total factor productivity for each country. Firms in EIBIS are weighted with value added.

**Both the public and private sectors are engaged in R&D with complementary roles.** In advanced economies, the business sector is the largest contributor to R&D investment. However, R&D investment by higher education institutions and research institutes is also essential to generate the new knowledge, human capital and skills needed by the private sector.<sup>2</sup> While most of business R&D spending is on experimental development and applied research, governments also make major investments in basic science that are key in supporting innovation in the private sector (Mazzucato, 2013).<sup>3</sup> A major role played by the public sector is to procure and create demand for innovative products in areas such as cybersecurity, space, military and health. In addition to direct involvement in R&D activities, the public sector plays a key role in providing supportive framework conditions for innovative firms.

**Public support for innovation should go beyond direct support for innovating firms.** Understanding how firms create and adopt innovations is important for the design and implementation of effective public support. An environment that facilitates the development and use of new ideas will enhance the productivity of the economy. Policymakers should not only focus on highly innovative firms in the manufacturing sector or on tax incentives for business R&D investment. They should also aim to create a self-sustaining ecosystem that enables the effective diffusion, circulation, commercialisation, adoption and adaptation of new products, processes and services. This is especially relevant for firms that do not innovate at the technological frontier (European Commission, 2018).

<sup>2</sup> The issue of employee training and how to better address skills shortages and skills mismatches to support firms in the EU is discussed in Chapter 7 of this report.

<sup>3</sup> There are three broad types of R&D activities defined in the OECD Frascati Manual: basic research, applied research and experimental development. Basic and applied research are both based on experimental or theoretical work undertaken to acquire new knowledge but, unlike applied research, basic research is not directed towards any particular application or use. Experimental development is directed towards producing new products or processes and to improving existing ones. Basic research does not necessarily lead to applied research and then to experimental development (OECD, 2015). Experimental development can support basic research with new findings, and basic research can also lead directly to new products, processes or services.

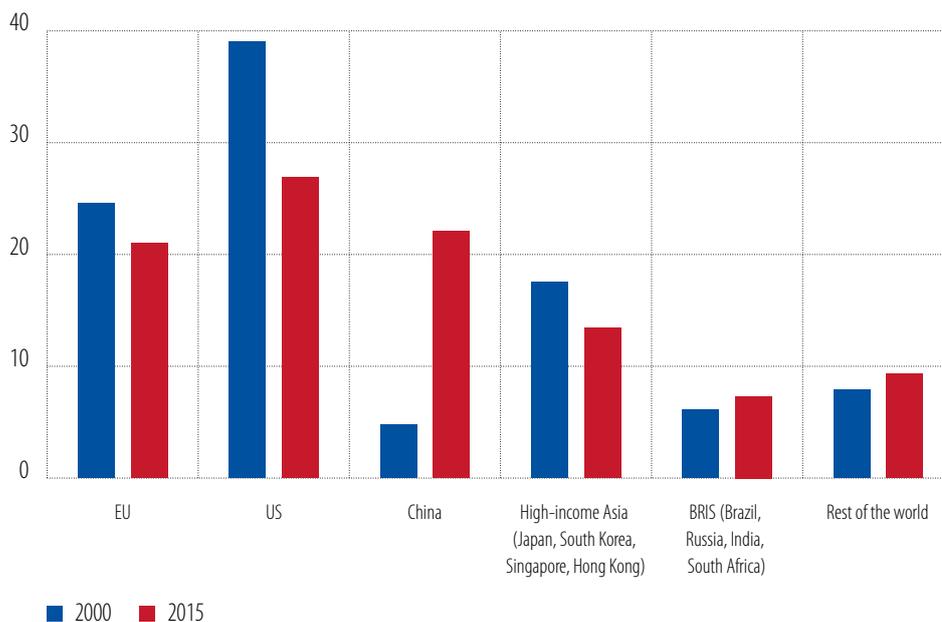
## Global R&D expenditures

**Global R&D expenditures increased rapidly over the past two decades.** R&D expenditures reached an estimated USD 1.92 trillion in 2015 (in current prices at PPPs), up from USD 722 billion in 2000: an increase of more than two and a half times in 15 years (National Science Board, 2018). The largest contributor to the rise in global R&D expenditures was China, accounting for more than 30% of the increase between 2000 and 2015. During this period, R&D investment in China increased by 18% annually (or around 16% adjusted for inflation), leading to an almost tenfold increase in the annual spend on R&D.

**The US is the economy that spends the most on R&D, followed by China and the EU.** However, the relative weights of the US and the EU in global R&D expenditures have been decreasing over time, mainly due to the rapid rise of China (Figure 3). Global R&D performance continues to remain concentrated in three geographic regions: North America, Europe and east Asia.

- The US represented 39% of global R&D spending in 2000 but only 27% in 2015;
- The EU share of global R&D investment fell from 25% to 20% between 2000 and 2015;
- Over the same period, China's share increased from 5% in 2000 to 22% in 2015.

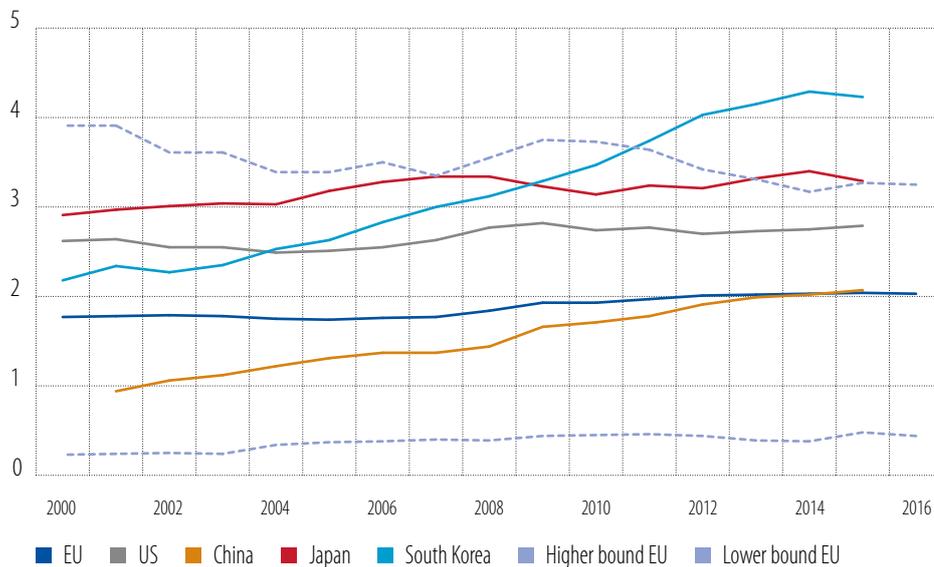
**Figure 3**  
Regional share of global R&D expenditures in 2005 and 2015 (in %)



Source: EIB calculations based on data from the UNESCO Institute for Statistics Data Centre.

**As a share of GDP, the EU is investing less in R&D than the US and China.** Over the past ten years, China and South Korea have rapidly increased their R&D investment intensity (R&D expenditure as a percentage of GDP), while the US, Japan and the EU have been less dynamic (Figure 4). South Korea has the highest R&D intensity among major economies, at 4.2% of GDP in 2015, after overtaking Japan in 2009 and Finland in 2011. In 2015, China overtook the level of the EU (2.07% of GDP for China compared with 2.04% for the EU). The EU is investing less in R&D as a share of GDP than other major global players, with potential negative implications for innovation and long-term growth. If policy measures are not taken to support R&D, some highly innovative EU firms may lose their comparative advantage compared with firms based in other countries. Lagging EU companies may also find it difficult to catch up and adopt technologies developed elsewhere.

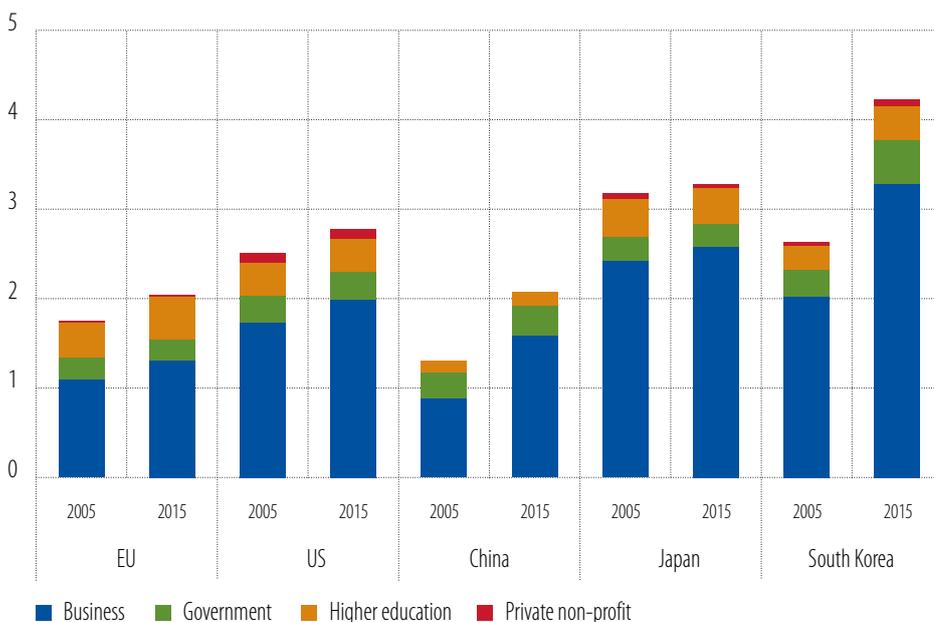
**Figure 4**  
R&D investment intensity in 2000 to 2016 (in %), EU and selected countries



Source: Eurostat.

Note: China except Hong Kong. No data for China in 2000. Data in 2016 only available for the EU. For each year, "higher bound EU" refers to the value of the EU Member State with the highest R&D intensity; "lower bound EU" refers to the value of the EU Member State with the lowest R&D intensity.

**Figure 5**  
Composition of R&D expenditures as a share of GDP (in %), 2005 and 2015, EU and selected countries



Source: Eurostat.

Note: China except Hong Kong.

**Finland and Sweden were the top EU performers in terms of R&D investment intensity in 2016 and Germany represents almost a third of total R&D expenditures in the EU.** Cyprus and Romania had the lowest levels of R&D expenditures in the EU as a share of GDP. There has only been a small tendency to catch up by the countries that were investing relatively little in R&D in 2000. The convergence in R&D investment intensity across EU countries over the past 15 years was mostly driven by the fall in R&D intensity in the top performing countries since 2009. In 2016, Germany represented 30% of total EU R&D expenditures, followed by France (17%) and the UK (13%). In the US, R&D expenditures are more concentrated geographically (at state level): in 2016, California accounted for 25% of total R&D spending, followed by Massachusetts (6%). California benefits from the presence of Silicon Valley, and both Massachusetts and California host high-technology industries and leading research universities (National Science Board, 2018).

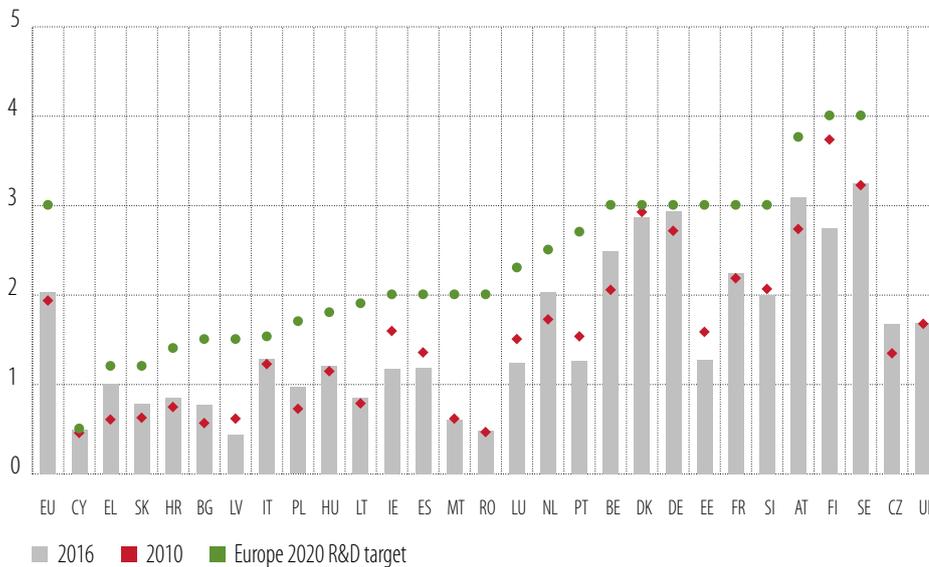
**The share of R&D investment by the business sector is lower in the EU than in the US, China and South Korea.** R&D expenditures can be disaggregated according to the different sectors carrying out R&D activities: the business sector, government, higher education and private non-profit institutions. The share of business R&D in total R&D expenditures is substantially lower in the EU (at 64%) than in the US (72%), or China, Japan and South Korea (almost 80%). The business sector is the driver of the rapid increase in R&D expenditures in China and South Korea (Figure 5). However, while most R&D is funded or performed by the business sector in Asia, this does not mean that the government is not supporting business R&D. For instance, in China, many large companies are controlled (directly and indirectly) by the state (Veugelers, 2013). The difference in R&D investment intensity across EU Member States is mainly driven by business R&D expenditures (EIB, 2017). This indicates that, to catch up with its peers, the EU will need to create a better framework and provide the right incentives for supporting more R&D activities by the business sector.

**The EU is not on track to reach the Europe 2020 strategy target of 3% of GDP invested in R&D by 2020.** R&D is one of the five headline targets of the Europe 2020 strategy, together with employment, climate change and energy, education, and poverty and social exclusion. By 2020, the EU aims to reach an overall R&D intensity of 3% (2% for business R&D intensity) through different national targets. While R&D expenditures have increased in most Member States over the last decade, it is unlikely that the EU target of 3% of GDP will be met by 2020. EU R&D intensity only increased from 1.93% of GDP in 2010 to 2.03% in 2016. As of 2016, Cyprus was the only EU country to have reached its national Europe 2020 strategy target (Figure 6). Germany and Denmark were also very close to reaching their national target.

**The annual R&D investment gap in the EU is estimated at EUR 140 billion, based on the target of 3% of GDP spending on R&D.** Gross domestic expenditures on R&D in the EU 28 were on average EUR 295 billion per year during 2014–16, corresponding to 2% of GDP. Actual spending falls short of the target by one percentage point, equivalent to about EUR 140 billion invested in R&D each year. While R&D expenditures were resilient and continued to grow throughout the crisis period in Europe (unlike other components of gross fixed capital formation), the R&D investment gap remains significant.

**Most Member States will need to increase R&D investment substantially if they are to attain their Europe 2020 strategy national target.** In 2016, several countries – Latvia, Finland, Ireland, Estonia, Portugal, Luxembourg, Spain, Slovenia and Denmark – were even investing less in R&D (as a share of GDP) than in 2010, when the target was set; for some countries, the 2020 target is ambitious. The decline in business R&D intensity in Sweden and Finland is mainly driven by lower R&D expenditures in the ICT sector (European Commission, 2016). However, the differences in business R&D investment across EU Member States are only partly driven by the industry specialisation of each country. The variation is also due to differences in the business environment, access to finance, human capital and the skills of the labour force. Given the large differences in R&D investment across EU countries, there is scope for public policy to intervene on several fronts to incentivise R&D investment. In addition, public intervention can be justified due to the positive externalities that are typically associated with R&D spending and innovation.

**Figure 6**  
R&D investment intensity in 2010 and 2016 (in %), and R&D target of Europe 2020 strategy, EU Member States



Source: Eurostat.

Note: Countries are ordered based on their national Europe 2020 strategy target for R&D. The target for Ireland is 2.5% of GNP, which corresponds to approximately 2% of GDP. The target for Luxembourg is between 2.3% and 2.6% of GDP. The target for Portugal is between 2.7% and 3.3% of GDP. There are no targets for the UK and the Czech Republic. The Czech Republic has a target of 1% of GDP for public R&D investment.

## R&D investment among the top global R&D companies

**Many large European companies are major global players in R&D and innovation.** R&D investment is characterised by high concentration, with a small number of companies, sectors and countries accounting for a large share of R&D expenditures. This section provides an overview of investment trends among the world's top R&D companies, the "league of big R&D spenders." It is based on data from the EU Industrial R&D Investment Scoreboard from 2008 to 2017 that ranks the 2 500 companies investing the most in R&D in the world.<sup>4</sup> The latest edition covers almost 90% of global business-funded R&D. Box A provides an overview of the sectorial focus of different regions of the world, highlighting the relatively weak presence of the EU in the electronics and technology sectors. In 2017, the league of big R&D spenders included:

- 822 companies from the US (representing 39% of total R&D expenditures by companies in the league);
- 567 companies from the EU (26% of R&D expenditures);
- 365 companies from Japan (14% of R&D expenditures);
- 376 companies from China (8% of R&D expenditures);
- 370 companies from the rest of the world (13% of R&D expenditures), including countries such as South Korea, Canada, Mexico, India, Norway and Switzerland.

**The high concentration of R&D spending is reflected in the fact that the top 10%, i.e. 250 companies, account for some 70% of R&D expenditures in the league of big spenders.** The top 1% (i.e. the top 25 companies) account for more than a quarter of R&D expenditures in the league. In Denmark and Belgium, the top 50 R&D spenders account for 70% of total business R&D investment (OECD, 2017). Focusing on the top 100 R&D investors, the global players are still predominantly based in the US and the EU. The number of Japanese firms in the top 100 fell between 2007 and 2016. China is still under-represented in the top 100 compared with the top 2 500 R&D companies, where its growing presence is much more evident.

**R&D concentration is particularly pronounced in high-tech, biopharma and digital sectors, but also in traditional industries, such as automotive and aerospace.** In fact, R&D investment is much more concentrated than sales and employment among a few global incumbent firms that have grown bigger over time (Veugelers, 2018). Unlike in the US, concentration has been stable or declining in Europe, and this has been associated with product market reforms and stronger anti-trust regulation (Veugelers, 2018).

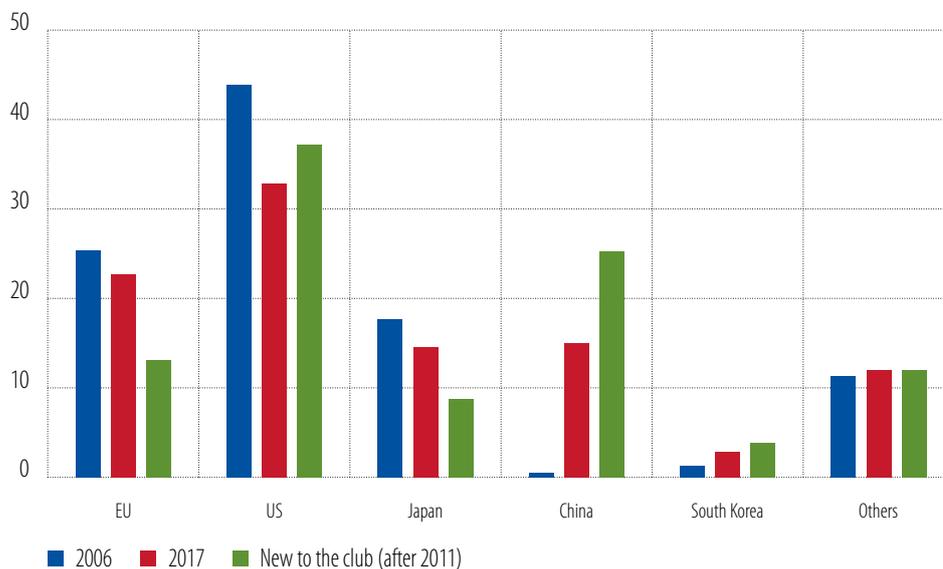
**Over the past decade, the global R&D landscape has started to shift from west to east, due to the rising importance of China.** With EUR 13.7 billion spent on R&D in 2017, Volkswagen is the top global R&D spender across all sectors and has topped the list in the past five years. Alphabet (the parent company of Google) is second in the global list, with EUR 12.9 billion of R&D spending – followed by Microsoft, Samsung Electronics and Intel (each spending more than EUR 12 billion on R&D). However, the traditional regional innovation leaders (the US, the EU and Japan) are losing ground. In 2006, Chinese companies made up less than 0.5% of global expenditures on R&D; in 2017, this share had grown to 8%. This is also reflected in the growing number of Chinese companies qualifying for the league: up from less than 1% in 2006 to 15% in 2017 (Figure 7). Comparing the success stories of China and South Korea, the former dominated on entering the league of big spenders, as Chinese firms likely benefit from the large domestic market as a base (without necessarily immediately gaining global top class); South Korean corporates lack a large domestic market where they can expand, and have to serve international markets and compete globally.

<sup>4</sup> In addition to the top 2 500 global companies, the database also includes data on the top 1 000 EU companies.

**Much is at stake for Europe: EU firms need to be able to grow and scale up in order to become global innovation leaders. Europe is well represented among the top R&D leaders.** However, external conditions enabling firm growth appear to be less favourable in the EU. The US and China have a higher number of recent entrants into the league of global innovators than the EU and Japan – the new entrants are firms that were not among the top global innovators before 2011. In the case of the US, the high rate of entry is also associated with more exits – otherwise, the share of US firms in the league of big R&D spenders would presumably have increased over time. Most of the EU companies that joined the league of big R&D spenders after 2011 come from the UK. Without the UK, the EU would look even less dynamic in this respect.

**Figure 7**

**Regional share of top global R&D companies in 2006 and 2017 (in %), and share of new entrants (joined the club after 2011), EU and selected countries**



Source: EIB calculations based on the EU Industrial R&D Investment Scoreboard.

Note: "New to the club" refers to companies that were not in the list of top global R&D spenders before 2011.

**The EU specialises less in the new high-tech intensive sectors and this may explain the gap between the EU and the US in terms of creating new leading innovators.** This deficit has been associated with the lower average rates of return on R&D investment for firms based in the EU than in the US (Cincera and Veugelers, 2014). This could be due to different business conditions, including access to finance and a regulatory environment that does not support young firms undertaking risky and innovative investments (European Commission, 2016). For instance, the venture capital market is smaller in Europe than in the US or Asia (where it has grown rapidly in recent years, especially in China).<sup>5</sup>

**New market entrants in the league of big R&D spenders typically come from the health industries (pharma and biotech) and the tech sector.** However, market concentration is rising in tech-related industries, notably the digital sector, where economies of scale and winner-takes-all dynamics can be very important. Fostering innovation and improving the digital economy are critical to having more European players join the league of top R&D investors.<sup>6</sup>

<sup>5</sup> Chapter 6 of this report discusses how venture capital can finance innovative firms in more depth.

<sup>6</sup> Chapter 8 of this report focuses on the rising importance of digitalisation for firms in the EU and the US, as it is transforming the way firms operate.

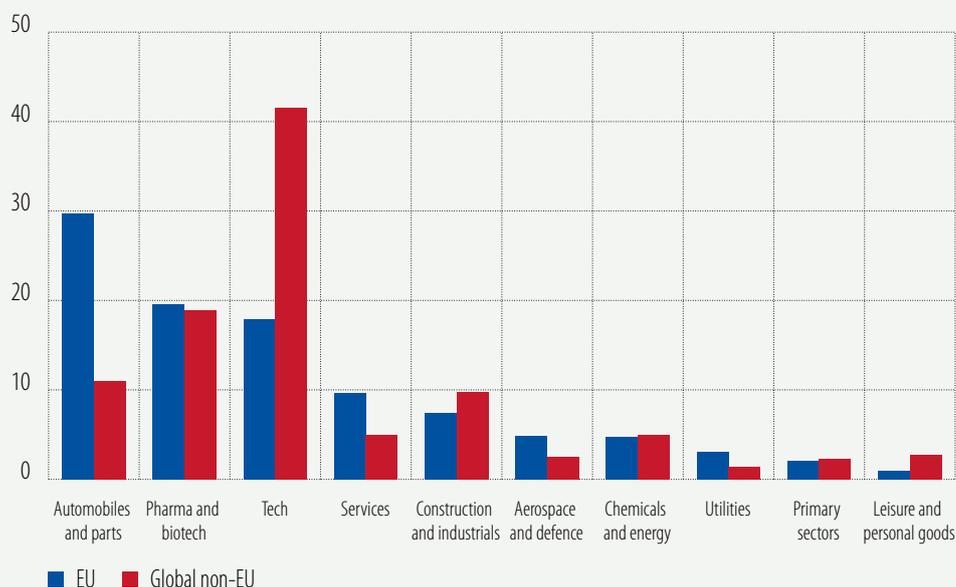
**Box A**

**Regional share of R&D expenditures among the top global R&D companies**

Three broad sectors dominate R&D expenditures of large innovative companies: automobiles and parts, electronics and technology, and pharmaceuticals and biotechnology.<sup>7</sup> Among large European innovative firms, the three sectors together make up around two-thirds of total business R&D spending (Figure A.1).<sup>8</sup> Compared with their global counterparts, EU automotive companies play a larger role in terms of R&D spending, while electronics and technology firms are less prominent in the EU.

**Figure A.1**

**Composition of R&D investment among the top EU and global non-EU R&D companies (in %, by sector (share of total in the EU and global non-EU))**



Source: EIB calculations based on the EU Industrial R&D Investment Scoreboard.

Note: Only companies with data on R&D and capital expenditures (capex) are included (total of EUR 185 billion for EU companies and EUR 529 billion for non-EU companies in 2017).

Europe is a global leader in R&D investments in the automotive industry. Global automotive R&D is heavily concentrated in a few European countries and Japan: the two regions account for about 75% of total R&D spending (Figure A.2).<sup>9</sup> In Europe alone, the top three champions (all German) make up 48% of total EU R&D investment in the sector. Volkswagen is the top global R&D spender across all sectors. Other large automotive companies include General Motors, Daimler and Toyota Motor, with ranks 11<sup>th</sup>, 12<sup>th</sup> and 13<sup>th</sup> in the Scoreboard: they each spent about EUR 7.5 billion on R&D in 2017.

7 Companies are classified into ten industrial sectors that are grouped into four broader sectors: tech, automotive, pharma and other/non-tech. Tech refers to companies in electronic and electrical equipment, technology hardware and equipment, and software and computer services; and other/non-tech all other companies except for automobile and parts, and pharmaceuticals and biotechnology.

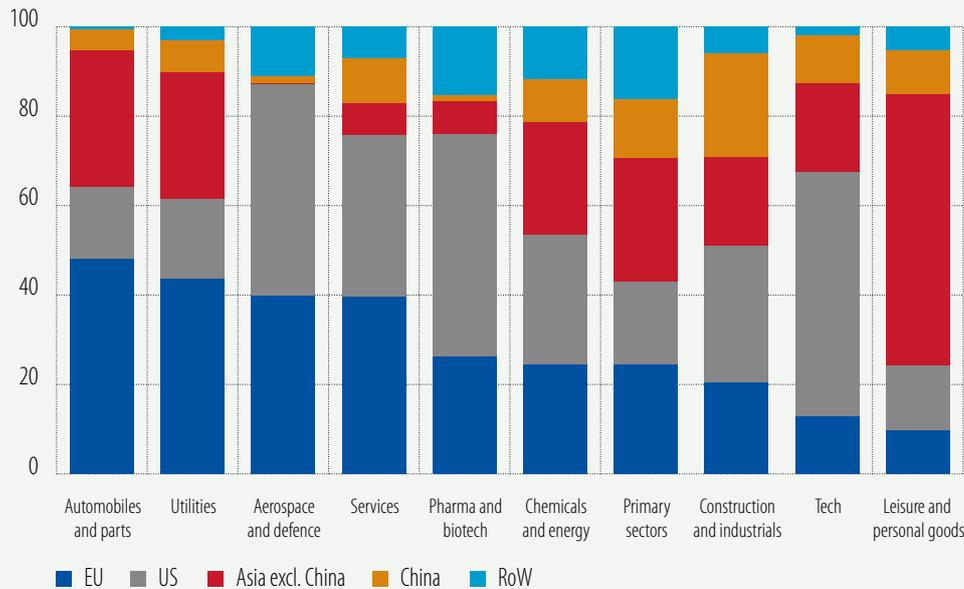
8 The OECD classifies the automotive sector as a medium-tech sector, while digital and biopharma are considered to be high-tech sectors (Veugelers, 2018).

9 The league of top R&D investors in the automotive and parts sector consists of 150 companies, together investing EUR 113 billion in R&D and generating sales for a total of more than EUR 2.58 trillion in 2017. Only a fifth of the companies are based in the EU, which indicates that EU automotive companies are large. Compared with non-EU global (notably Japanese) competitors, European automotive companies tend to invest more in R&D and less in capex.

For Europe, the automotive sector is historically one of the strongest traditional sectors. However, it is now experiencing a transformation, due to digitalisation and trends such as electrical vehicles, autonomous driving and car sharing. This development emphasises the need for continuous efforts in R&D activities as well as new investments in the sector.

**Figure A.2**

**Regional share of R&D expenditures among top global R&D companies (in %), by sector**



Source: EIB calculations based on the EU Industrial R&D Investment Scoreboard.

The pharmaceuticals and biotechnology industry is dominated by US companies, which account for half of the R&D spending in that sector. However, with 26% of global R&D investment in this sector, EU companies continue to be important players (Veugelers, 2013). Most R&D investment in pharmaceuticals and biotechnology is concentrated among a few champions: the top 10% of firms included in the league of big R&D spenders make up 80% of R&D expenditures in this sector.

Europe is less prominent within the electronics and technology sectors, where it accounts for 13% of R&D expenditures in the league of top tech R&D spenders. The major players in Europe – Siemens, Nokia, Ericsson and SAP – account for half of EU R&D investment in the sector (around EUR 16 billion of the EU total of EUR 33 billion). US companies account for the majority (55%) of total R&D investment in the tech sector. Ranking second to seventh in the overall Scoreboard, the six global tech champions Alphabet, Microsoft, Samsung (South Korea), Intel, Huawei (China) and Apple jointly invest EUR 70 billion (more than 25% of R&D spending in the tech sector, out of a total of some EUR 255 billion).

The presence of large Asian companies in the tech sector is increasing rapidly. This is also reflected in measures of innovation other than R&D, such as the stock of international patents (IMF, 2018). For instance, South Korea is a world leader in the number of patent applications (relative to its population), followed by Japan, Germany and the US, in part thanks to industry leaders, such as Samsung and LG Electronics (Zastrow, 2016).

Europe has strong traditional industrial sectors that were not born digital. Many indicators point towards Europe falling behind in digital transformation at a time when Industry 4.0 is gaining momentum and has started to change the business models of traditional industries substantially. Digitalisation

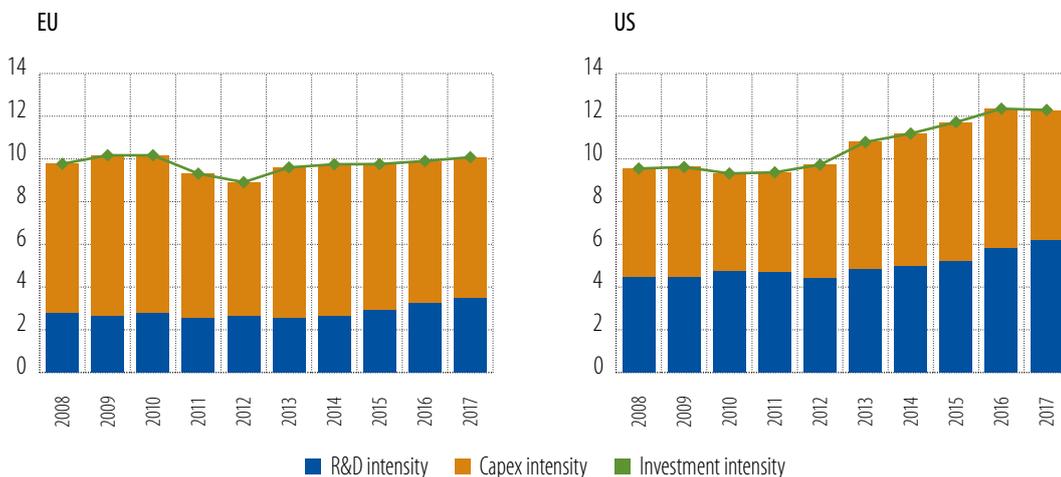
pervades the global economy and is arguably one of the most important drivers of firms' innovation, competitiveness and growth. The potential gains from new emerging technologies are very large, with various estimates suggesting that the digital shift could add between 10–14% to EU GDP by 2025–30, equivalent to some EUR 9–12 trillion (McKinsey Global Institute, 2016; PWC, 2018).

## Capital and R&D expenditures among the top global R&D companies

**R&D expenditures are not the only relevant form of investment for innovative companies.** Fixed capex, including ICT, are also a crucial component of investment for innovative companies in fast-growing markets – in particular digital companies when they scale up their operations. In order to obtain a broader picture of investment trends among these companies, the analysis therefore includes data on capex.<sup>10</sup> As a share of GDP, the EU invests less than the US in IPP, machinery and equipment.<sup>11</sup> But investing simultaneously in IPP and machinery and equipment is becoming more important for the performance of innovative companies because of significant complementarities between different asset types – as discussed in the last section of this chapter.

**US top R&D companies have a higher investment intensity than EU companies.** In this section, the combined expenditure on R&D and capex is referred to as “investment.” The investment intensity (investment as a share of net sales) by top EU R&D investors has averaged 9.7% over the past decade (Figure 8). While total investment intensity has now returned to its pre-crisis level, the composition has changed, with an increase in the relative importance of R&D intensity – indicating that R&D investment was more resilient than capital expenditures during the crisis in Europe. However, this evolution is specific to the EU. In the US, both R&D and capex intensity have increased over time, reaching a 50/50 split in 2017.

**Figure 8**  
Investment intensity of the top EU and US R&D companies (in %)



Source: EIB calculations based on the EU Industrial R&D Investment Scoreboard.

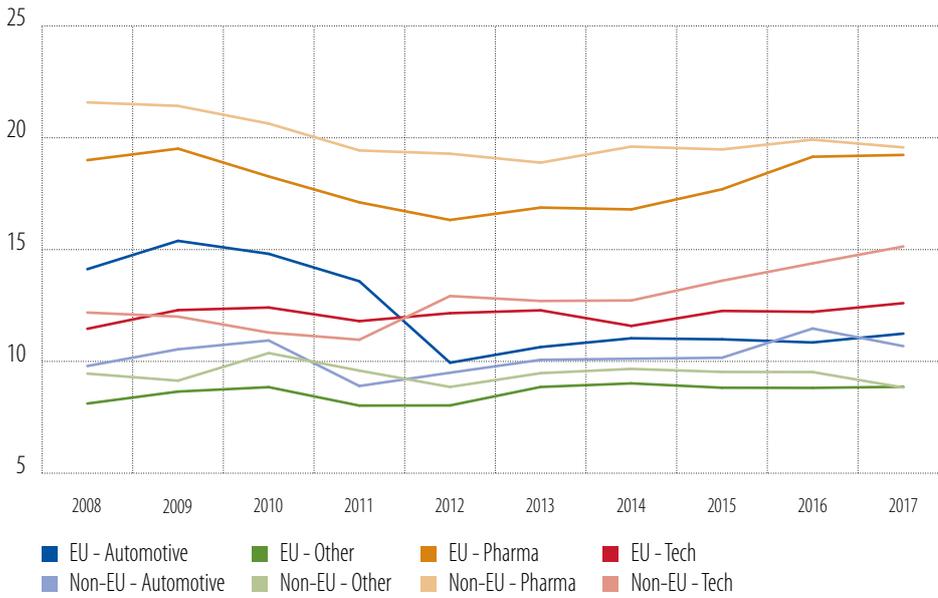
**The pharma sector has the highest investment intensity.** In the wake of the financial crisis, investment fell in all sectors. EU pharmaceutical and biotechnology companies recovered and closed the gap with non-EU companies, investing some 19% of their sales in R&D in 2017 (Figure 9). In the automotive sector,

<sup>10</sup> Only companies with data on both R&D and capex are included in the analysis.

<sup>11</sup> Chapter 1 of this report discusses recent developments in investment activity in the EU and the US in more depth.

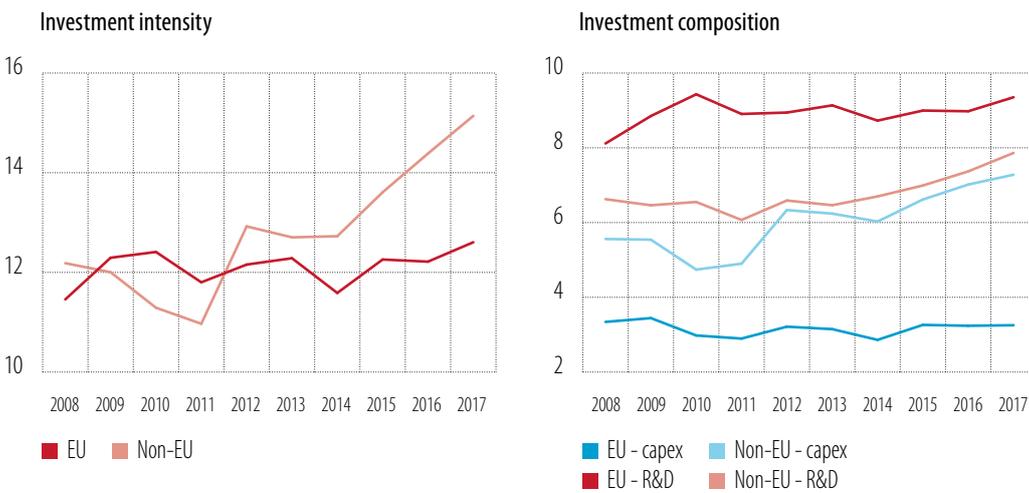
the investment rate of EU companies was substantially above non-EU peers in 2008 but it was heavily affected by the crisis: many EU companies reduced their capex, while R&D expenditures remained relatively stable. The investment intensity of EU and non-EU automotive companies is now similar (11% in 2017).

**Figure 9**  
Investment intensity of the top EU and non-EU global R&D companies (in %), by sector



Source: EIB calculations based on the EU Industrial R&D Investment Scoreboard.

**Figure 10**  
Investment intensity, and investment composition (R&D and capex), top EU and non-EU global R&D tech companies (in %)

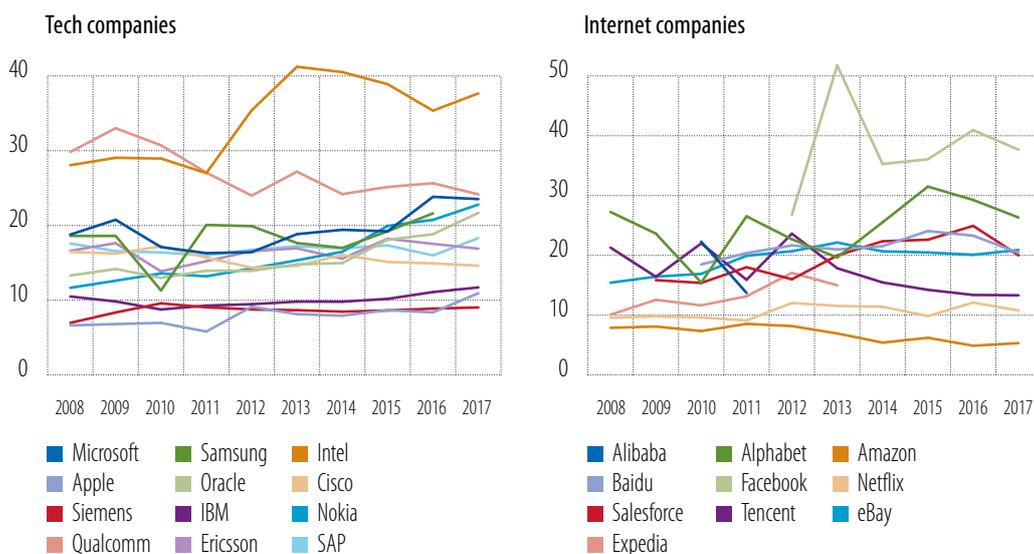


Source: EIB calculations based on the EU Industrial R&D Investment Scoreboard.

**EU tech companies are investing less than their global non-EU peers and the gap in investment rates has increased.** Almost ten years ago, both global and European tech companies had about the same investment rate. However, the investment gap between EU and non-EU tech companies has widened: EU tech companies stagnated at around 12%, while their global peers have made progress since 2011 and reached an investment rate of 15% in 2017 (Figure 10). This is almost entirely explained by the lower capex intensity of EU tech companies that averaged 3.2% in the past decade (only half the rate of global competitors).

**EU tech companies show persistent weakness in sales, growth, presence on the global stage and investment volume and intensity.** For most EU tech firms, sales (inflation-adjusted) are lower today than ten years ago, while they have increased rapidly in China – on the back of the rise of a few exceptionally large and successful US and Chinese tech companies, for which Europe has no equivalent. Among hardware companies, Intel stands out, and on the European side, Nokia and Ericsson show much lower investment rates (Figure 11). On the software side, Facebook has the highest investment rate (albeit very volatile). Alphabet, Microsoft, Oracle and SAP (Germany) also display high investment intensity. However, Europe is completely absent from the list of the largest internet champions, where the top ten are split between the US and China (including Baidu, Alibaba and Tencent). In this group, the investment rate of Amazon (5%) is substantially lower, owing to its more service-providing orientation.

**Figure 11**  
**Investment intensity of top tech companies and top Internet companies (in %)**



Source: EIB calculations based on the EU Industrial R&D Investment Scoreboard.

**Europe lags behind the US and Asia in microelectronics, consumer electronics, communication equipment, digital services, cybersecurity and digital infrastructure.** EU companies in the technology sectors invest less than their global competitors and the investment gap has been growing. This may explain the underperformance of the EU in the digital and technology sectors compared with the US and Asia, in particular China.

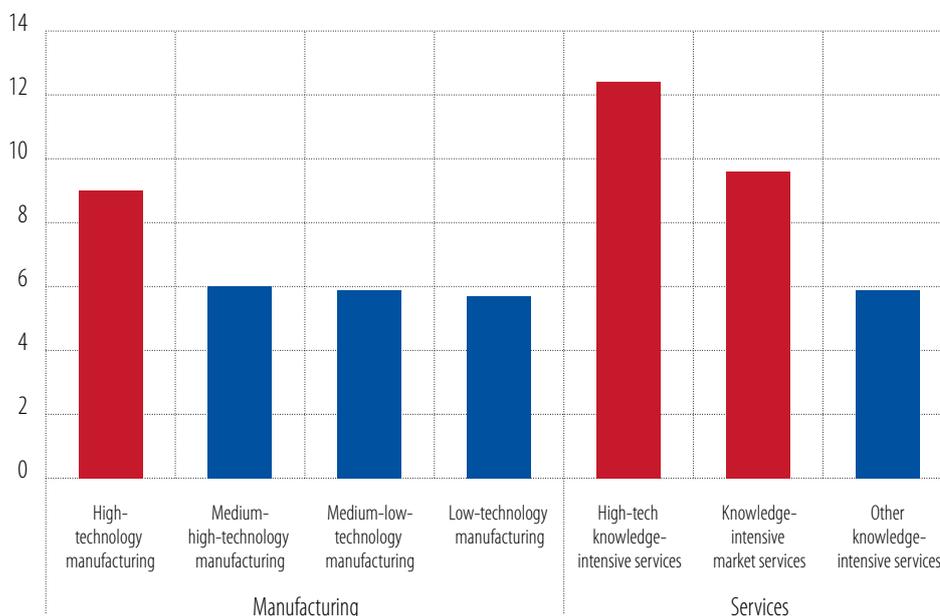
**If a digital base is absent in Europe, future tech champions will most likely emerge from other regions, where they can develop new technologies relying on existing digital infrastructure (hardware, software, services, platforms etc.).** European companies are essentially absent from digital B2C (business-to-consumer platforms). However, they may still be well positioned to drive the creation of B2B (business-to-business) platforms in areas where they can leverage their market and expertise in various domains,

including the manufacturing and automotive sectors. At the same time, platforms benefit from network effects that can lead to oligopolistic or monopolistic market structures, thereby reinforcing winner-takes-all dynamics and potential market failures. Due to a weak European digital sector, EU companies and citizens will lack the ownership of their data, leaving their control to non-EU actors.

**The digital transformation of traditional industries and the development of new emerging technologies in the EU require substantial efforts in R&D.** The ability to scale up and to bring laboratory successes out to the world also relies on investment in new machinery, equipment and enhanced and expanding capabilities. In order for more players to join the league of big R&D spenders, there needs to be an increase in R&D investment and capex in the EU, particularly in the tech sector.

**Firms in higher value added activities tend to grow faster, underlying the rising importance of innovative firms for economic growth.** The share of high growth enterprises (HGEs) in the EU is significantly higher in innovative sectors, such as high-tech intensive sectors in manufacturing – including pharmaceuticals and computer, electronic and optical products – and (high-tech) knowledge-intensive services (Figure 12).<sup>12</sup> There is no significant difference in the share of fast-growing firms across large industry classes such as manufacturing, services, construction and infrastructure. This tends to confirm that innovation can be one driver of fast growth, particularly in economic activities with high value added. At the same time, as discussed in Chapter 6 of this report, HGEs tend to be more financially constrained in the EU, which may explain the difference between the performance of high-tech innovative sectors in the EU and the US. This suggests that a better environment should be fostered to support investments by firms in high value added sectors in the EU.

**Figure 12**  
**Share of high growth enterprises (HGEs, in %), by technology intensity of the sector**



Source: EIB calculations based on Bureau Van Dijk's Orbis database (2003-16).

Note: HGEs are defined as companies that have had significant growth (above 10%) in turnover over three consecutive years and had at least ten employees at the beginning of the growth period. Eurostat aggregation of manufacturing industry according to the technological intensity based on NACE code at two-digit level. Firms in Orbis are weighted with value added.

<sup>12</sup> High growth enterprises (HGEs) are defined as enterprises that have an average annual growth rate of turnover greater than 10% per year over a minimum three-year period and at least ten employees at the beginning of the growth period. Firm growth can be measured either by the number of employees or by turnover. The threshold to identify HGEs can be either 10% or 20% and it has also been used as a standard OECD and Eurostat definition (Ahmad and Rude Petersen, 2007).

## Innovation profiles in the EU and the US

**The US have a higher share of leading innovators than the EU.** Firms can be classified by five different innovation profiles based on R&D investment and innovation activities (EIB, 2017). In the EIB Investment Survey (EIBIS), firms report whether they invest to develop or introduce new products, processes or services; the new products can be new to the company, new to the country or new to the global market. Firms also report whether they made significant investments in R&D (including the acquisition of intellectual property). Both the share of firms that introduce products new to the country or the global market and the share of firms that invest in R&D are higher in the US than in the EU. The five innovation profiles consist of basic firms, adopting firms, incremental innovators, leading innovators and developers (Figure 13).

**Figure 13**  
Innovation profiles in the EU and the US

Investment in R&D	Active	<b>Developers</b> EU: 7% US: 15%	<b>Incremental innovators</b> EU: 12% US: 14%	<b>Leading innovators</b> EU: 8% US: 16%
	Inactive	<b>Basic</b> EU: 49% US: 43%	<b>Adopting</b> EU: 24% US: 12%	
		No	New to the company	New to the country or the global market
Developing or introducing new products, processes or services				

Source: EIB calculations based on EIB Investment Survey (EIBIS wave 2018) and EIBIS Digital and Skills Survey 2018.

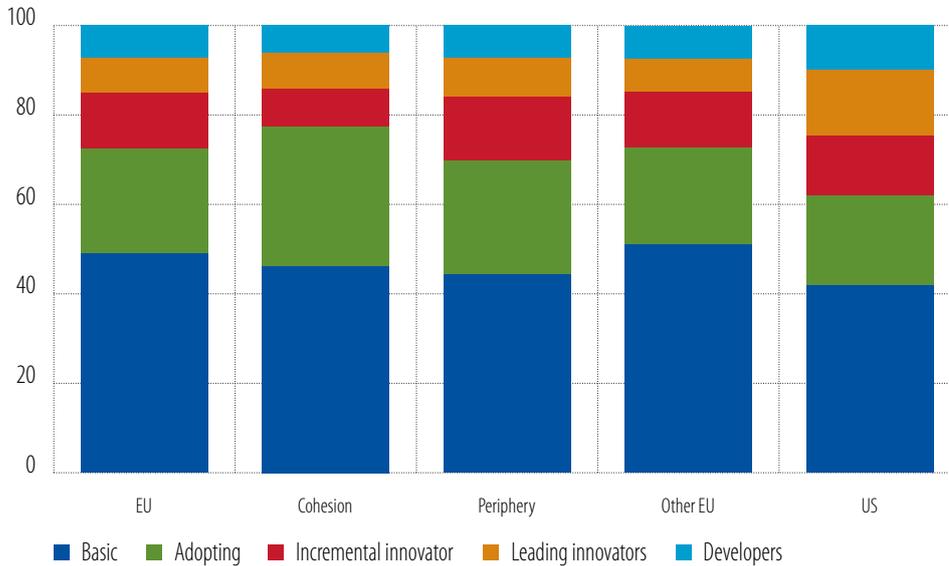
Note: R&D inactive: firms with an R&D investment intensity (i.e. R&D investment divided by turnover) below 0.1%. Firms in the EU are weighted with value added. Firms in the US are weighted with employment.

**The share of firms that do not conduct R&D is higher in cohesion countries than in in periphery or other EU countries.** In particular, the share of firms that adopt innovation is significantly higher in cohesion countries (Figure 14). Leading innovators that introduce products new to the country or the global market also operate in cohesion and periphery countries – they are not only present in other EU countries.

**Leading innovators grow faster than basic firms.** The median growth rate of employment over the past three years is significantly higher for leading innovators than for basic firms, particularly in the US (Figure 15). The share of firms with positive employment growth is higher among leading innovators (68% of leading innovators in the EU increased employment over the past three years) than basic firms (51% of basic firms in the EU). Leading innovators are also more likely to be exporters: 80% of leading innovators directly export goods and services, compared with only 39% of basic firms. The economic literature stresses that firms that export are more productive because they have to compete on international markets (Melitz and Redding, 2014). This indicates that innovative firms are more dynamic and more competitive.

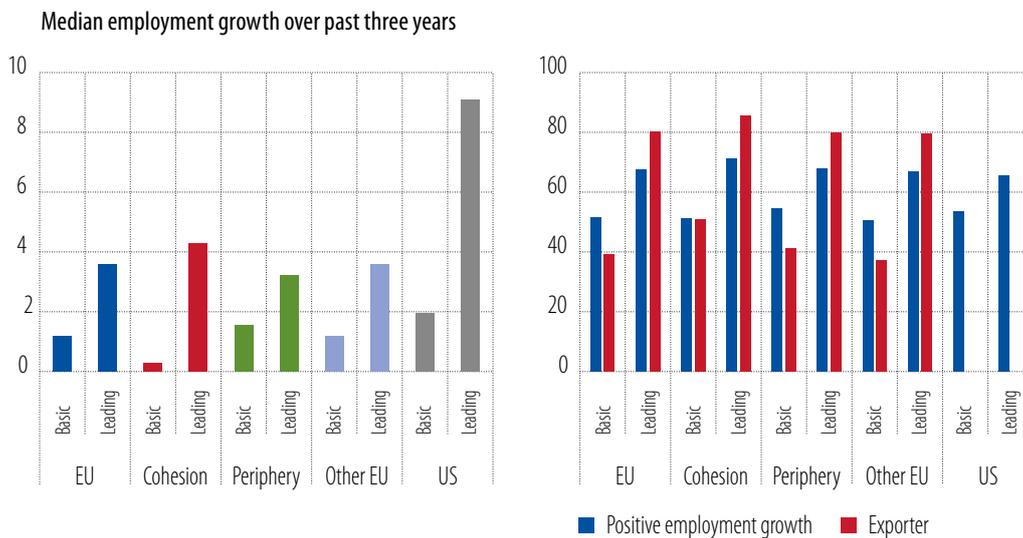
**Leading innovators tend to be smaller in the EU than in the US.** Firms that do not conduct any R&D (basic and adopting firms) are more prevalent in the EU. They employ a higher share of capital and labour in the economy, particularly in cohesion countries (Figure 16). This may affect excellence in innovation in the EU. The resources locked by basic firms could be reallocated to innovative firms if market exit were easier. More effective policy support and a better business environment should help innovative firms to enter a market and grow, but also to exit the market if they do not perform well.

**Figure 14**  
Innovation profiles in different groups of EU Member States (in %)



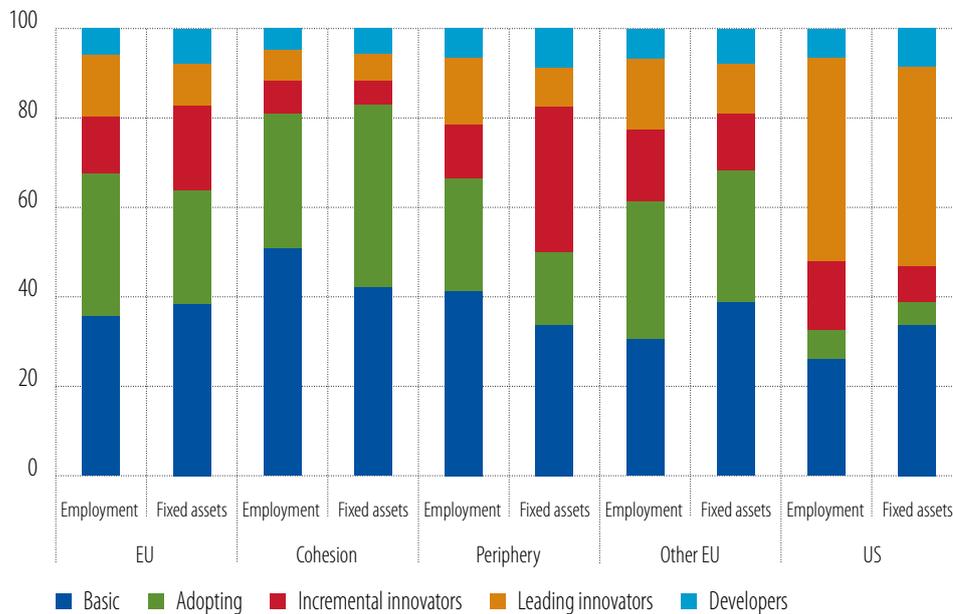
Source: EIB calculations based on EIB Investment Survey (EIBIS wave 2018) and EIBIS Digital and Skills Survey 2018.  
Note: Firms in the EU are weighted with value added. Firms in the US are weighted with employment.

**Figure 15**  
Employment growth over past three years (in %), share of firms with positive employment and share of firms that export (in %), for basic firms and leading innovators



Source: EIB calculations based on EIB Investment Survey (EIBIS wave 2018) and EIBIS Digital and Skills Survey 2018.  
Note: No data on export activities in the US. Firms in the EU are weighted with value added. Firms in the US are weighted with employment.

**Figure 16**  
**Share of employment and fixed assets (in %), by innovation profile and country group**



Source: EIB calculations based on EIB Investment Survey (EIBIS wave 2018) and EIBIS Digital and Skills Survey 2018.  
Note: Firms in the EU are weighted with value added. Firms in the US are weighted with employment.

## Investment activities of leading innovators in EU regions

**Investment conditions and access to finance for leading innovators may vary across regions within EU Member States.** In most EU countries, the capital regions (usually the finance centres) are more developed. Following the approach underlying EU cohesion policy, NUTS 2 regions are classified into three groups, based on the level of regional development:

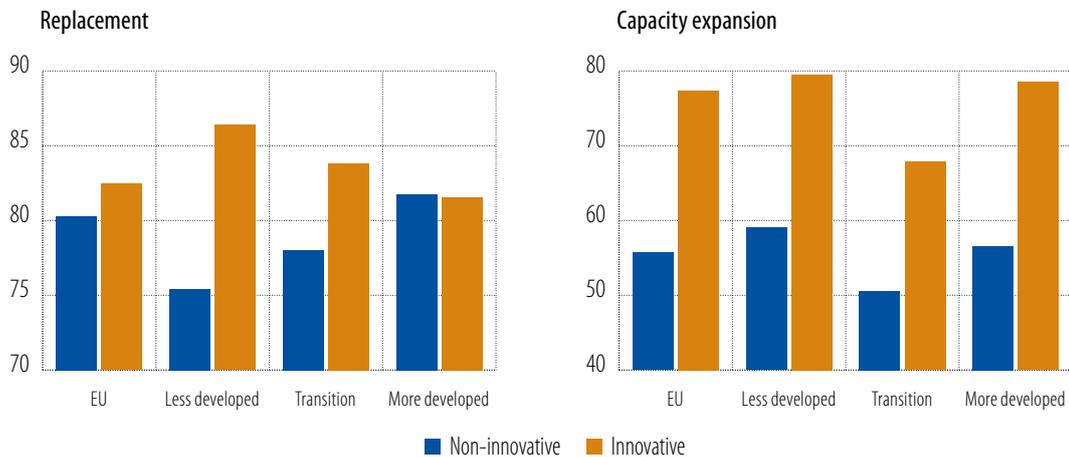
- Less developed: regions with GDP per capita below 75% of the EU average;
- Transition: regions with GDP per capita 75%-90% of the EU average;
- More developed: regions with GDP per capita above 90% of the EU average.<sup>13</sup>

**Innovative firms are more likely than non-innovative firms to invest to expand capacity.** Innovative firms in transition and less developed regions are also more likely to invest to replace capacity (Figure 17).<sup>14</sup> This indicates that they can be a source of jobs, growth and investment opportunities, particularly in less developed regions.

<sup>13</sup> The classification of EU regions into three groups is based on Article 90 of Regulation (EU) No. 1303/2013 of 17 December 2013. See also <https://ec.europa.eu/eurostat/web/regions/background>

<sup>14</sup> In the remainder of this section, innovative firms are defined as leading innovators: they have developed or introduced a product, process or service that is new to its market or globally new, and have significant investments in R&D (including the acquisition of intellectual property).

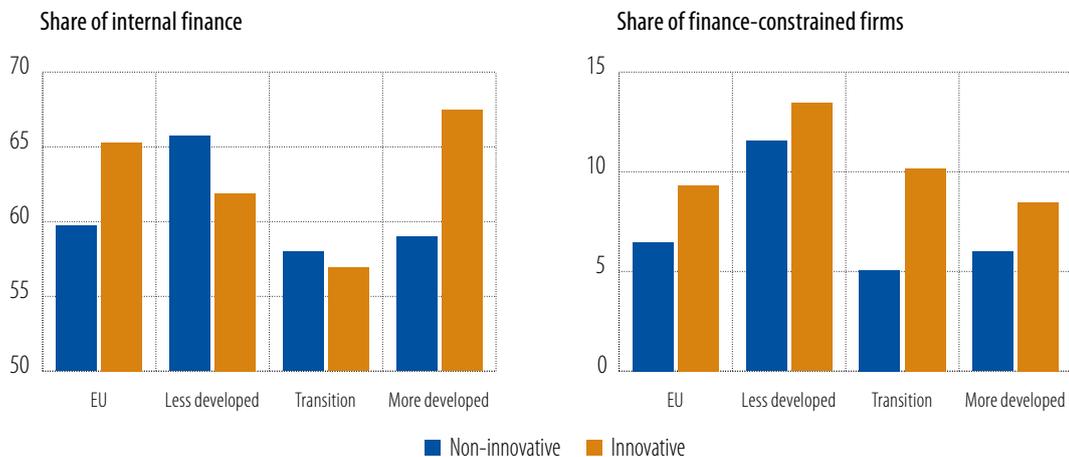
**Figure 17**  
Share of firms that invest in capacity replacement and share of firms that invest in capacity expansion, by level of regional development and innovation status



Source: EIB calculations based on EIB Investment Survey (EIBIS wave 2017).

Note: Investment in replacement: replacing capacity (including existing buildings, machinery, equipment and IT); investment in capacity expansion: expanding capacity for existing products or services. Firms in EIBIS are weighted with value added.

**Figure 18**  
Share of internal funds to finance investment and share of firms that are finance-constrained, by level of regional development and innovation status



Source: EIB calculations based on EIB Investment Survey (EIBIS wave 2017).

Note: Internal finance: internal funds and retained earnings (including cash and profits). Finance-constrained: the firm was (i) rejected when seeking any external financing for an investment; (ii) quantity-constrained (dissatisfied with the terms and the amount received in the last request for external financing); (iii) price-constrained (the firm did not apply because it thought the conditions of external financing would be too expensive); or (iv) discouraged from seeking any external financing (the firm did not apply because it thought the application would be turned down). Firms in EIBIS are weighted with value added.

The most important obstacles to investment for firms in the EU are uncertainty about the future, lack of staff with the right skills, labour market regulations and business regulations and taxation. Innovative firms and firms in transition regions are more likely to report that these factors limit their investment activities – in particular, the availability of employees with the right skills. Investment

barriers may result in lower levels of innovation and, ultimately, weaker economic growth.<sup>15</sup> In transition regions, more than 90% of innovative firms find that staff and labour market regulations are obstacles to investment activities, indicating that the labour market in these regions is facing serious issues and that policy measures should be taken to improve its functioning.

**Innovative firms consider the top priority for public investment to be professional training and higher education.** Public investment in professional training may help firms to overcome the investment obstacle related to the lack of staff with the right skills. Non-innovative firms, on the other hand, report that transport infrastructure should be the top priority area for the next three years.

**Leading innovators and firms in less developed regions tend to rely more on internal sources to finance investment; they are also more likely to report that they are finance-constrained.** This may further increase the existing regional disparities. In the EU, internal funds represent 65% of investment finance for innovative firms, compared with 60% for non-innovative firms (Figure 18). Poor availability of external finance could be an explanation for the higher share of firms that report being finance-constrained in less developed regions. Financial sectors tend to be geographically concentrated, and credit availability depends on their proximity. At the same time, highly innovative companies in more developed regions may be reluctant to share information for fear of leakages of private information needed for an external financier, which may explain why they have a higher share of internal finance. These results are in line with the academic literature in economics and finance discussed in Box B, which links distance to banks and access to finance for firms.

<sup>15</sup> Obstacles to investment activities in the EU are discussed in more depth in Chapter 1 of this report.

#### Box B

##### Distance to banks and access to finance for innovative firms

R&D investment tends to be difficult to finance with external debt. Innovative firms face binding financing constraints that may prevent them from growing because of asymmetric information problems, skewed and highly uncertain returns and lack of collateral value (Hall and Lerner, 2010).

The asymmetric information problem refers to the fact that the firm typically has better information about the likelihood of success and the nature of the innovation project being considered than its potential investors. Innovative companies (in particular, young SMEs) are in a vulnerable position (Freel, 2007). The premium for financing R&D projects can be higher than for ordinary investment (shorter-term or lower-risk projects) because investors have more difficulty distinguishing good innovative projects from bad projects.

The challenges in obtaining finance may be aggravated by the firm's inexperience in communicating information on its finances, lack of long-term market reputation and inability to signal the project's quality. Lack of information on a firm's history and potential is likely to lead to higher interest rates and a less than socially optimal level of R&D or innovation activities, particularly if the firm does not have fixed tangible assets that they can use as collateral (Berger and Udell, 1998).

Investment in innovation is also characterised by the degree of uncertainty associated with its output. The unpredictability and volatility in expected returns creates uncertainty. The external financiers are often not able to properly evaluate the risks of the project to be financed. This uncertainty tends to be greatest at the beginning of a research programme or project. Risky innovation projects with small probabilities of great success in the future may be worth continuing, but the firm will have to make large investments in R&D upfront that cannot be capitalised on if the innovation is unsuccessful.

In addition to the difficulty in evaluating the potential of the project before agreeing to finance the innovative company, the financier is often not in a position to monitor the project's riskiness, as the new products, services or processes are in their development phase. For instance, after obtaining the finance, the innovator may deviate from the original plan and engage in different projects because of difficulties in the local investment environment without informing the investor. The financier thus may set higher initial interest rates for loans to innovative firms.

Moreover, the primary output of innovation activities is the knowledge of how to make new products, processes and services. If the new knowledge is non-rival, use by one firm does not preclude its use by another. If the new knowledge cannot be kept secret, returns to investment cannot be appropriated by the firms undertaking innovation activities. As a result, firms may be reluctant to invest, leading to the underprovision of investment in innovation in the economy.

Financial activities tend to be concentrated in major cities. Along with technology-assisted lending, the financial system has increased the outreach of its activities while becoming geographically concentrated in clusters. Both functional distance (between bank branch and headquarters) and operational distance (between bank branches and clients) have grown over time (Degryse and Ongena, 2005). This may affect access to finance for innovative firms in more distant locations (Lee and Brown, 2017; Zhao and Jones-Evans, 2017).

The finance literature argues that technology can have both positive and negative effects on regional finance gaps. Two opposite viewpoints on the advancement of technology suggest that:

- Technology has eliminated the importance of location and distance for access to finance (Petersen and Rajan, 2002). Computerised information collection diminishes the value of personal contact for financing decisions (Beck and Demirguc-Kunt, 2006). Relationship banking has been increasingly replaced by strictly data-based decision-making in lending. Hence, regional finance gaps are becoming less relevant for all types of firms (innovative or non-innovative, small and large);
- Credit availability for firms depends on the physical distance to the lender, and equity finance tends to be unevenly spread geographically, favouring the regions near the financial centres. Access to external finance for innovative firms in distant locations thus tends to become more difficult (Degryse and Ongena, 2005; Berger and Udell, 2006; Alessandrini et al., 2009; Wojcik, 2011; Mason and Pierrakis, 2013).

Relationship lending is based on long-term client relations, "soft" information and the financier's in-depth comprehension of the client's business model and market (Udell, 2015). Physical distance can complicate communication (Scott, 2004). It can also reduce cognitive, institutional and organisational proximity (Wojcik, 2011), potentially discouraging distantly located firms from applying for finance. Despite the higher demand for bank finance, firms in distant locations are less likely to apply, and their applications are more often rejected (Lee and Brown, 2017).

The regional aspect is particularly relevant in fostering economic, social and territorial cohesion and supporting projects in less developed regions of Europe. Innovation is one of the key priorities of EU Cohesion Policy in the 2014-2020 programming period: the focus for supporting EU companies (in particular SMEs) has been the enhancement of innovation capacity, typically measured by investments in R&D.

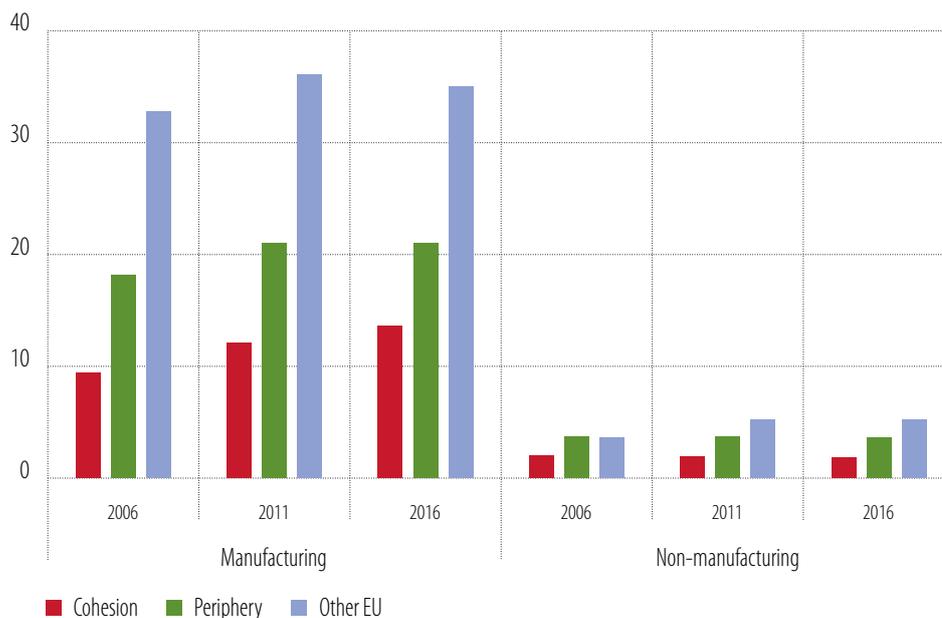
Addressing obstacles to investment activities in cohesion regions is an effective way to tackle the disparities in regional development. This can help companies located in these regions to survive and grow. Investments in R&D and innovation need to be complemented with other internal and external resources as well as supportive framework conditions – including the regulatory framework, market conditions, access to finance, creation and diffusion of knowledge, human capital, entrepreneurial capabilities and entrepreneurial culture (European Commission, 2017).

## Regional framework conditions and patenting activities in the EU

**By creating property rights to a new invention, patents can lower the cost of external finance and incentivise investment in innovative projects.** While R&D expenditures are typically used as a proxy for innovation input, patenting activity is widely used as a measure for innovation outcomes: patents are preceded by the basic and applied research phases within a firm, and they can be followed by a development process that aims to introduce new products, processes or services on to the market.

**Some 13% of EU firms have published at least one patent in the past five years, according to the results of the EIBIS.** Firms in manufacturing are much more likely to engage in patenting activities than those in other sectors: 30% of manufacturing firms in the EU had published at least one patent since 2011 (Figure 19). This is consistent with the evidence that manufacturing firms tend to conduct more R&D than firms operating in other sectors. The share of firms that patent is lower in the periphery and cohesion countries than in other EU countries. The gap between these three groups of countries has narrowed only slightly over the past ten years.

**Figure 19**  
**Share of firms that published a patent over the past five years**



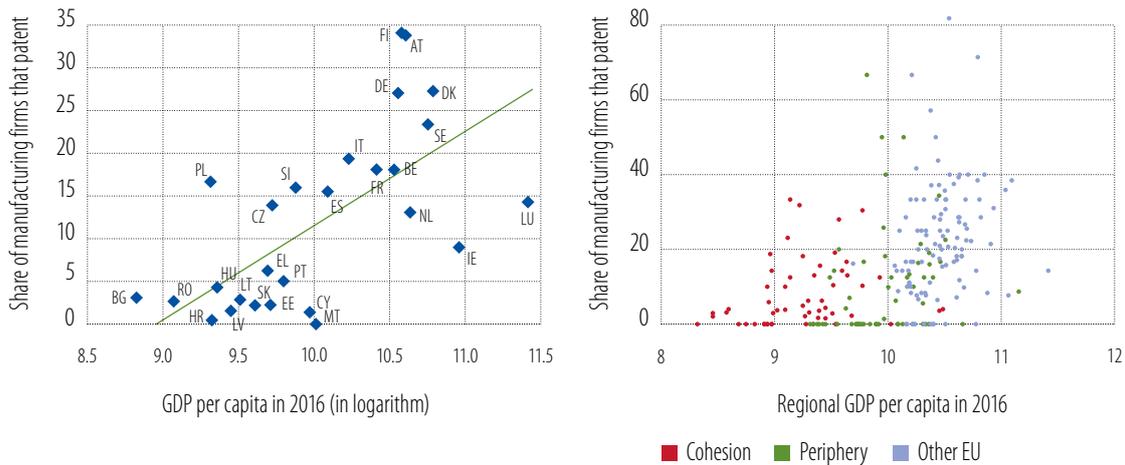
Source: EIB calculations based on EIB Investment Survey (EIBIS waves 2016 and 2017) matched to Bureau van Dijk's Orbis database.  
Note: Firms in EIBIS (matched to Orbis) are weighted using value added.

**Patenting activity can be explained by the industry composition of the economy, but it is also associated with the framework conditions supportive of innovative firms.** Patenting activities are correlated with GDP per capita at country and regional level (Figure 20). Manufacturing firms in Finland, Austria, Denmark and Germany are the most active – with more than 25% of firms having patented in the past five years. At the same time, only a very limited percentage of manufacturing firms in countries such as Malta, Croatia, Cyprus and Latvia report patenting activities.

**Patenting firms tend to be more competitive and productive.** According to EIBIS data, they tend to show higher labour productivity and a higher level of capacity utilisation. They are also more likely to export their goods or services and to invest abroad. They are also larger firms. Clearly, they are also much

more likely to introduce new products, processes or services. In addition, patenting firms tend to show a greater share of machinery and equipment that is state-of-the-art, and they outperform non-patenting firms in terms of productivity performance (measured using either labour productivity or total factor productivity).

**Figure 20**  
**Share of manufacturing firms that published a patent over the past five years, and GDP per capita in 2016, EU Member States and EU regions**



Source: EIB calculations based on Eurostat and EIB Investment Survey (EIBIS waves 2016 and 2017) matched to Bureau van Dijk's Orbis database.

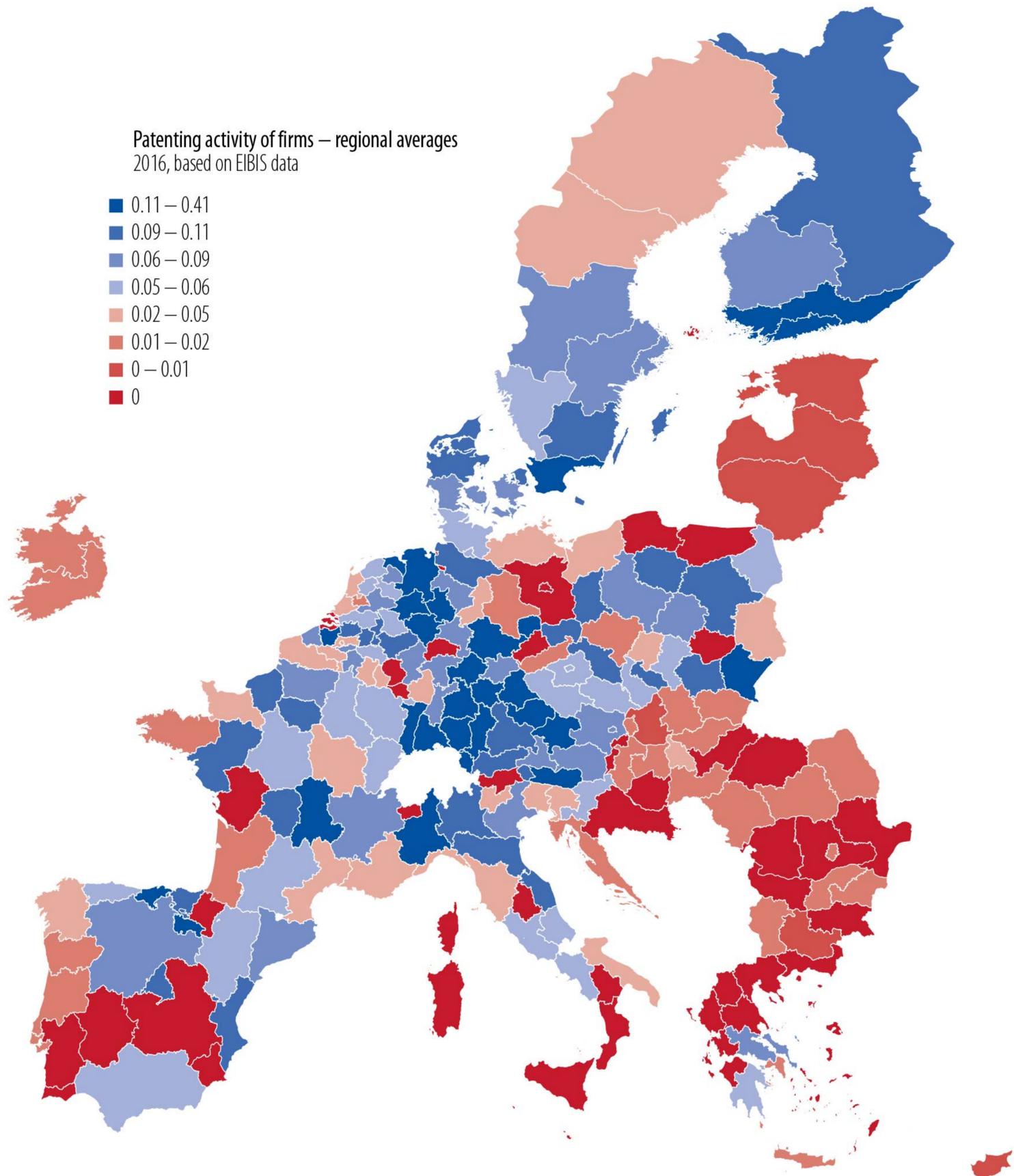
Note: Firms in EIBIS (matched to Orbis) are weighted using value added.

**Patenting firms show better financial health indicators.** According to Orbis data, patenting firms have higher levels of liquidity (proxied by the current ratio) than firms that do not patent. They are also slightly less leveraged (using the ratio of loans plus long-term debts to total assets), and as good as non-patenting firms in terms of their profitability (captured by return on assets).

**There is a strong regional variation in patenting activities, notably in France, Italy and Spain.** Patenting activities remain relatively weak in periphery and cohesion countries (Figure 21). However, there are some notable exceptions (e.g. some regions in Poland have good patenting performance, while some regions in Germany show low patenting activity).

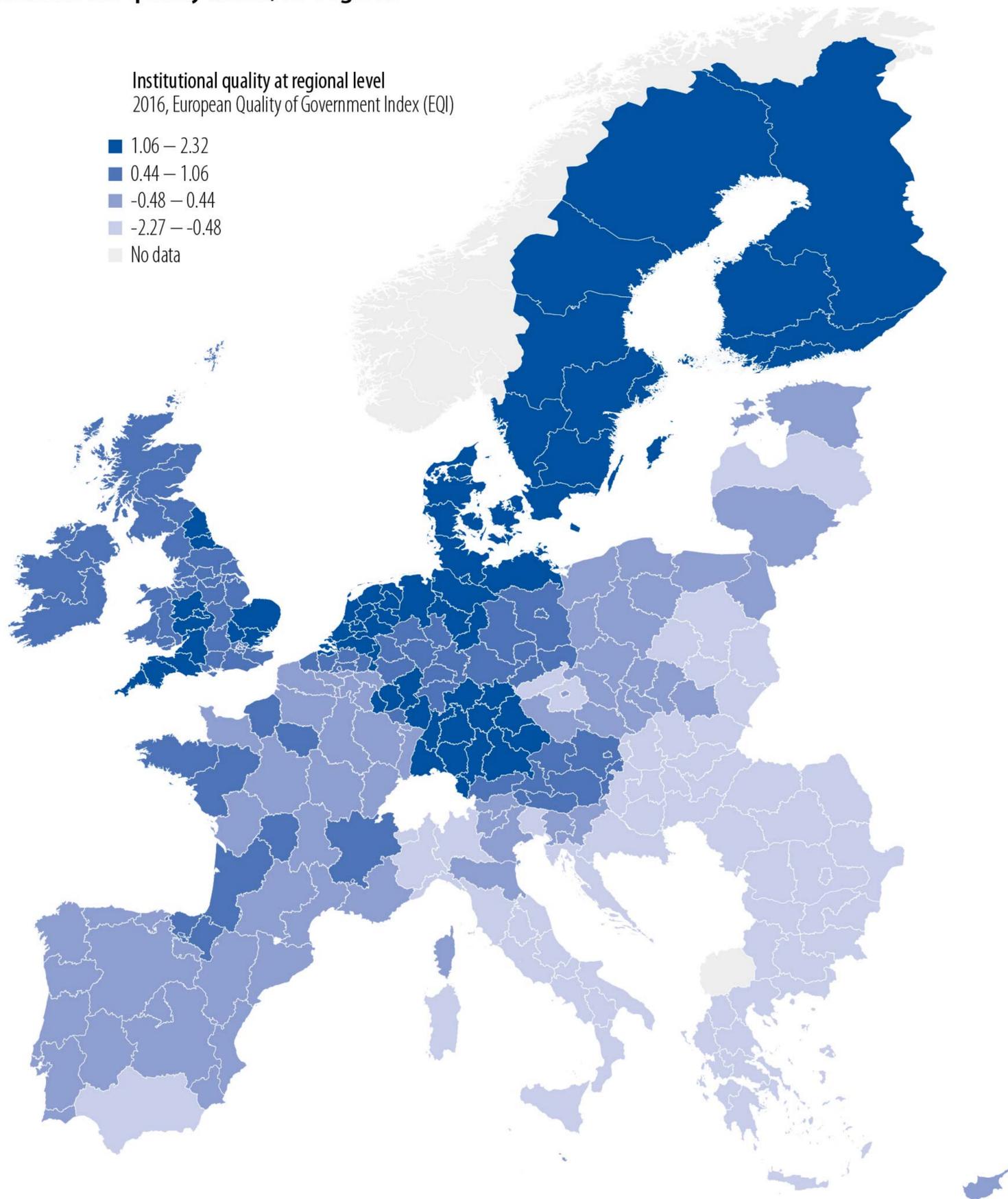
**A good mix of institutional quality, R&D expenditures and skilled labour force is crucial for promoting firms' innovative activities.** However, there is considerable heterogeneity in factors that characterise the environment in which firms operate across regions within EU Member States (Figure 22). An index of the overall quality of regional framework conditions can be constructed based on three measures: institutional quality (measured by the sub-index on institutional quality of the European Regional Competitiveness Index – RCI), R&D expenditures and the quality of the labour force (measured as the share of employment with tertiary education).

**Figure 21**  
**Share of firms that have published at least one patent over the past five years, EU regions**



Source: EIB calculations based on EIB Investment Survey (EIBIS waves 2016 and 2017) matched to Bureau van Dijk's Orbis database.  
Note: No data available on UK regions.

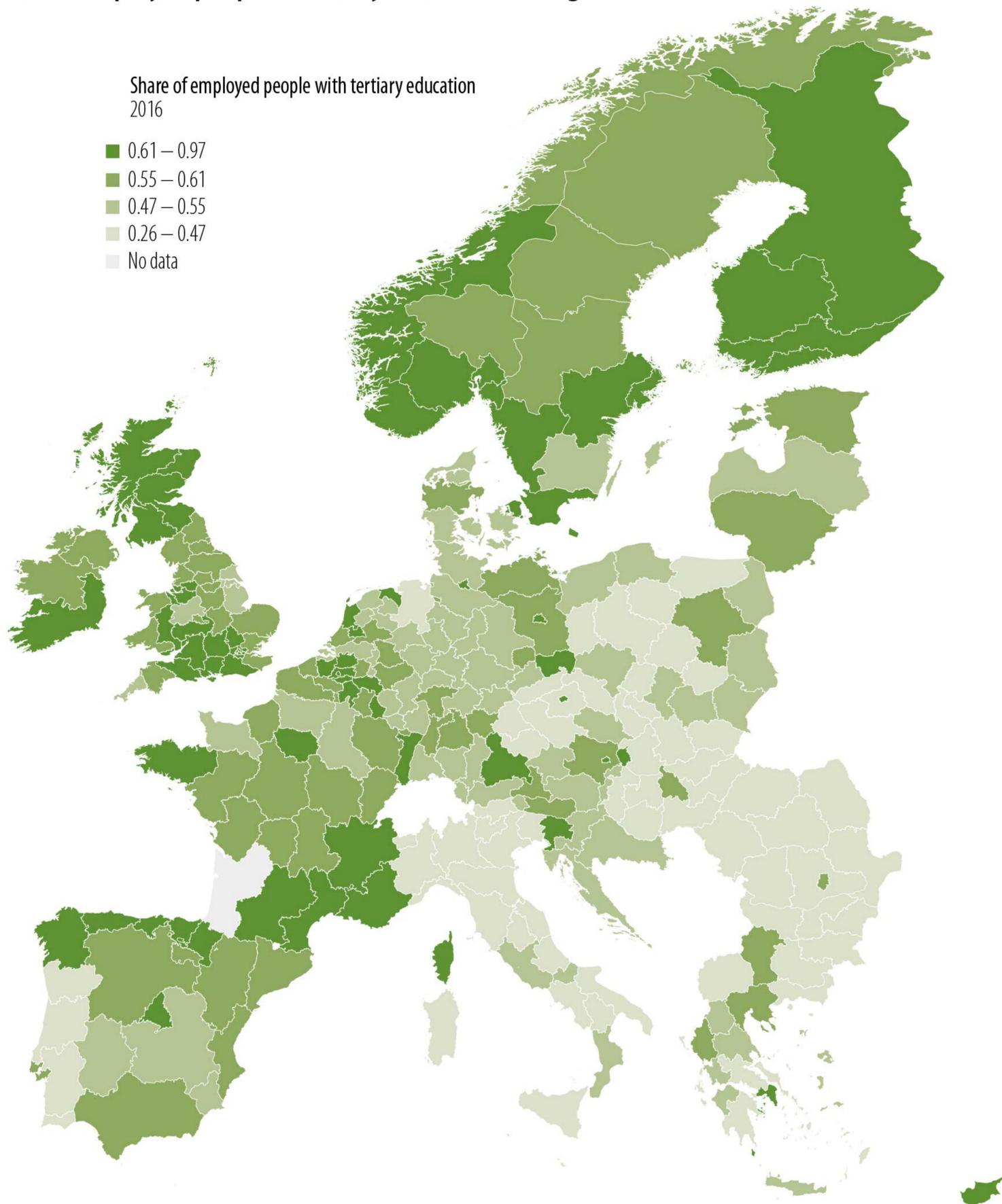
**Figure 22a**  
**Institutional quality index, EU regions**



Source: EIB calculations based on European Quality of Government Index (EQI)

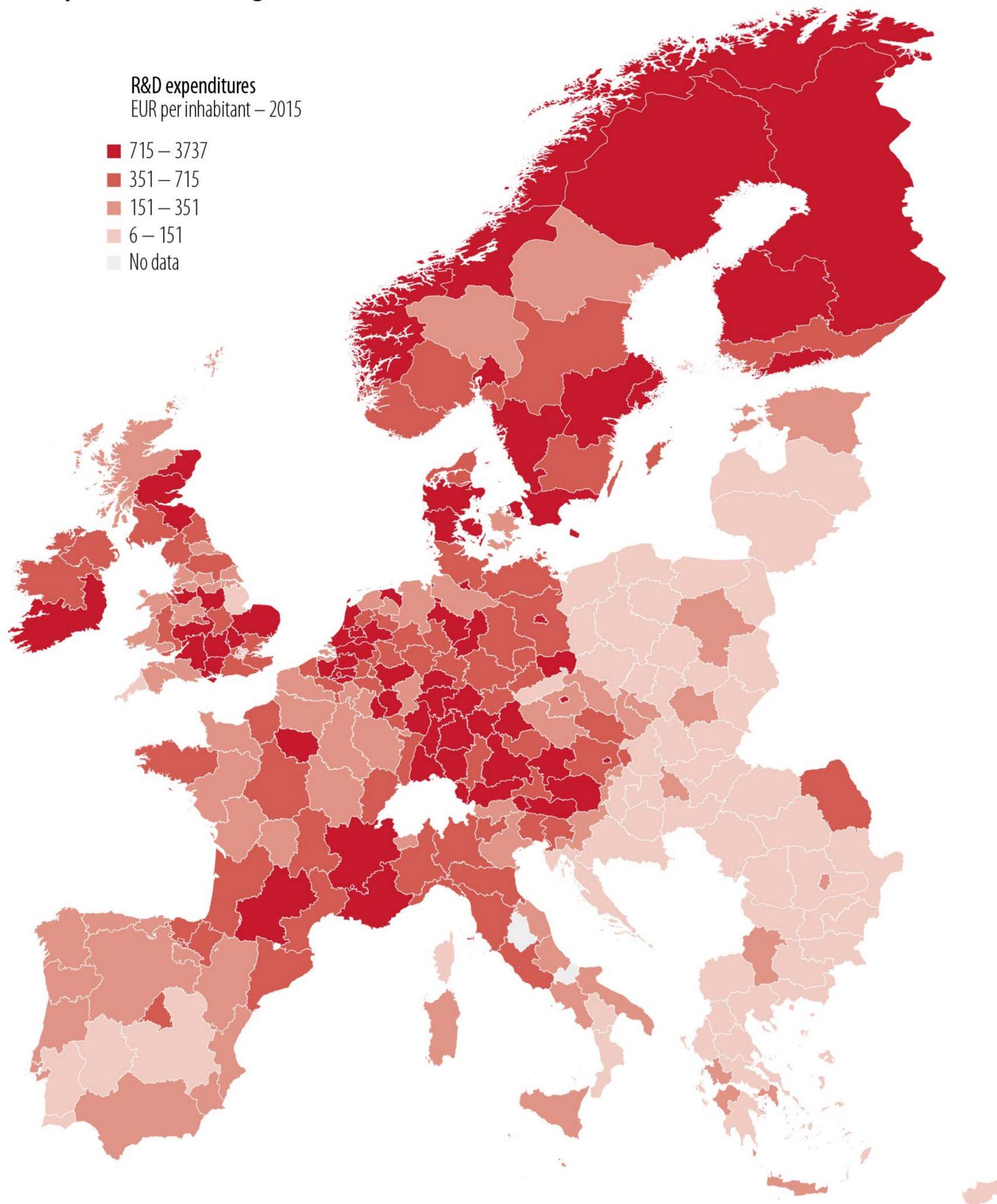
Note: No data for Norway in the European Quality of Government Index.

**Figure 22b**  
**Share of employed people in tertiary education, EU regions**



Source: EIB calculations based on Eurostat.

**Figure 22c**  
**R&D expenditures, EU regions**

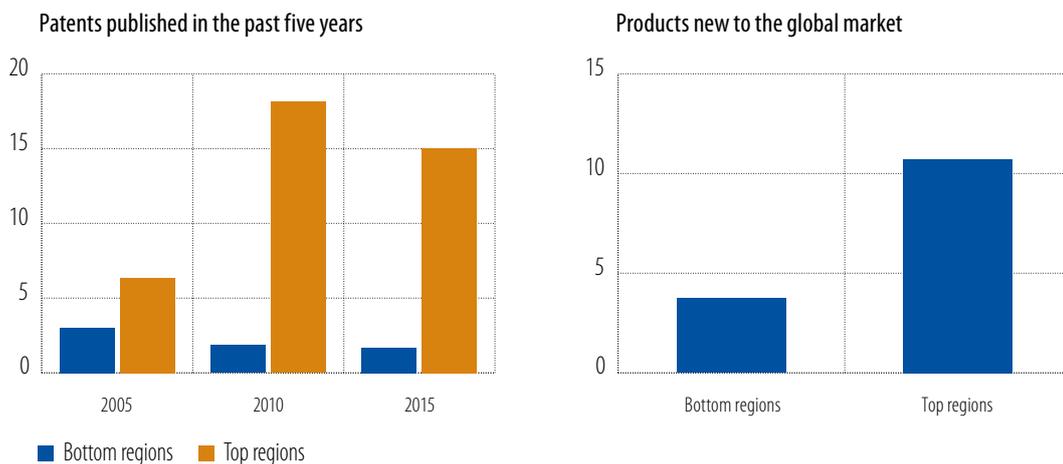


Source: EIB calculations based on Eurostat.

Note: Data on R&D expenditures for France refer to 2013.

**Regions with better institutions, more skilled workers and higher R&D expenditures have a higher share of firms that innovate.** Combining and improving all framework conditions in regions where significant gaps exist can improve firms' innovation performance: those that operate in regions with better framework conditions are more likely to publish patents and develop products that are new to the global market (Figure 23). The results are in line with the recent literature on the role of regional framework conditions for innovation (Pose and Di Cataldo, 2014). In regions that are in the top quartile in all three dimensions of regional framework conditions (European Quality of Government Index, share of employment with tertiary education and R&D expenditures), patenting activity was twice that in the regions ranked among the bottom quartiles in the three dimensions in 2005. In 2015, the difference in patenting activity between firms in top and in bottom regions increased to a factor of nine. This suggests that there is growing divergence between regions that innovate and those that do not, possibly due to the increasing importance of clusters.

**Figure 23**  
**Share of firms that have published at least one patent over the past five financial years, and share of firms that introduced products new to the global market in 2015, by index of regional framework conditions**



Source: EIB calculations based on Eurostat, European Quality of Government Index (EQI) and EIB Investment Survey (EIBIS waves 2016 and 2017), matched to Bureau van Dijk's Orbis database.

Note: Bottom (top) regions: regions ranked simultaneously in bottom (top) quartile of European Quality of Government Index (EQI), bottom (top) quartile of the share of employed people with tertiary education, and bottom (top) quartile of R&D expenditures. Firms in EIBIS (matched to Orbis) are weighted using value added.

**Resources devoted to R&D and human capital are not sufficient to support innovation activities; they must be combined with high-quality institutions and favourable business context.** Pushing R&D investment and raising the quality of the labour force are key elements in developing regions and keeping firms close to the technological frontier (or helping to close the gap). However, these elements need to be complemented with supportive framework and regulatory conditions. A similar relationship holds when looking at regional productivity growth; Box C discusses how framework conditions can support productivity growth. Given the heterogeneity in regional characteristics, regions need to be able to identify the most efficient policy mix to support innovation and competitiveness and adapt it to their local context.

**Box C****R&D expenditures and productivity in EU regions**

Efficient innovation systems, especially at local level, are essential to support innovative firms. Many factors can explain the uneven distribution of technological capabilities across and within countries. These range from institutional factors (financial and legal structures, governance and inter-organisational networks) to infrastructure (public services availability, research infrastructure), policy (innovation and industrial policies in particular) and locally embedded and tacit knowledge (Lundvall, 1992; Patel and Pavitt, 1994).

The role of institutions is particularly relevant for regional systems of innovation. This box investigates the relationship between innovative efforts at the regional level, i.e. investments in R&D or changes in the workforce's skills and productivity, highlighting the importance of regional framework conditions (Cooke et al., 1997).

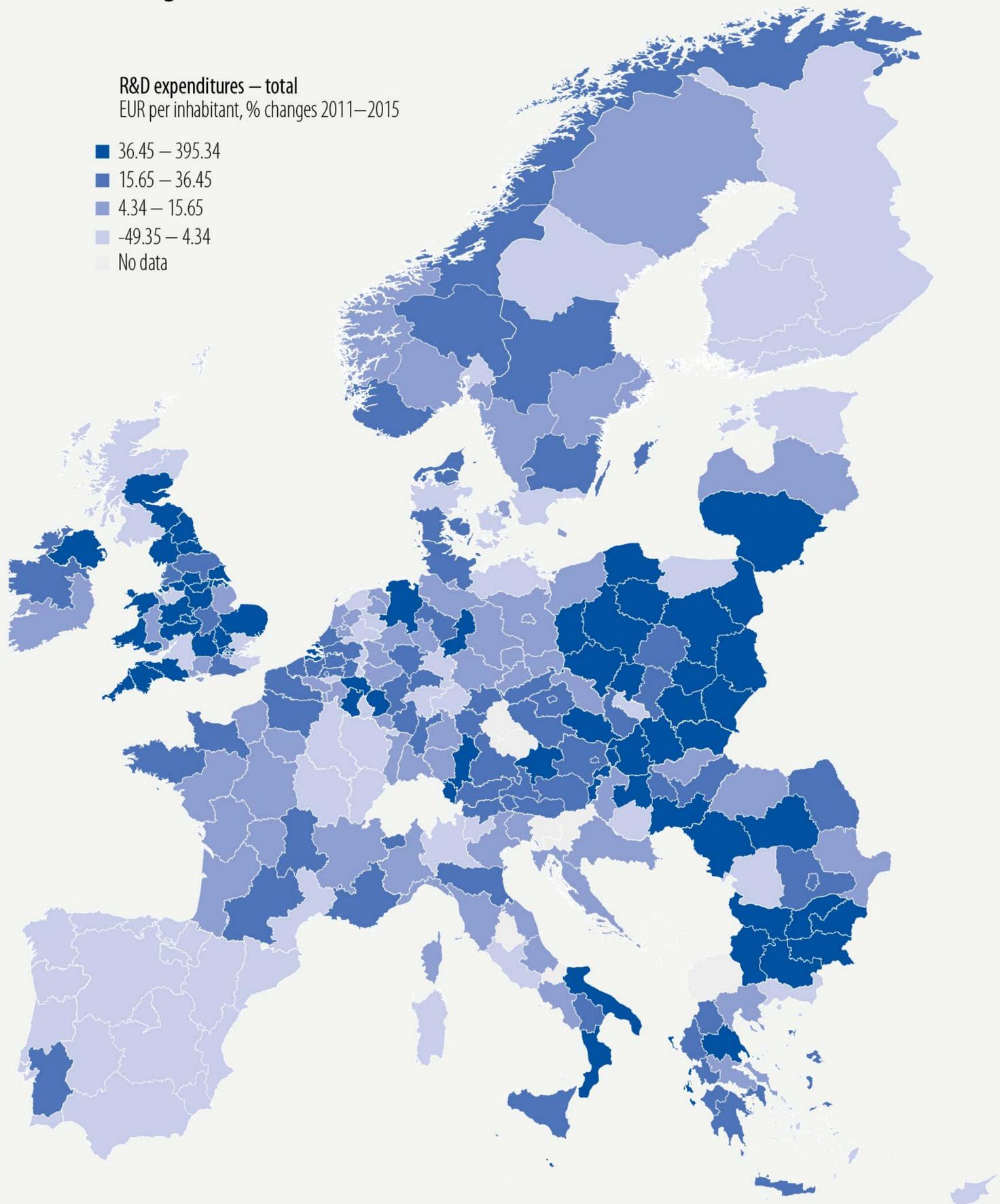
The dynamics of R&D expenditures vary across regions within the same country. Between 2011 and 2015, R&D expenditures per capita increased rapidly in the less developed regions of Europe (Figure C.1). Several regions where innovation performance was previously lagging were catching up, particularly in cohesion countries (notably some regions in Poland, Hungary, Czech Republic, Slovakia, Romania and Bulgaria) but also in less developed regions belonging to periphery countries (several regions in Italy, Portugal and Greece). R&D expenditures per capita also grew rapidly between 2011 and 2015 in several regions in other EU countries (Belgium, Germany and the UK in particular).

In recent years, the level of human capital has increased faster in more developed regions. Between 2014 and 2017, employment in knowledge-intensive sectors and employees with tertiary education (both as a share of total employment) increased rapidly in several other EU countries (notably Sweden, Finland, France and the UK), in the periphery (Portugal, Greece and Italy) and in a few regions of cohesion countries.

Total factor productivity growth is associated with the growth of R&D expenditures and the increase of human capital at the regional level. This evidence is in line with Figure 2 of this chapter, which compares average firm productivity and the average share of investment spent by firms on developing new products at the country level. It is also consistent with the results investigating the nexus between innovation and productivity at the regional level (Asikainen and Mangiarotti, 2016; Männasoo et al., 2018). Regression analysis shows that annual TFP growth over the period 2000–2015 is positively correlated with the annual growth of R&D expenditures per capita and human capital: both variables have direct positive effects (Table C.1 - first column). However, other factors (e.g. the productivity gap with respect to the region with the highest level of productivity) also matter: this suggests convergence in total factor productivity over time across EU regions. In other words, it is easier for regions far from the technological frontier to catch up than for the leader to push the frontier outwards.

More human capital can help regions converge to the frontier faster. In the catching up phase (when the gap with the frontier is wide), strengthening human capital can be more important than increasing R&D spending. However, when the gap with the frontier is small, R&D spending can be a more efficient way to approach the frontier. In the regression analysis, the interaction term of R&D expenditures with the TFP gap is negative and the interaction term of change in the share of employment with the TFP gap is positive. This suggests that, for less innovative regions, the adoption of technologies that already exist elsewhere may be more relevant than developing new technologies to achieve faster TFP growth.

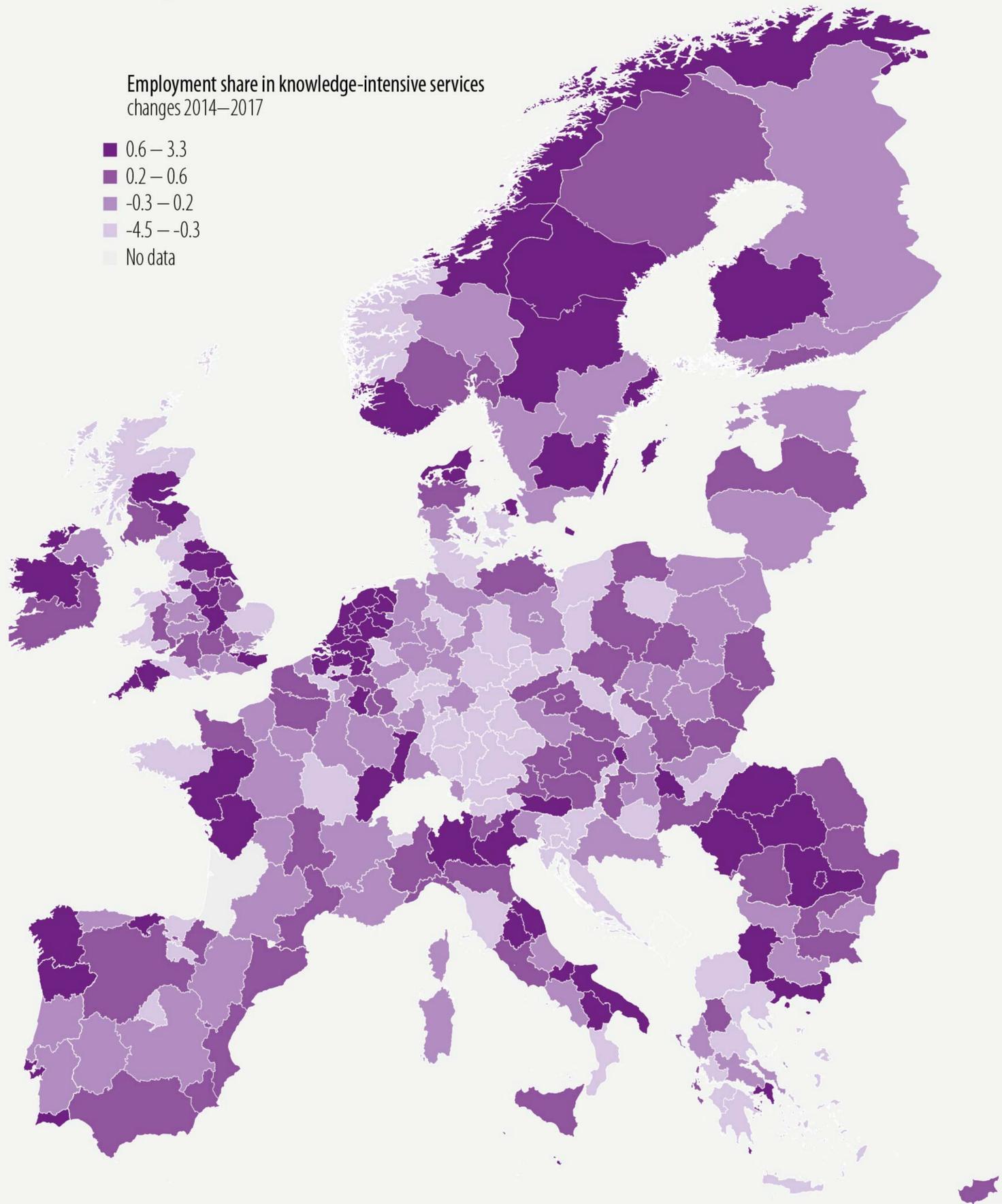
**Figure C.1a**  
**Growth of R&D expenditures per capita (in %),**  
**2011–15, EU regions**



Source: EIB calculations based on Eurostat.

Note: Intramural R&D expenditures in all sectors. Data for France refer to changes in R&D expenditures between 2009 and 2013.

**Figure C.1b**  
**Growth of employment share in knowledge-intensive services (in %),**  
**2014–17, EU regions**



Source: EIB calculations based on Eurostat.

**Table C.1**
**Association of regional TFP growth with TFP gap, growth in R&D expenditures, change in share of employment in knowledge-intensive sectors (KIS), and framework conditions, EU regions**

	Dependent variable: annual regional TFP growth				
TFP Gap (vs the frontier)	0.040 *** (0.000)	0.023 *** (0.000)	0.017 *** (0.001)	0.018 *** (0.002)	0.017 *** (0.002)
Growth in R&D expenditures per capita	2.534 ** (0.019)	1.806* (0.100)	1.740 (0.113)	1.753 (0.111)	1.745 (0.112)
Change in share of employment in KIS	1.197 *** (0.000)	1.193 *** (0.006)	1.188 *** (0.000)	1.192 *** (0.000)	1.186 *** (0.000)
Interaction TFP Gap and R&D exp.	-0.012 *** (0.000)	-0.004 ** (0.032)	-0.003* (0.083)	-0.003 ** (0.041)	-0.003* (0.055)
Interaction TFP Gap and change in KIS	0.004 *** (0.000)	0.004 *** (0.000)	0.004 *** (0.000)	0.004 *** (0.000)	0.004 *** (0.000)
Index of institutional quality		0.678 *** (0.005)			
Existing financial constraint			-6.238 *** (0.001)		
Obstacles to investment					
<i>Availability of finance</i>				-3.188 *** (0.000)	
<i>Uncertainty about the future</i>					-1.726 *** (0.019)
Sample size	1 394	1 390	1 394	1 394	1 394

*Source:* EIB calculations based on Eurostat (2000 to 2015), European Quality of Government Index (EQI) 2017, EIB Investment Survey (EIBIS waves 2016 and 2017 matched to Bureau van Dijk's Orbis database).

*Note:* Panel regression with regional total factor productivity growth as the dependent variables and selected explanatory variables: TFP regional gap (with respect to region with highest TFP level in each year); regional growth in R&D expenditures per capita; regional share of employment in R&D; change in regional share of employment in knowledge-intensive sectors (KIS); index of regional institutional quality (European Quality of Government Index – EQI 2017); existing financial constraints (EIBIS); long-term obstacles to investment (EIBIS); availability of finance, uncertainty about the future. Annual regional data from 2000 to 2015. p-values based on robust standard errors are given in parentheses. \*\*\*p < 0.01, \*\*p < 0.05, \*p < 0.1.

Framework conditions and the business environment can play a crucial role. Regional framework conditions, proxied by the sub-indices of the European Regional Competitiveness Index (RCI) on the quality of the business environment and the quality of local government, are also associated with TFP growth (Table C.1 – second column).

Financial constraints related to firms' activity and long-term obstacles to investment are associated with lower productivity growth. This highlights the role of the context in which firms operate, notably that of the financial sector (proxied by whether firms are finance-constrained and whether the availability of finance is an obstacle to investment activities; Table C.1 – columns 3 and 4). Uncertainty about the future matters as well (Table C.1 – last column). The results suggest that the attitude of the financial sector in supporting firms' investment activities is key, as they need a stable and predictable environment.

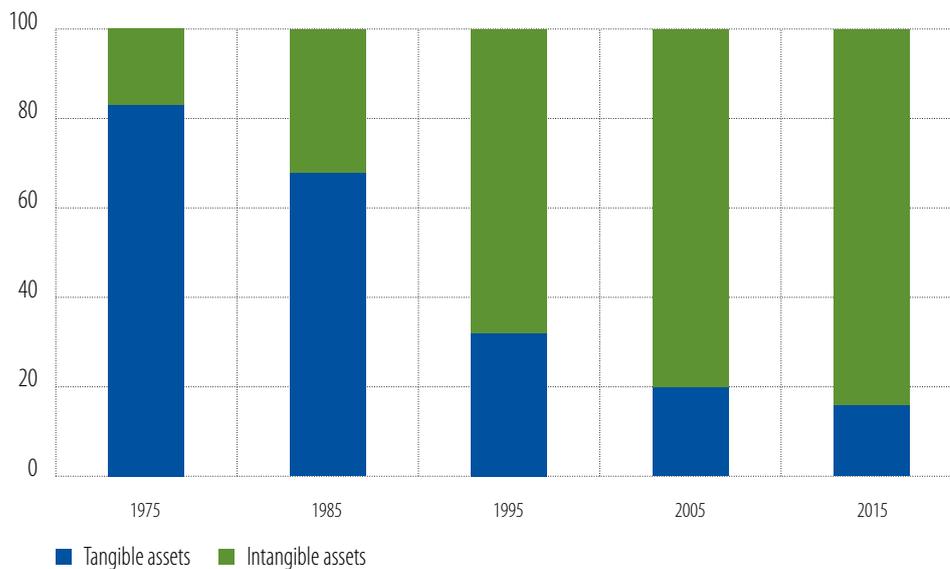
The public sector also has a crucial role to play in promoting efficient innovation systems beyond traditional policy areas. It can tackle market failures in basic research and support innovation through the adoption of new technologies with procurement. In the EU, the public sector has increasingly supported private sector R&D through tax incentives (as discussed in Chapter 1 of this report) and other industrial policies. However, there are also significant differences in innovation across regions within the same country. Beyond national policies, regions should identify the most efficient policy mix to support innovation and competitiveness based on their level of human capital and their gap with respect to the frontier. Contributing to the creation of a pro-innovation environment by providing good institutions and business conditions can be a crucial enabling factor for productivity.

## Intangible investment in the EU and the US

In addition to R&D, other types of intangible assets – including software and databases, employee training and organisational capital – can also be important sources of firm performance. In the US and several EU countries (including Sweden, the UK and Finland), investment in intangibles represents a large part of gross fixed capital formation, which now exceeds that in tangible assets (EIB, 2016). The rising importance of intangible capital has also been associated with some structural features of advanced economies, in particular slow productivity growth and rising inequality, over the past two decades (Haskel and Westlake, 2017).

Intangible assets have become a crucial component of the market value of large listed firms. In 1975, tangible assets made up 83% of the market value of companies included in the S&P 500 index, while intangible assets only accounted for 17%. Four decades later, intangibles represented 84% of the market capitalisation of the S&P 500 (Figure 24). Intangible assets for the market value of European companies in 2015 are less relevant, as they accounted for 71% of the market value of the S&P Europe 350 index (Elsten and Hill, 2017). This reflects lower investment in intangibles by EU firms as well as the presence of US firms that are particularly rich in intangibles, notably large digital champions such as Alphabet, Amazon, Apple, Facebook and Netflix.

**Figure 24**  
Composition of S&P 500 market value (in %)

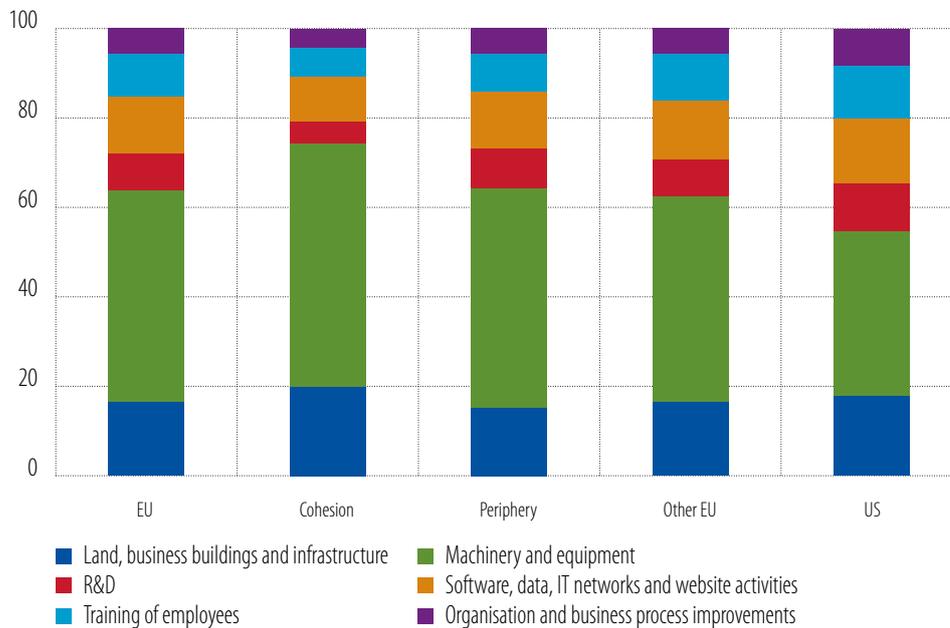


Source: Elsten and Hill (2017).

Note: The value of intangible assets for each company on the S&P 500 index is computed by subtracting net tangible asset value from its market capitalisation. Company data are aggregated for the S&P 500 index, and net intangible asset value is then divided by market capitalisation to determine the portion of the index's value that is derived from intangible assets.

Investment in intangible assets is higher in the US than in the EU. In 2017, US firms allocated 48% of total investment to intangibles (R&D, firm training, organisational capital and software and databases), compared with 36% in the EU, according to EIBIS (Figure 25). The share of investment that goes into intangibles is much lower in cohesion countries, at 26%. This difference in the importance of intangibles between the US and the EU is in line with estimates from macroeconomic statistics on intangible capital (EIB, 2016).

**Figure 25**  
**Composition of investment in EU country groups and the US (in %)**



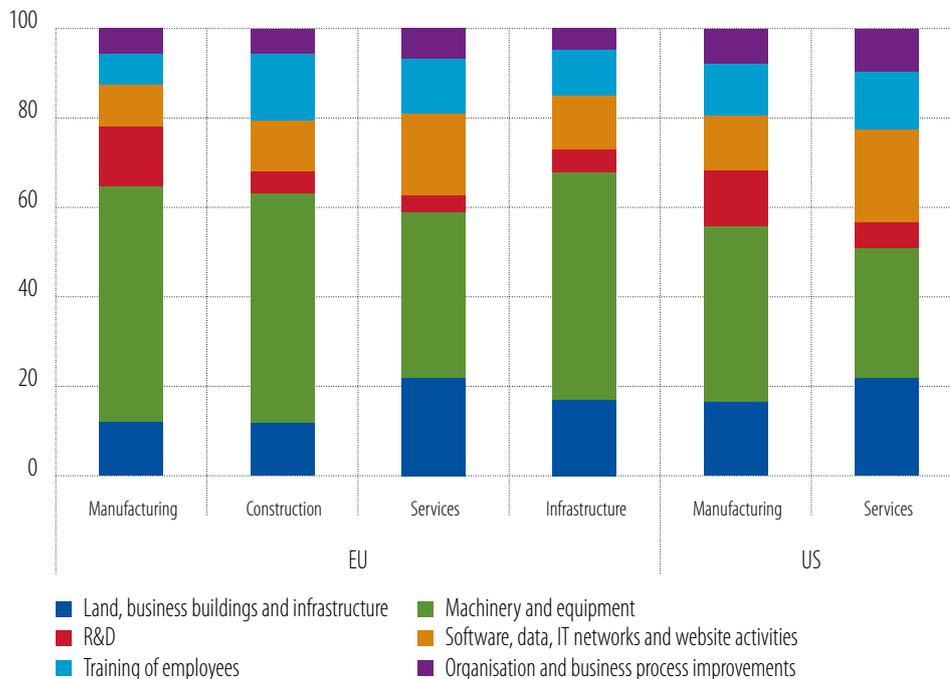
Source: EIB calculations based on EIB Investment Survey (EIBIS wave 2018) and EIBIS Digital and Skills Survey 2018.

Note: Firms in the EU are weighted with value added. Firms in the US are weighted with employment.

**Manufacturing firms conduct much more R&D than other sectors, while firms in services allocate a higher share of investment to software and data, IT networks and website activities.** Focusing on investment areas across sectors, machinery and equipment remains the most important investment area for all firms, even for firms in services – which tend to invest relatively more in land, business buildings and infrastructure (22% of total investment).

- R&D expenditures represent 13% of total investment for manufacturing firms in the EU, compared with only 4% in services, 5% in construction and 7% in infrastructure (Figure 26);
- EU firms in services allocate 17% of investment to software and data, IT networks and website activities, compared with only 9% in manufacturing and 13% in construction and infrastructure;
- The share of investment allocated to the training of employees varies from 6% in manufacturing to 15% in construction (12% in services and 10% in infrastructure);
- There is little variation across sectors in the share spent on organisation and business process improvements (5% to 6%). The shares allocated to different investment areas vary across sectors and country groups (as firms in cohesion countries tend to spend less on intangibles) but the ranking of the importance of areas is generally preserved.

**Figure 26**  
**Composition of investment in the EU and the US (in %), by sector**



Source: EIB calculations based on EIB Investment Survey (EIBIS wave 2018) and EIBIS Digital and Skills Survey 2018.  
Note: EIBIS data for the US do not include firms in construction or infrastructure (electricity, gas, steam and air conditioning supply; water supply; sewerage; waste management and remediation activities). Firms in the EU are weighted with value added. Firms in the US are weighted with employment.

## Selected stylised facts on intangible firms in the EU

**Innovation activities are correlated with investment in intangibles.** Firms that allocate a greater share of investment to intangibles (R&D, firm training, organisational capital and software and databases) tend to innovate more: they are more likely to develop or introduce new products, processes or services (Figure 27).<sup>16</sup> R&D investment is the main driver of this positive correlation between intangible assets and the introduction of new products, processes or services. However, investment in software and databases and in organisation and business process improvements matter as well. This again emphasises the importance of complementarity across intangible assets for firm innovation, suggesting that public policies aiming to support innovation in the EU should not only promote R&D investment. Intangible firms also tend to be more productive, in particular in other EU countries. The association between total factor productivity and intangible investment is also positive in the periphery and cohesion countries, but it is slightly weaker than in other EU countries.

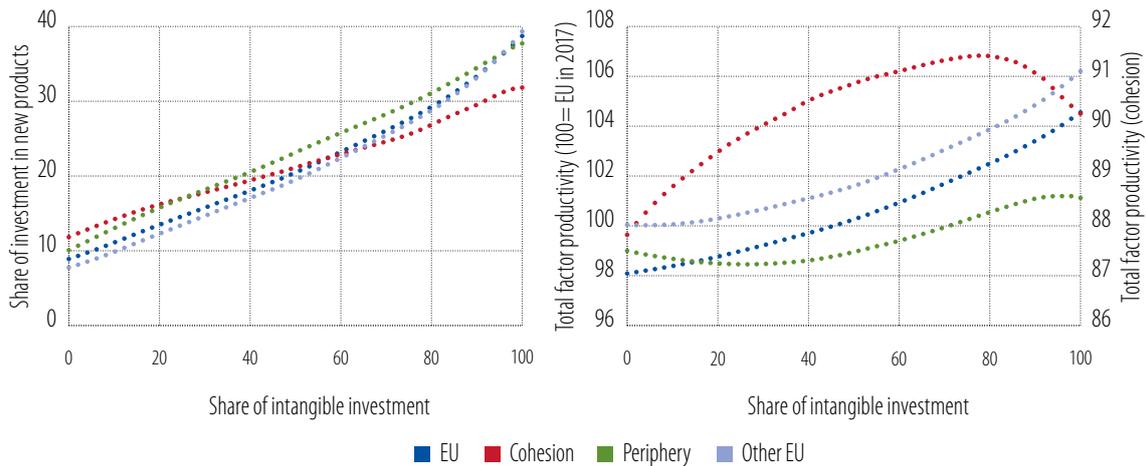
**Intangible firms increase their presence on international markets either by exporting their goods or services or by investing in a foreign country.** Exporters also tend to invest more in intangibles (Figure 28) – especially in R&D. Firms that invest in another country also allocate a higher share of investment to intangibles.<sup>17</sup> On average, firms in cohesion countries are more likely to export, while they are less likely

<sup>16</sup> All the results presented in figures using local linear regression discussed in this section are qualitatively similar to the estimates of OLS regressions that control for country, sector, size and year (for the EU and the three country groups).

<sup>17</sup> To account for the nature of the dependent variable – an indicator variable taking a value of 1 (if the firm exports goods or services) or 0 (if the firm does not export) – the analysis was also repeated using local constant regression, instead of local linear regression, and the results were qualitatively similar.

to invest in another country. Exporters are also much more likely to invest in products that are new to the country and global markets, suggesting that investing in innovation at the frontier is especially relevant for these firms if they want to remain competitive in international markets.

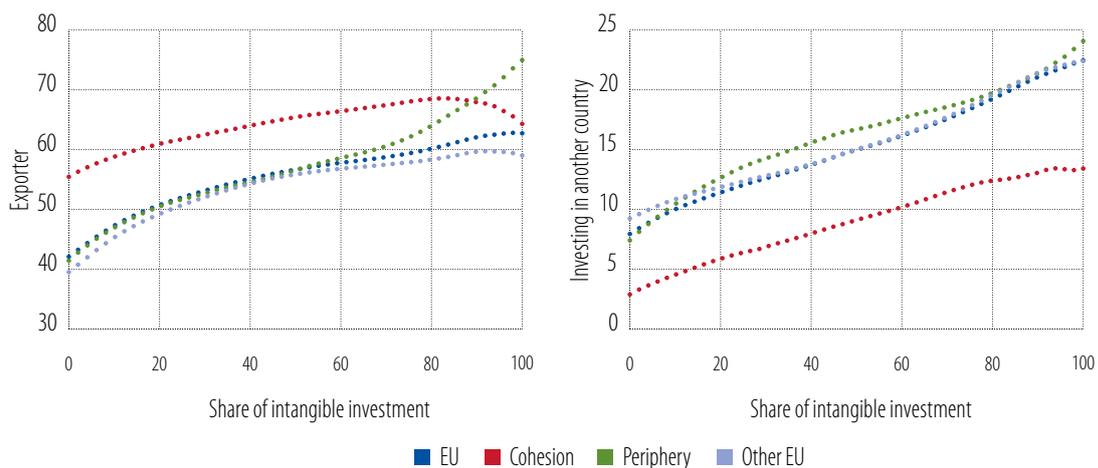
**Figure 27**  
**Share of intangible investment and investment in new products, processes and services, and share of intangible investment and productivity**



Source: EIB calculations based on EIB Investment Survey (EIBIS waves 2016, 2017 and 2018).

Note: Local linear regression of share of investment in new products, processes or services on share of intangible investment (left panel). Local linear regression of total factor productivity on share of intangible investment (right panel). Data on all firms are pooled from EIBIS (waves 2016, 2017 and 2018). Firms in EIBIS are weighted with value added.

**Figure 28**  
**Share of intangible investment and exporter status, and share of intangible investment and investing in another country**



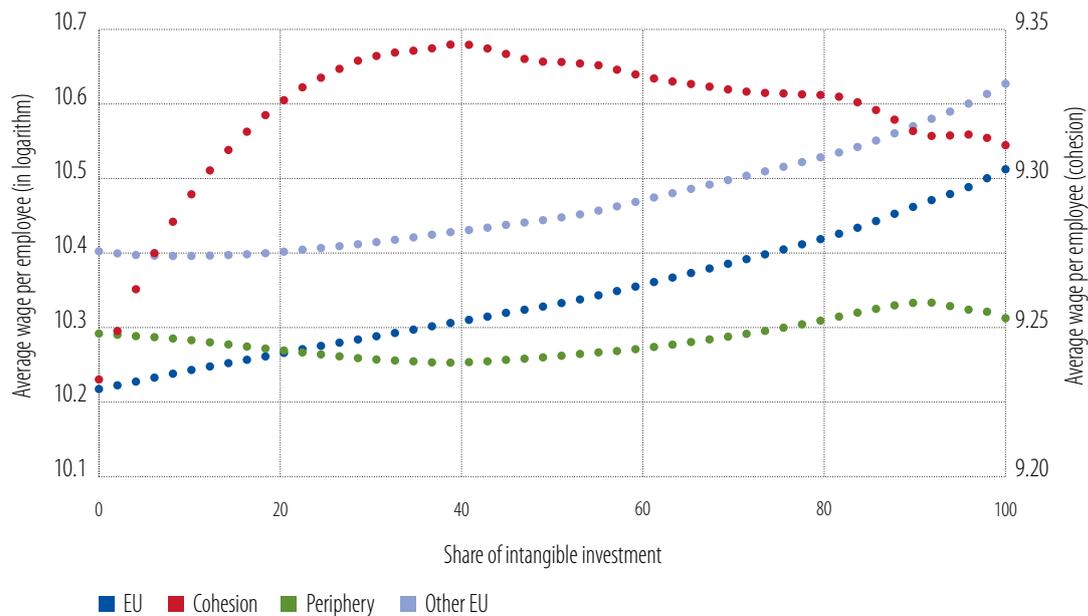
Source: EIB calculations based on EIB Investment Survey (EIBIS waves 2016, 2017 and 2018).

Note: Local linear regression of exporting goods and services on share of intangible investment (left panel). Local linear regression of investing in another country on share of intangible investment (right panel). Data on all firms are pooled from EIBIS (waves 2016, 2017 and 2018). Firms in EIBIS are weighted with value added.

**Intangible firms tend to pay their employees more.** However, this is mostly driven by firms in core EU countries: firms that invest heavily in intangibles in the periphery do not pay their employees much

more than basic firms (Figure 29). Overall, the evidence of a positive relationship in other EU countries is consistent with the findings of Aghion et al. (2018), who show that UK firms with higher R&D intensity tend to pay higher average wages.

**Figure 29**  
**Share of intangible investment and average wage per employee**

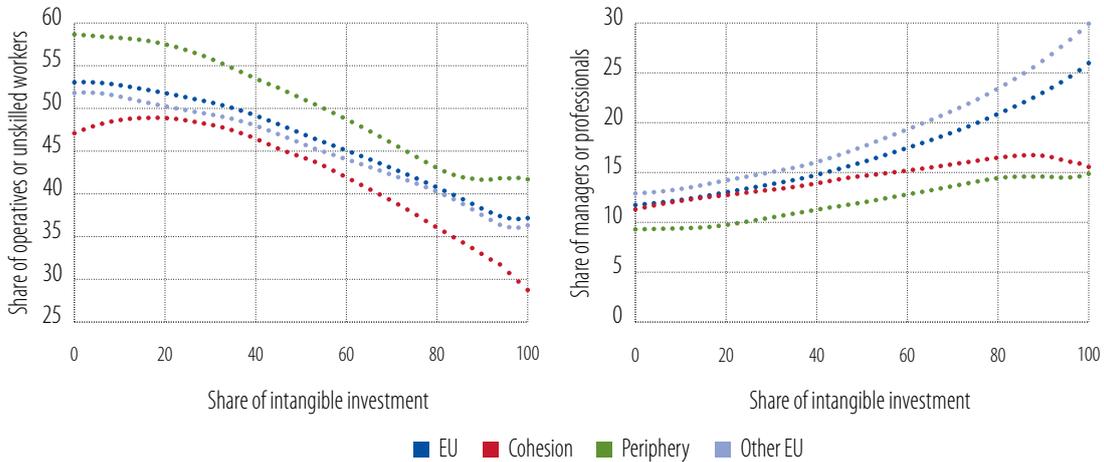


Source: EIB calculations based on EIB Investment Survey (EIBIS waves 2016, 2017 and 2018).  
Note: Local linear regression of average wage per employee on share of intangible investment. Data on all firms are pooled from the EIBIS (waves 2016, 2017 and 2018). Firms in EIBIS are weighted with value added.

**Intangible firms have fewer workers in lower-level occupations and more workers in higher-level occupations.** Firms that invest more in intangibles tend to employ fewer operative or unskilled workers and more managers and professionals (Figure 30). This is in line with the evidence of Aghion et al. (2018), who find that R&D firms employ fewer low-skilled workers and more high-skilled workers. This could explain why intangible firms tend to pay a higher wage per employee. At the same time, intangible firms are not smaller in size and do not have lower employment growth than other firms (but they do not necessarily grow at a faster pace). In other words, they do not necessarily suppress employment by replacing low-skilled workers with computers or machines and only keeping a handful of high-level professionals. However, it is also possible that highly intangible firms outsource lower-level occupation tasks more frequently than more traditional firms. In the periphery and cohesion countries, intangible firms also tend to have a higher share of intermediate level occupations (technicians or skilled trades), possibly substituting for unskilled workers. In addition, the positive relationship between investment in intangibles and a higher share of managers and professionals could also be driven by greater investment in training – as highly skilled workers tend to receive more intensive training (and training is a component of intangible investment).

**Intangible firms tend to use more internal funds to finance investment.** In addition, intangible firms in cohesion and periphery countries are more finance-constrained than firms that allocate a small share of investment to intangibles (Figure 31). This is in line with the evidence reported in Figure 18 of this chapter for leading innovators (firms that introduce products that are new to their market and that make significant investments in R&D). Intangible firms tend to be more innovative and more productive than firms that do not invest in intangibles. They also support better jobs by paying higher wages and employing more workers in higher-level occupations (and fewer workers in lower-level occupations). This suggests that policy measures should be taken to better support intangible firms, as they can be a source of high-quality employment opportunities.

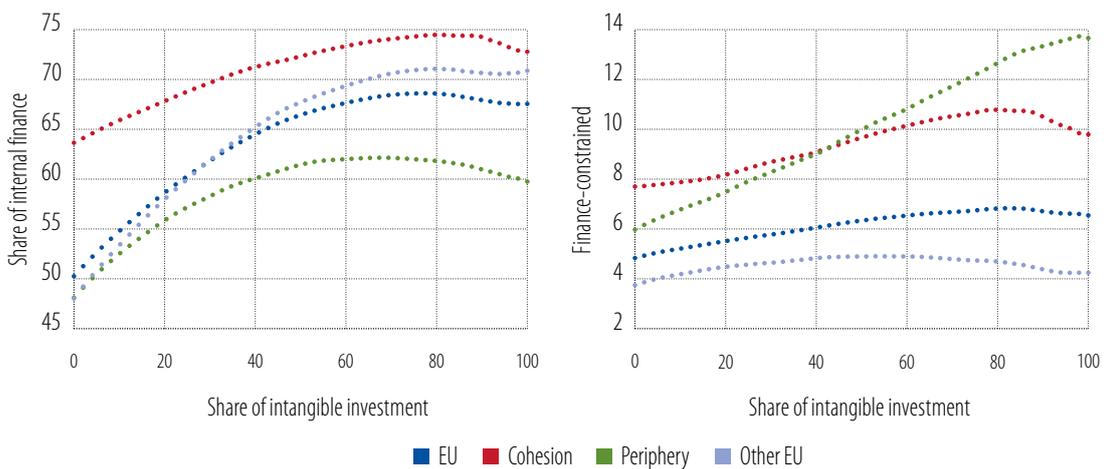
**Figure 30**  
**Share of intangible investment and of workers in lower-level occupations, and share of intangible investment and of workers in higher-level occupations**



Source: EIB calculations based on EIB Investment Survey (EIBIS waves 2016, 2017 and 2018).

Note: Local linear regression of share of lower-level occupation workers (operative or unskilled workers) on share of intangible investment. Local linear regression of share of higher-level occupation workers (managers and professionals) on share of intangible investment. Data on all firms are pooled from EIBIS (waves 2016, 2017 and 2018). Firms in EIBIS are weighted with value added.

**Figure 31**  
**Share of intangible investment and of internal funds to finance investment, and share of intangible investment and being finance-constrained**



Source: EIB calculations based on EIB Investment Survey (EIBIS waves 2016, 2017 and 2018).

Note: Local linear regression of share of internal finance on share of intangible investment. Local linear regression of share of finance-constrained on share of intangible investment. Internal finance: internal funds and retained earnings (including cash and profits). Finance-constrained: the firm was (i) rejected when seeking any external financing for an investment; (ii) quantity-constrained (dissatisfied with the terms and the amount received in the last request for external financing); (iii) price-constrained (the firm did not apply because it thought the conditions of external financing would be too expensive); or (iv) discouraged from seeking any external financing (the firm did not apply because it thought the application would be turned down). Firms in EIBIS are weighted with value added. Data on all firms are pooled from EIBIS (waves 2016, 2017 and 2018). Firms in EIBIS are weighted with value added.

## Characteristics and complementarities of intangible assets

**Intangibles have several characteristics that distinguish them from tangible assets.** Some of these characteristics are associated with market failures and suboptimal investment decisions as discussed in Box B of this chapter. In addition, these characteristics tend to reinforce each other, strengthening their individual effects (Haskel and Westlake, 2017):

- Intangibles generate positive *externalities*, associated with limited appropriability and partial excludability (non-rival and non-excludable). Due to these positive spillover effects, social returns tend to be higher than private returns, leading to underinvestment;
- Intangibles have notable synergies and *complementarities*, meaning that they work more effectively when combined. Any given technology depends on bringing together existing ideas and technologies, e.g. hardware and software;
- Intangibles are easy to scale up. Because of *scalability*, network effects therefore become crucial and may trigger inequality and winner-takes-all effects;
- Intangibles are characterised by non-tradability and non-transferability, leading to high *sunk costs* and the absence of market valuations. Intangible investments tend to be firm-specific and are more difficult to re-sell on secondary markets. It is hence harder to use them as collateral;
- Intangible assets tend to be *difficult to value*. The lack of visibility and the lack of physical embodiment make it difficult to measure and value the level of capital stock over time;
- There is a great deal of uncertainty around innovation and intangible assets, notably that related to the *skewness of rewards*: if an innovative activity is unsuccessful, the value will be virtually zero; but if it is successful, it will be worth much more. The unpredictability and volatility in expected returns creates uncertainty. The sunk cost of, for example, R&D may imply that a firm will have to make large investments upfront that cannot be capitalised on if the innovation turns out to be unsuccessful;
- Another feature of the intangible economy relates to *contestedness*, that is, it is often difficult to prove who owns intangible assets, and the benefits tend to spill over to others. Traditionally, this is addressed through intellectual property rights, but it can be more difficult to manage it in an economy increasingly dependent on new forms of intangibles, such as the digital economy.

**Complementarities between different types of investment matter.** Firms that invest simultaneously in different areas of intangible assets can benefit from spillover effects. Firms that invest more in machinery and equipment, software and databases, and training of employees tend to have higher turnover and produce more value added (Table 1 – “direct effect”). Focusing on the interaction of tangible and intangible investment, firms that simultaneously invest in machinery and equipment and in R&D tend to perform better, which points to complementarities between the two investment areas (Table 1 – “interaction with investment in other area”). Focusing on the interactions of investing in different intangibles at the same time, firms that invest in software and employee training tend to have a higher value added (but not necessarily higher turnover).

**Presumably, the quality of the investments and amount spent are both important to obtain positive complementarities.** While firms that invest more in firm training perform better, the interaction term of firm training with machinery and equipment or R&D is negative, indicating that they could be substitutes (rather than complements in terms of investment decisions). The timing of the investments may matter as well. Not all investments pay off immediately: knowledge spillovers from investing in intangibles and skills may need time and persistence to be successful. Overall, the evidence based on firm-level data of EIBIS is in line with results using macroeconomic statistics, supporting the view that there are important complementarities between tangible and intangible assets, as discussed in Box D.

**Table 1**  
**Interactions between investment in different areas (tangible and intangible assets)**

Outcome variable:	Direct effect	Interaction with investment in other area				
Turnover		B.	C.	D.	E.	F.
A. Land and business buildings	0	+	0	0	-	0
B. Machinery and equipment	+		+	0	-	0
C. R&D	0			0	-	0
D. Software and databases	+				0	0
E. Training of employees	+					+
F. Organisation improvements	0					

Outcome variable:	Direct effect	Interaction with investment in other area				
Value added		B.	C.	D.	E.	F.
A. Land and business buildings	0	+	+	+	-	0
B. Machinery and equipment	0		+	0	-	0
C. R&D	0			0	-	0
D. Software and databases	+				+	+
E. Training of employees	+					+
F. Organisation improvements	0					

Source: EIB calculations based on EIB Investment Survey (EIBIS waves 2016, 2017 and 2018).

Note: The tables are based on an OLS regression, where turnover (or value added) is the dependent variable and the explanatory variables are the investment in each area (in logarithms) and the interactions between investments in different areas. Other explanatory variables include the country, sector, firm size and year. The sample size is 32 265 with turnover as dependent variable and 27 929 with value added as dependent variable. The first column lists the six different investment areas and the second column reports whether each investment area is associated with turnover (or value added). Columns 3 to 7 report estimated coefficients on the interaction terms. "+": estimated coefficient on the interaction is positive and statistically significant at the 5% confidence level; "-": estimated coefficient on the interaction is negative and statistically significant at the 5% confidence level; "0": estimated coefficient not statistically significant at the 5% confidence level. Data on all firms are pooled from EIBIS (waves 2016, 2017 and 2018). Inference is based on standard errors clustered by firm. Firms in EIBIS are weighted with value added.

**Box D****Complementarities of investing in different asset types<sup>18</sup>**

Europe's economic outlook continues to improve, with robust growth, falling unemployment and more solid public finances thanks to lower public deficits. However, productivity growth remains sluggish, despite a recent upturn. Ensuring more resilient economic growth will require speeding up productivity enhancements, notably by boosting investment, particularly that in knowledge-based (or intangible) assets and innovation creation and diffusion across the European economy.

The relevance of intangible investments for productivity, competitiveness and economic growth is widely acknowledged by policymakers. It is also increasingly discussed in the economic literature (Jorgenson and Stiroh, 2000; Oliner and Sichel, 2000; Corrado et al., 2017; Roth and Thum, 2013; van Ark, 2015). Correspondingly, the capitalisation of spending on R&D under the European System of Accounts (ESA 2010) goes some way towards recognising intangible assets and appropriately accounting for respective investments.<sup>19</sup>

The increasing importance of intangible capital is underscored by the rise of digital technologies, such as artificial intelligence or the Internet of Things, that are deeply transforming the economy. Innovation has become more complex due to the convergence of digital technologies with the physical world. Innovators need to master technological development, but also to reorganise their production and distribution channels and to retrain their labour force, as a prerequisite for reaping the full benefits of innovation.<sup>20</sup> For example, the main competitive advantage of a company like Zara has been its focus on applying advanced IT systems to obtain near real time information on consumption patterns across the globe. Exploiting this information requires sophisticated IT systems both to obtain data and to reorganise production and distribution systems to make them more agile and better able to respond to customers' preferences.

Doing business and innovating successfully requires investment in many different types of assets and increasingly in knowledge-based capital. Conceptually, this includes:

- intellectual property products captured in national accounts (i.e. "NA intangibles"), such as R&D, computer software and databases;
- intangible assets not covered by national accounts, such as training of employees and skill development, organisational investments, management consulting, design, brand equity and marketing expenditure (often referred to jointly as "non-NA intangibles"); and
- corresponding physical capital (e.g. hardware).

Understanding the nature of and relationship between different asset types, and whether they are complementary to or substitute each other (in terms of both co-investment decisions and their ability to boost productivity growth) is crucial for identifying and removing potential investment bottlenecks and ensuring the economic success of individual investments. An investment in one asset type may affect the success (productivity, return on investment) of that in another (intra-intangibles or tangibles and intangibles). Similarly, a barrier that hampers investment in one asset type may affect the investment in another, either by holding back the decision to invest *ex ante* or by lowering the returns on a specific investment project *ex post*.

18 Prepared by Anna Thum-Thysen (European Commission, DG ECFIN), Peter Voigt (European Commission, DG ECFIN) and Beñat Bilbao-Osorio (European Commission, DG RTD).

19 However, as highlighted in the economic literature (Thum-Thysen et al., 2017), the picture remains incomplete, as spending on many relevant intangible assets is not treated as investment in national accounts.

20 See European Commission (2018) for a thorough review of changing innovation dynamics.

Some studies have tried to shed light on this relationship, but the results do not seem to unequivocally support complementarity or substitution across asset types. Hall et al. (2012) and European Commission (2018) do not find conclusive evidence about the relationship between ICT and R&D investment, for example. While, individually, both types of investment contribute to productivity growth, their joint investment does not seem to give an additional boost to productivity. Spiezia (2011) finds that ICT enables the adoption of innovation but does not increase the probability of innovation developed in-house.

Other studies have found significant complementarities across investments in different types of asset. Crass and Peters (2014) find that two components of innovative properties (R&D and patent stocks, i.e. intellectual property) are complements, as the marginal productivity of R&D increases with the patent stock, i.e. the more intellectual property a company has, the more productive its R&D investment becomes. Their research also shows that innovative property and human capital are complementary, highlighting the importance of skills in the ability to exploit and reap the benefits of innovation outputs. Brynjolfsson and Hitt (2000, 2003) and Brynjolfsson et al. (2002) suggest the existence of complementarities between ICT and organisational capital, arguing that the joint investment increases benefits accruing purely to investment in ICT. Belitz et al. (2017) argue that tangible and intangible assets tend to complement each other but there are remarkable differences across industries. Corrado et al. (2017) study the channels through which intangible assets may affect productivity growth and find complementarities between ICT (hardware) and intangible capital, as well as evidence of knowledge spillovers from investments in intangible capital and skills.

With a view to identifying drivers and barriers to investment and distinguishing fixed and intangible assets (including intangible assets not captured in national accounts), Thum-Thysen et al. (2017) use an accelerator model and find evidence of complementarities between intangible and tangible assets, as well as between different types of intangible assets, in driving investment.<sup>21</sup> Accordingly, the strongest link was found between tangible and (total) intangible capital, while complementarities between various types of intangibles are also significant, but seem to be somewhat smaller (Table D.1).

This evidence suggests that there is a need for further research to better understand the linkages of investments in various asset types and their impact on innovation, productivity and economic growth. The ability to identify causal relationships will also help better address potential policy needs in terms of public support for intangible investment. In this regard, in addition to the question of complementarities between different asset types (tangibles and intangibles, and also subcategories of intangibles), the role of intangible assets not captured in official statistics and national accounts warrants particular attention.

<sup>21</sup> The accelerator model postulates that changes in capital are proportional to changes in economic output. The accelerator term describes the relationship between an increase in income and a resulting increase in investment. As described in Knox (1970), the principle of the accelerator argues that when income increases, demand for consumer goods also increases. Consequently, investment must increase to raise the productive capacity to meet the increased demand.

**Table D.1**  
**Complementarities between different asset types**

	Total intangibles	NA intangibles	Non-NA intangibles	Tangibles
Accelerator term	0.040* (0.019)	0.052** (0.020)	0.029*** (0.009)	0.210*** (0.037)
Tertiary education	0.001*** (0.000)	0.000 (0.000)	0.001*** (0.000)	-0.000 (0.000)
Long-term interest rate	0.000 (0.000)	-0.001** (0.000)	0.000 (0.000)	-0.001*** (0.000)
EPL (strictness of selective dismissals)	-0.008*** (0.002)	0.003 (0.003)	-0.006** (0.002)	0.008** (0.003)
Tangible investment	0.227*** (0.051)			
Non-NA intangible investment		0.570* (0.275)		
NA intangible investment			0.205* (0.010)	
Total intangible investment				1.021*** (0.260)
Country dummies	yes	yes	yes	yes
Time trend	no	no	no	yes
Crisis control	yes	yes	yes	yes
Sample size	194	194	194	194
R-squared	0.602	0.436	0.569	0.775
Number of countries	13	13	13	13

*Source:* Eurostat, INTAN-Invest, Commission services; annual data for the period 1995–2013 covering 13 EU countries (for details, see Thum-Thyssen et al., 2017, especially Table A7).

*Note:* Robust standard errors in parentheses. \*\*\* $p < 0.01$ , \*\* $p < 0.05$ , \* $p < 0.1$ . All variables are expressed as percentages. The explanatory variables are added in lag-form (i.e. referring to the previous year). The crisis control is specified as an indicator variable taking value 1 for the year 2009 (and 0 otherwise), and an interaction term between the indicator variable and the accelerator term. The time trend is linear. The data cover the period 1995–2013 (however, the final sample size depends on the availability of data on intangible investment). Estimated coefficients refer to averages across countries and can hide country-specific heterogeneity in the relationships between the explanatory variables and the dependent variables.

## Conclusion and policy implications

**The global innovation landscape is changing rapidly.** The importance of the digital sector and the intangible economy is rising. China has become one of the top three global players for the level of R&D expenditures, together with the United States and the European Union. While remaining in the top league, the EU is spending less on R&D, as a percentage of GDP, than other major economies. The EU is not on track to reach the Europe 2020 strategy target of 3% of GDP invested in R&D by 2020. The gap in R&D intensity for Europe is largely driven by business R&D investment.

**The EU is lagging in terms of excellence in innovation, failing to produce new leading companies in the fast-growing technological, electronics and digital sectors.** Innovative firms tend to rely more on internal funds, equity and grants to finance their investments. They use a more diversified set of financial instruments. At the same time, they are more finance-constrained when they seek external finance, especially in less developed EU regions. By better using equity and public grants to finance innovative projects, financial diversification can be an effective innovation policy, especially in such regions.

**To catch up with its peers, the EU will need to create better framework conditions – at the EU level, but also at the national and regional levels.** There are also a number of issues with market exit that may lock resources – capital and labour – into less productive firms. Innovation financing policy should be embedded in an environment that addresses barriers to innovation (such as access to finance and finding workers with the right skills) and provides the right incentives to support investment by fast-growing innovative small and young firms. Strong barriers to investment for new innovative market entrants in the EU and less dynamism with lower market exit could cause a systemic innovation deficit for Europe, especially in the rapidly changing digital sector.

**Access to finance for firms investing in intangibles cannot be tackled in isolation.** Difficulties in access to finance do not always make a case for government intervention in support of innovative firms. Even if there is a case to be made for intervention in terms of financial market failure, governments need to be careful to redress this failure without distorting the business environment. Innovation policy intervention needs to be regularly evaluated to assess whether the policy instrument is the most appropriate to best alleviate market failures at the local level. Public policies to enhance innovation and their growth-conducive nature should include measures to:

- support public R&D and the development and redefinition of business R&D, in particular in the digital sector;
- improve the business environment and framework conditions for innovative firms in all EU regions – they can be as important as direct public R&D investment;
- promote investment in all forms of intangible assets (including software and database or organisational and business processes) for all firms in all sectors, not only focusing on R&D or manufacturing firms;
- support the development of financial markets (private and public equity) to finance investment by innovative firms and promote the use of intangible assets as collateral;
- support fast-growing small and young innovative firms, in order to balance network effects and winner-takes-all dynamics;
- make it easier for firms that are not performing to exit the market so that capital and labour can be reallocated to more productive firms;
- develop the skill base of the labour force by supporting professional training and higher education;
- improve digital infrastructure;
- stimulate initiatives that enable synergies and network effects in basic science and business R&D;
- improve competition policy, the functioning of product and labour markets and the implementation of the digital single market in the EU.

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## Chapter 4

### Investment in climate change mitigation

**EU investments in climate change mitigation (CCM) technologies declined until 2014, and only marginally rebounded over the next three years, with diverging trends across the sectors.** Investments in the solar segment were the main driver of this drop, due to both lower capital costs and fewer new additions. Several factors have influenced investments in the clean energy landscape, including the recent economic downturn and market, regulatory and technological developments, and have led to a less predictable and stable environment.

**Energy efficiency is the backbone of the EU's long-term plans to move to a low-carbon economy.** In June 2018, a political agreement was reached on new, more ambitious climate targets for 2030 by EU institutions. This means that countries will have to step up their efforts to unleash the energy-efficiency potential of the economy.

**Energy audits are the first step in unleashing the potential energy efficiency.** Audits can help to overcome the information gap that is one of the main barriers to energy-efficiency investments. Analysis indicates that their information is crucial, especially to small firms. Financial instruments, combined with information campaigns, are some of the most efficient ways of promoting energy audits across firms. However, our analysis points out that the benefits of energy audits can materialise only when firms have easy access to finance.

**Access to CCM financing is important to facilitate investments in energy efficiency.** An innovative experiment shows how firms assess CCM investment projects; its results suggest that the decision-making process for most firms resembles that of any other projects, with the payback period playing an important role. In addition, our analysis indicates that higher interest rates and other constraints, such as higher collateral amounts required and lower amounts of loans offered, reduce firms' willingness to proceed with energy-efficiency projects.

**Sending the right price signals is the best way to increase awareness among consumers and promote CCM investments.** Policies that will remove environmentally harmful subsidies, strengthen the carbon price and align the current market design with the objectives of low-carbon transition would make investments in CCM more economically attractive. This would, in turn, increase society's willingness to pay for the energy transition and boost private financing that would mobilise resources from capital markets for CCM projects.

## Introduction

**The European Union (EU) has consistently been at the forefront of global action against climate change.** It has developed various ambitious energy and climate policies both to mitigate climate change and to limit the global increase in temperature to less than 2°C, in line with the recent Paris Agreement. In 2009, the first interim step towards achieving a low-carbon economy by 2020 set a number of climate and energy targets known as “20-20-20” (Figure 1). This was followed in 2014 by the 2030 framework for climate and energy, which set EU-wide targets and policy objectives for the period between 2020 and 2030. The aim of the new targets remains the same: to help the EU to achieve a more competitive, secure and sustainable energy system and to meet its long-term 2050 greenhouse gas (GHG) reductions target (80–95%).

**Figure 1**  
European targets for 2020, 2030 and 2050 compared with 1990 levels

	2020	2030	2050
Increase in energy efficiency	20%	32.5%	TBD
Share of renewables	20%	32%	TBD
GHG emissions reduction	20%	40%	80-95%

Note: TBD stands for to be decided.

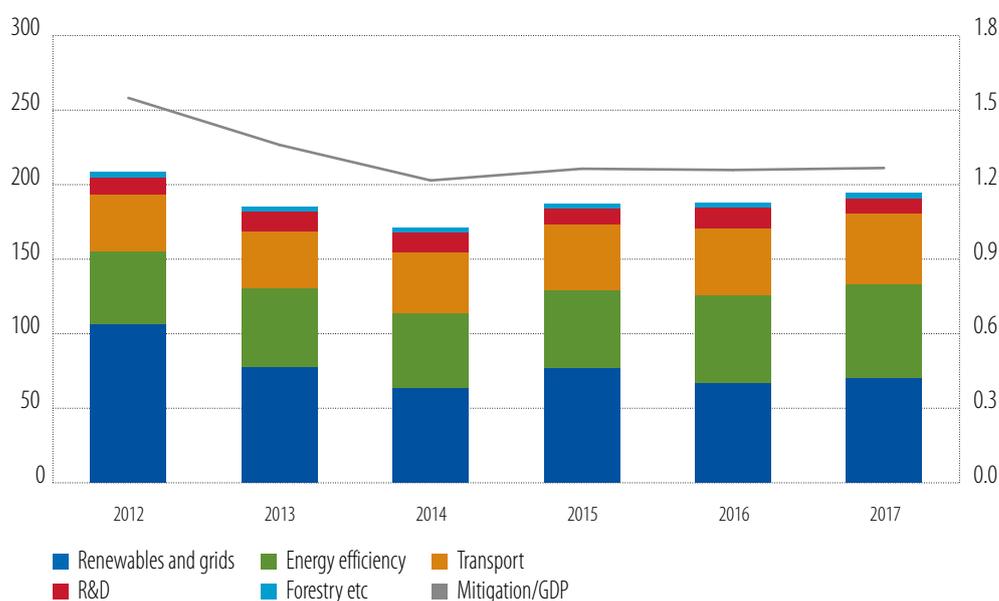
**Efforts should step up in order to meet the 2030 objectives, despite the considerable progress made towards realising the 2020 objectives by both the EU as a whole and individual Member States.** The European Commission (EC) identified the general overhaul of current EU energy legislation, and in 2016 proposed a new legislative package to bridge the gaps between the targets and the current policies. It became evident from the EC’s analysis that a sharp increase in investment in climate change mitigation (CCM) is needed to achieve the long-run climate policy objectives (2050). Meeting this investment challenge requires, among other things, an improved knowledge base in terms of climate finance tracking in order to be able to link climate and energy objectives with corresponding investment needs. Yet, the lack of a unified data source for CCM investment limits research in various critical areas with respect to the investment determinants and investment gaps. Against this background, this chapter focuses on the critical questions surrounding CCM investment today, with a view to guiding decision-makers in designing climate finance policies and promoting CCM investment.

**The structure of this chapter is as follows:** Section 2 assesses the current trends in CCM investment based on the database developed by the European Investment Bank (EIB). Section 3 discusses the evolution of the main determinants of investments in CCM. Section 4 assesses the role of energy audits in promoting investments in energy-efficiency measures of corporates. Section 5 reveals firms’ financing preferences and willingness to pay for energy-efficiency investments. Section 6 concludes and provides some policy recommendations.

## Total EU investment in Climate Change Mitigation

**Total EU investments in CCM declined after 2012 and have only recently started to marginally pick up.** In 2017, total EU investment flows increased by almost 3.5% compared with the previous year, to EUR 194.3 billion. However, their share decreased from 1.6% in 2012 to 1.3% of GDP, and from 8.3% to 6.3% of gross fixed capital formation, in 2017 (Figure 2). Despite this drop in relative terms, investments in CCM were four times higher than the amount spent on fossil fuel production, suggesting their importance in the new energy economy landscape.

**Figure 2**  
**Evolution of EU28 climate change mitigation investment per sector (EUR billion, % of GDP)**



Source: IEA, Bloomberg new energy finance, Eurostat, and author's calculations

**There were diverging trends in investment in CCM across sectors between 2012 and 2017.** While investment in energy efficiency and transport infrastructure has risen after reaching a low point in 2014, investment in renewable energy (including the grids investment component attributed to renewables) in 2017 recorded an increase of only 4% to EUR 70 billion and seemed to stabilise around this level. Reduced new additions in generation capacity and falling capital costs were the main factors of this trend. Investments in R&D and forestry were also slightly lower than for 2012.

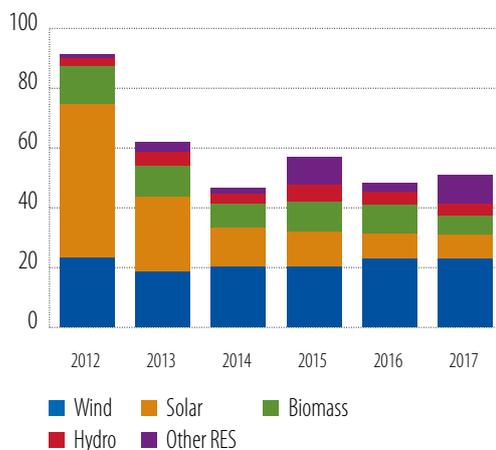
### Renewables and grids

**Renewable energy continues to attract the lion's share of investments in power generation, which suggests its rising importance in the EU generation mix.** In 2017, the estimated investment in this sector reached EUR 52.9 billion (Figure 3), almost nine times the amount invested in fossil fuel generation (mainly coal and gas oil), which was EUR 6 billion (IEA, 2017a). In addition to these investments, renewables deployment also included investments related to the reinforcement of electricity networks, which amounted to EUR 17 billion.<sup>1</sup> Their objective is to accommodate the intermittent nature of renewables and ensure the security of energy supply.

<sup>1</sup> This estimation is based on the methodology described in the Annex and refers to the EIB project-based methodology for defining a share of grid cost to renewable energy and thus climate action lending.

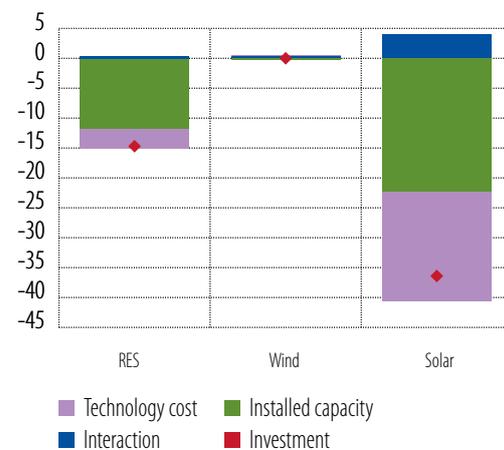
**Wind farms hold the highest share of new investments in renewables, confirming wind's status as one of the most mature renewable technologies.** In 2017, investments in wind farms totalled EUR 22.9 billion, most of which concerned onshore wind installations. This figure has remained stable in recent years. Despite this stagnation in spending, the new additions in installed wind capacity follow an increasing trend: presenting an annual compound growth rate of almost 2% between 2012 and 2016. This implies that total capital spending remained constant over the period due to some capital cost reductions in wind turbines.

**Figure 3**  
EU28 investment in renewables (EUR billion)



Source: IEA.

**Figure 4**  
Decomposition analysis of compound annual growth rate (CAGR) of EU28 investments, between 2012 and 2016 (%)



Source: Author's calculations.

**The next most important renewable technologies are solar and biomass, accounting for 15% and 12%, respectively, of the total new investments.** Investments in both technologies, but particularly solar, are declining. The falling investments in solar are almost evenly driven by negative changes in installed capacity and falling capital costs (Figure 4). However, as the capital cost goes down, investments pick up slightly, as indicated by the positive contribution of their interaction term. The increasing manufacturing capacities and supply of purified silicon feedstock are among the main factors driving down capital costs in the solar segment. Similarly, the financial crisis and the subsequent capital constraints, together with structural problems in some markets, are factors of the reduced appetite for investments in solar in recent years.

**Investments in hydro and biofuels declined in recent years, while geothermal technology has recorded a significant increase.** Thanks to geothermal's contribution, the share of renewable technologies other than solar, wind and hydro in total renewables investment skyrocketed from 10% in 2012 to almost 30% in 2017; investment in geothermal plants increased from EUR 1.4 billion in 2012 to EUR 9.7 billion in 2017. By contrast, the biofuels sector suffered the strongest drop in investment, from EUR 3.4 billion in 2012 to EUR 1.9 billion in 2017, influenced by the economic downturn. Investment in hydro declined from a peak of EUR 4.9 billion in 2015 to EUR 3.8 billion in 2017. Over the last three years, there has been hardly any new capacity in hydro plants.

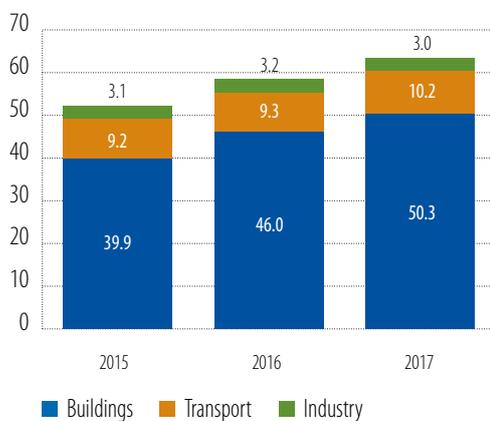
**Approximately half of the total electricity network investment is attributed to CCM efforts.<sup>2</sup>** In 2017, CCM investment in electricity networks was EUR 17 billion, increasing steadily at an average of almost 6.5% per year since 2012, in line with the deployment rate of renewables. Of the total amount of CCM investments in electricity networks, EUR 10 billion concerns the expansion of networks, integration of renewable generation and smart grids and EUR 7 billion concerns the replacement of old transmission and distribution equipment.

<sup>2</sup> For more information about the estimation of investment in networks attributed to CCM efforts, see methodology in the Annex.

## Energy efficiency

**Energy-efficiency improvements play a pivotal role in the EU's endeavour to reach its long-run climate objectives.** Using energy more efficiently saves money, reduces greenhouse gas emissions and decreases dependence on imported fossil fuels. That is why a new, more ambitious target than that proposed initially by the EC in 2016 was agreed by the European Parliament and Council negotiators. In June 2018, the EU reached a deal on a new 32.5% energy-efficiency target for 2030, to be reviewed by 2023. The revision will consider the potentially significant cost reductions resulting from economic or technological changes. This means that efforts should be stepped up in this area to meet the new objective.

**Figure 5**  
EU28 investment in energy efficiency per sector (EUR billion)



Source: IEA.

**Figure 6**  
EU28 investment in railways and inland waterways (EUR billion)

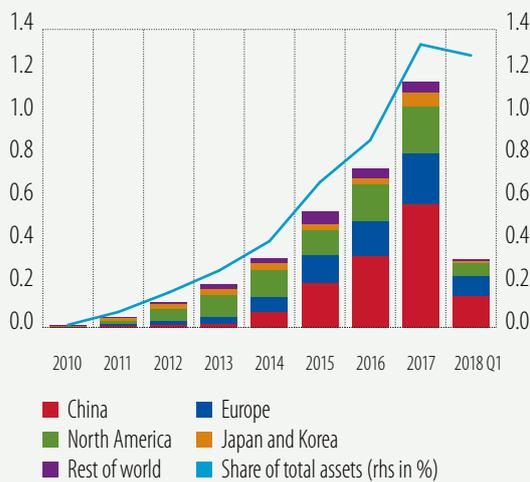
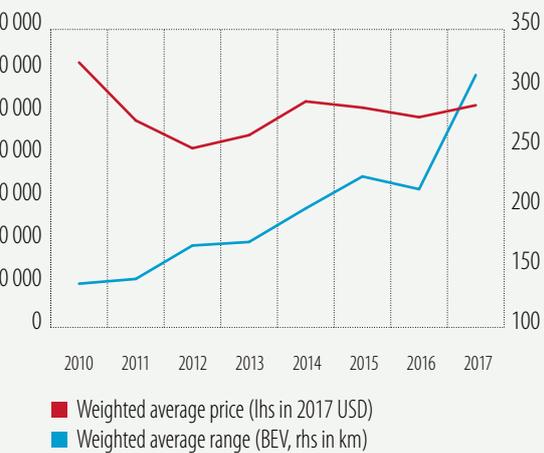


Source: OECD, Eurostat.  
Note: \*Projected values.

**Energy-efficiency investments in the EU were estimated at EUR 63.5 billion in 2017, up by 8.6% compared with 2016, and contributed positively to realised energy savings.** Over three-quarters of this investment is in buildings (Figure 5), with the remainder relating to transport vehicles (16%) and industry (5%). Investment in buildings includes the building envelope (walls, windows, etc.), heating and cooling systems, control systems, appliances and lighting. The building envelope accounts for the majority of efficiency investment in this category, mostly involving improvements in insulation and windows. In the transport sector, the energy-efficiency measures are vehicle-specific and focus on improvements in technology and vehicle operations. In the industrial sector, energy-efficiency options are classified as those aimed at mass-produced products and systems, and those that are process-specific. Energy-efficiency investments in both buildings and transport increased by 9% compared with 2016, while investments in industry declined by 4%.

**Box A<sup>3</sup>****As the market for electric vehicles matures, its underpinning policies will evolve**

Exponential growth in the sales of electric vehicles (EVs) continued in 2017, at 54%, reaching 1.1 million – the first time sales have exceeded the 1 million mark (Figure A.1).<sup>4</sup> However, the share of EVs in the total stock of passenger vehicles, commercial vehicles and buses is still low, at less than 0.4%. Consequently, their impact on oil and electricity demand remains modest: EVs, buses and commercial vehicles sold in 2017 will reduce global oil demand by around 30 000 barrels per day. Global oil demand rose by 1.5 million barrels per day in 2017. The annual electricity needs of these EVs sold in 2017 was around 1.3% of global demand growth in 2017. To meet the level of EV deployment projected in the IEA Sustainable Development Scenario, average annual EV sales growth would need to be 33% until 2030.

**Figure A.1****Global sales of electric vehicles (millions)****Figure A.2****Weighted average price of electric vehicles in the EU**

Source: IEA, *World energy investment report 2018*.

The EU share of the market for electric vehicles was 18% in 2017, a decline from the high of 26% in 2015, due to China's rapidly growing share. However, in absolute terms, EU sales are rising rapidly, with 36% growth to 207 000 in 2017. This is equivalent to 85% of the total growth in the market for light-duty passenger vehicles in Europe, signaling that EVs are significantly impacting growth in the market for purely internal-combustion-engine-powered vehicles. Among European countries, the top three electric vehicle markets in 2017 were Norway, Germany and the UK. In terms of EV market share, the top three European countries were Norway (39% of all vehicle sales in 2017), Sweden (6.3%) and the Netherlands (2.7%). By comparison, the global average was 1.3%, a share maintained at the start of 2018.

Electric vehicles sold in Europe in 2017 represent a total purchase cost of USD 12 billion, a 40% increase since 2015. Most of these purchases benefit from some kind of government incentive (national or local). In 2017, purchase incentives provided by central and local European governments amounted to around USD 1.5 billion. While spending on incentives declined in Denmark and Sweden, this was more than offset by growth in, for example, Germany and Norway. However, at one-eighth of

<sup>3</sup> The text in this box is an excerpt from the IEA World Energy Investment 2018 report, with some adjustments to provide Europe-specific information. Much of the underlying data are derived from IEA Global EV Outlook 2018, OECD/IEA, Paris.

<sup>4</sup> EVs are defined here as battery electric vehicles (without an internal combustion engine), plug-in hybrids and fuel cell electric vehicles.

total spending on electric vehicles, the average government share of EV purchase costs in Europe is significantly below the global average, partly due to a higher share of plug-in hybrid electric vehicles than China. Nonetheless, as the EV market expands, governments are aiming to ensure that public budgets for electric vehicle incentives remain manageable.

Policy changes in some countries to rein in the cost of these subsidies include: portfolio standards and trading, as announced by the Chinese government in September 2017; environmental performance standards, as proposed by the EC in November 2017; bulk public procurement, as adopted by India following its successful programme used to deploy light-emitting diodes; and scheduled bans on vehicles with only internal combustion engines (ICEs). Worldwide, eight countries<sup>5</sup> have announced bans on ICE sales by 2040, while 19 cities have announced restrictions on ICEs by 2040 at the latest (six of which take effect by 2025).

In Europe, total spending on EVs is rising, partly because of rising average vehicle prices, but also because vehicle performance is improving (Figure B.2). The weighted average price of an electric vehicle in Europe is drifting upwards, which reflects the introduction of an increased number of larger vehicles onto the market. At the same time, the average driving range of a purely electric vehicle in Europe increased sharply, from 170 km in 2013 to over 300 km in 2017. Electric vehicle prices therefore reflect not only cost reductions due to economies of scale and battery prices, but also performance improvements. However, the long-term price trend is expected to decline: the Renault Zoe and Nissan Leaf are 25% and 33% cheaper than they were in 2012, despite improved battery capacity.

Battery performance is expected to continue to improve, with concurrent declines in costs. An EV has around 1 000 times the battery capacity of a laptop, and electric vehicles were likely to overtake consumer electronics as the largest market for lithium-ion batteries in 2017. Thanks largely to demand in China, electric buses, which have battery sizes ten times those of electric cars, and electric two-wheelers are not far behind. As the cost of the battery is the main determinant of the price of an EV, the uptake of EVs and their impact on oil demand will be strongly influenced by developments in the lithium-ion value chain, which is characterised by high uncertainty. Companies involved in the EV value chain face critical decisions about technology and timing. Suppliers of lithium and cobalt need to make projections about future commodity prices based on projections of EV demand and cathode chemistry. Vehicle makers, whose assets are mainly geared to producing ICE-powered vehicles, face a range of strategic decisions that influence the best timing to invest in EV production.

Policymakers have a role to play in providing regulatory certainty over future EV demand, sustainability requirements for raw materials and recycling policies. Some countries, especially in Europe, are keen to attract investment in particular parts of the EV value chain and appear willing to accept some of the risks associated with supply bottlenecks. Experience with mass production of solar PV has demonstrated some of the risks for higher-cost suppliers, but batteries may offer more opportunities for differentiating technology, leading innovation and integrating elements along the value chain. Yet this could slow the development of highly standardised low-cost manufacturing of battery packs and hold back cost reductions.

<sup>5</sup> France, Ireland, Netherlands, Norway, Slovenia, Sri Lanka, Sweden, United Kingdom. In the cases of Sri Lanka and Sweden, the targets are for car fleets without ICEs, equating to *de facto* sales bans.

## Transport

**The transport sector, which remains almost entirely fossil-based, is one of the central areas for increasing energy efficiency and reducing GHG emissions.** Nevertheless, it has shown limited progress in reducing GHG emissions because it relies heavily on the use of conventionally fuelled private cars, which need to be replaced by other transportation modes. For example, urban mass transit systems and infrastructure to shift freight from road to rail are beneficial transport investments for climate mitigation. They reduce both CO<sub>2</sub> emissions per passenger kilometre, or per metric tonne-kilometre, and the reliance on fossil fuels. In this context, all investments in inland waterways and all rail infrastructure investments count as CCM.

**EU investment in rail and inland waterways was estimated at EUR 47.1 billion in 2017, equivalent to 1.5% of gross fixed capital formation.** This is a significant contributor (24%) to total mitigation investments (Figure 6). Even so, it is probably an underestimate because it does not include all transport mitigation projects. Transport integration and city planning, transport demand management and intermodal terminals also have CCM impacts.

## Agriculture, forestry and land use

**The land-use and forestry sector is a crucial pillar of the EU's 2030 climate and energy framework, alongside the Emissions Trading System and the Effort Sharing Regulation.** However, until recently GHG emissions and removal from land use, land-use change and forestry (LULUCF)<sup>6</sup> were not part of the 2020 climate strategy. This changed in July 2016, when the EC proposed a regulation concerning their inclusion in the EU 2030 climate and energy framework, after the decision of the European Council in October 2014. The new regulation, which is aligned with the UNFCCC "land-based" reporting framework, requires Member States to balance emissions and removal from the land-use sector over two five-year periods between 2021 and 2030 and allows for certain flexibilities. Its overall aim is to simplify and adapt the current accounting methodology under the Kyoto Protocol.

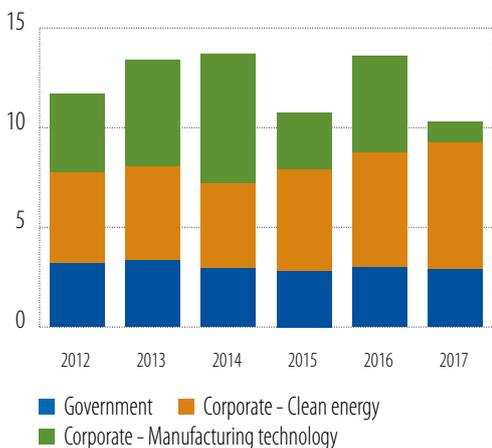
**Investments in LULUCF have increased steadily since 2007 in the EU, in response to the urgent need for GHG emission mitigation.** The overall amount reached its highest level in 2011, at EUR 3.6 billion, and then stabilised at around EUR 3 billion per year. This represents on average 0.11% of EU gross fixed capital formation. Almost 70% of EU land use, land-use change, and forestry spending is concentrated in five countries: Sweden accounted for 25%; 15% went to Finland; and the remaining 30% was evenly distributed between Germany, Poland, and France.

## Research and development

**Investments in climate-related technologies research and development (R&D) varied greatly between 2012 and 2017.** They reached a peak of EUR 13.7 billion in 2014 and then dropped to EUR 10.3 billion, their lowest level since 2012 (Figure 7). This variation is driven mainly by the cut of corporate investments, as government investments remained almost stable. The share of R&D investments in climate-related technologies in the total EU was relatively low, representing only 3.8%. However, the share of spending in climate-related R&D in the EU is similar to the US (3.1%) and higher than in China (1.7%) and Japan (1.1%). Climate-related R&D investments are one of the five headline targets of the EU 2020 strategy, based on which the EU should reach an overall R&D investment intensity (as a % of GDP) of 3% by 2020 for all five targets.

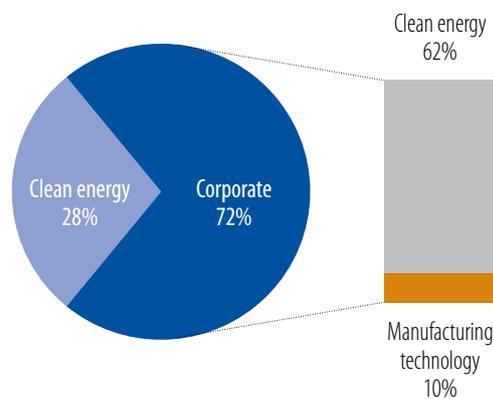
<sup>6</sup> The land-use sector (managed cropland, forestry, etc.) can be responsible for GHG emissions (for example, from deforestation or draining of wetlands) as well as removals of GHG from the atmosphere (notably CO<sub>2</sub>, which is absorbed by plant growth and agricultural soil management). Harvested wood products can be a store of carbon (for example, when used as building materials), but can also cause GHG emissions (for example, when burned as biomass for energy).

**Figure 7**  
**Evolution of EU28 climate-related R&D investments (EUR billion)**



Source: Bloomberg new energy finance (BNEF), EIB estimates.

**Figure 8**  
**Allocation of EU28 climate-related R&D investments, 2017 (% in total)**



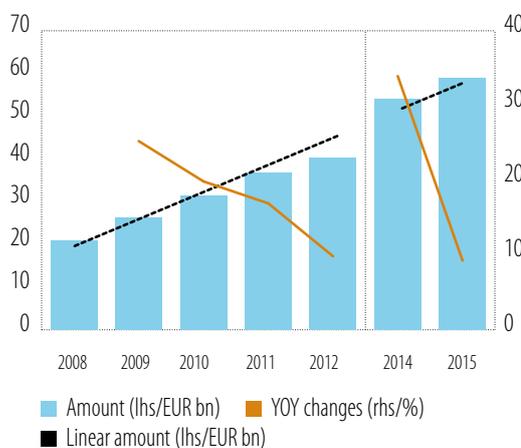
Source: BNEF, author's estimates.

**The corporate sector is the largest source of climate-related R&D funding in the EU.** Corporate spending accounted for 72% of the total in 2017 and amounted to EUR 7.4 billion – more than twice government spending (Figure 8). Corporate investment in climate-related technologies concerns research into clean energy technologies and energy-efficiency improvements – hence lower emissions – by companies in the automotive, chemical and other manufacturing sectors. In 2017, corporate spending in clean energy, representing almost 86% of corporate R&D spending, increased by 10% despite falling investment in solar and wind R&D. It seems that the increased R&D in manufacturing sectors, including automotive technology, outweighed the declining trends in solar and wind R&D activities and contributed to the overall increase. By contrast, government spending in 2017 dropped by almost 3%.

## Determinants of climate change mitigation investments

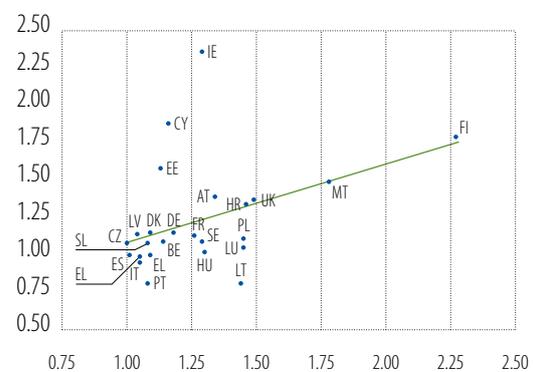
**Investment conditions in CCM technologies have changed considerably in recent years.** The recent economic downturn, the declining returns in the sector, the lack of effective market mechanisms, regulatory failures, low fossil fuel price and technological developments have created a less predictable and stable framework and sent mixed signals to existing and future investors. Though the impact of these factors varies significantly among types of clean energy investments and investors, as well as between the EU Member States, some general conclusions can be drawn based on their relative importance for the different clean energy opportunities.

**Figure 9**  
**Evolution of EU28 renewable support scheme cost**



Source: ECOFYS, CEER, ECFIN.  
Note: Data sources for years 2008–12 were ECOFYS and ECFIN, and for 2014–15 was CEER. This is why an increase is observed between 2012 and 2013.

**Figure 10**  
**Scatter plot of changes in capacity and in RES support schemes**



Source: Eurostat, CEER.

**Retroactive measures on support schemes have negatively affected past investments' profitability and possibly discouraged new investments in renewables.** The main role of public incentives, such as support schemes, is to reduce the risk associated with clean energy investment decisions, by providing a stable framework and decreasing market uncertainty. However, several factors have forced policymakers to reevaluate their subsidy regimes by scaling back incentives<sup>7</sup>: the financial crisis, other budgetary constraints and both electricity tariff deficits (European Commission, 2014) and increasing electricity prices due to rising renewable levies (Figure 9). This led to a reduction in the growth rate of support scheme costs, the amount of which reached EUR 59 billion in 2015, and in the growth of new additions in installed capacity probably due to the changing regulatory environment (Figure 10).

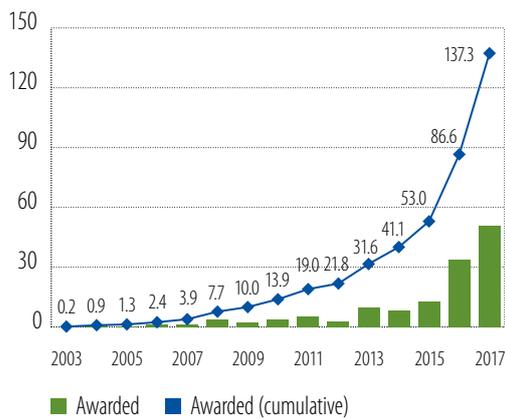
**The rising concerns about support scheme<sup>8</sup> costs led many EU countries to switch to auctions as a means of allocating renewable energy capacity.** This was also partly a response to the updated European State Aid Guidelines and to the general aim to increase the market integration of renewables. As some clean energy technologies such as onshore wind and solar photovoltaic have matured, auctions have been a better instrument than regulatory processes to reveal the real cost of technologies. Though the

7 In Spain an annual cap was imposed on the number of hours that PV projects could sell electricity at the feed-in tariff (FiT); in Greece and Portugal financial support for renewable producers was reduced by the additional financial taxes imposed to compensate for the high FiT rates; and in Italy large solar producers were forced to accept a reduced FiT with the possibility of extending their pre-agreed remuneration period. Retroactive measures were also taken in the Czech Republic, Romania, and Bulgaria.

8 For more information on the national support schemes by RES technologies per EU Member State see Council of European Energy Regulators (2017).

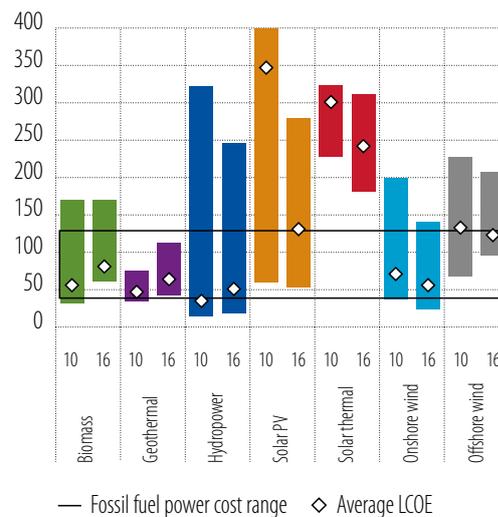
details of the auctions and their outcomes vary across countries, there is no doubt that auctions have been more flexible than the administrative procedures and more successful in driving down costs<sup>9</sup> (Figure 11 and Figure 12). Notwithstanding these cost benefits, it is too early to tell how much investment will eventually be delivered, because of the short period the successful bidders have to realise their projects.

**Figure 11**  
Global auctioned renewables capacity, 2013-17 (GW)



Source: Bloomberg new energy finance (BNEF).

**Figure 12**  
Evolution of unit cost of electricity over the lifetime of the generating asset (LCOE)<sup>10</sup> for low-carbon technologies (USD 2016)



Source: IRENA.

**Existing market mechanisms in the EU electricity sector have been unsuccessful in providing the right signals for clean energy investment.** In particular, the ETS has failed to deliver a sufficient carbon price to drive the adoption of renewables and energy-efficiency measures: the price of carbon declined from about EUR 30 per tonne in 2008 to EUR 5 per tonne in 2014, well below the 2020 target price of EUR 25 per tonne, in the EC’s impact assessment analysis (European Commission, 2016b,c). This decline was driven by the penetration of renewables, which reduced the demand for EU carbon allowances, together with technology developments and the economic crisis. Only after the last quarter of 2017 did the carbon price start to pick up, and in September 2018 it exceeded EUR 20 per tonne; this rise came in response to the EU measures to reduce the permanent oversupply on the carbon market experienced in the last few years (Market Stability Reserve).

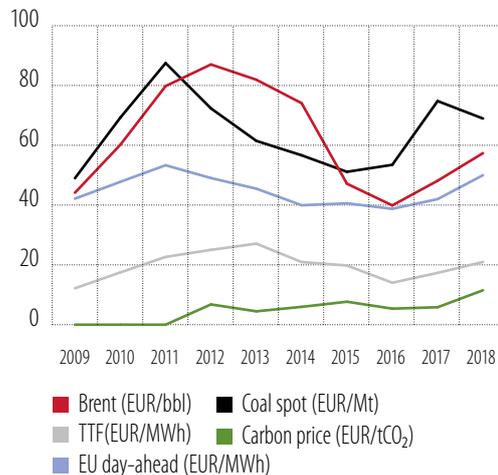
Similarly, the increasing penetration of renewables into the European electricity markets has lowered wholesale prices and raised some concerns about the alignment of the current market design and the objectives of the low-carbon transition. “Energy-only”<sup>11</sup> markets appear to provide few incentives for investments in low-carbon technologies in the absence of a strong carbon price signal or support schemes, due to the high upfront capital costs. Current wholesale prices are around EUR 50/MWh (Figure 13), which is sufficient to ensure full cost recovery for some, but not for most clean energy technologies (Figure 12).

<sup>9</sup> The latest data from renewables’ auctioned capacity in September 2017 indicate that winning bids per MWh have been as low as EUR 38 per MWh for offshore wind in Germany, down by 11% compared with last year’s auctions. Similarly, in the Netherlands’ offshore wind auction in December 2017, a 700 MW project resulted in several bids without any subsidy at all; and in the UK auction in September 2017, winning bidders agreed to build 3 MW offshore wind farms at GBP 57.50 per MWh, at a discount of 50% compared with the first Contract-for-Difference auctions in early 2015.

<sup>10</sup> All costs are in 2016 USD. The weighted average cost of capital is 7.5% for OECD and China and 10% for rest of world. Preliminary data for 2016. LCOE stands for levelised cost of electricity.

<sup>11</sup> An energy-only market relies solely on the price signals from the day-ahead (wholesale) market.

**Figure 13**  
Evolution of energy commodity and carbon prices



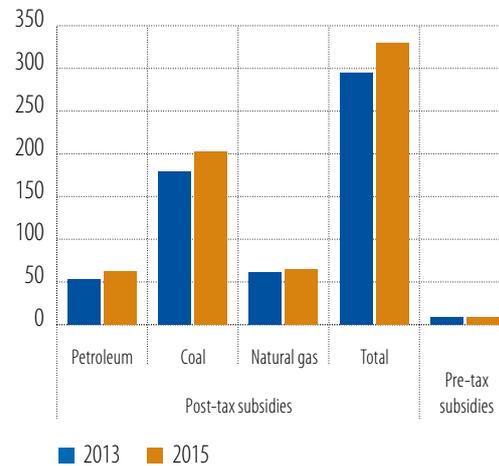
Source: Bloomberg.

**Low fossil fuel prices and the capacity overbuild in some EU countries make investment conditions challenging for renewable energy and energy efficiency.** By January 2015, oil prices had dropped below USD 45 per barrel (bbl) from their peak of USD 115/bbl in June 2014 and only after 2016 did they start picking up again, reaching USD 60/bbl (Figure 13). Gas prices followed oil prices downwards in EU gas markets, despite the decline of oil indexation in long-term gas supply contracts. Coal prices also declined from EUR 87/MT in 2011 to EUR 51/MT in 2015, as the US produced more shale gas and Chinese demand for coal imports fell. Consequently, investment projects that reduce energy consumption or substitute for fossil fuels became less profitable than conventional investments and more difficult to finance than they would otherwise have been.

Furthermore, with plentiful capacity in electricity generation and low growth or declining electricity demand in many EU countries, the incentives for investment in renewables are low. For example, between 2010 and 2015, EU generation capacity in renewables increased by 130 GW, and in conventional generation by 78 GW, while electricity demand remained flat and only 44 GW of conventional generation was retired.<sup>12</sup> These factors limit the space for new additions in renewables and have challenged their investments.

**The continued subsidies allocated to fossil fuels have hindered investment in clean energy technologies, especially in the current environment of low fossil fuel prices.** Both direct and indirect fossil fuel subsidies (e.g. tax expenditures) affect the differences between fossil fuel and clean energy projects' profitability, and thus investment decisions. Globally, subsidies for fossil fuels and nuclear power have continued to exceed those for renewable technologies. Prices of fossil fuels are not representative of their true cost (including global warming and other externality costs), which means clean energy technologies are entering an unequal playing field. According to IMF<sup>13</sup> estimates, pre-tax and post-tax subsidies in 2015 amounted to USD 8.64 billion and USD 330 billion (Figure 14), up by 1% and 12%, respectively, from 2013. To that end, fossil fuel subsidies have not only constrained the growth of renewable energy production – which enjoys fewer subsidies (if one takes into account the avoided fuel cost) – but also diverted capital from more productive activities, such as energy-efficiency measures.

**Figure 14**  
Evolution of pre- and post-tax fossil fuel subsidies (USD billion)



<sup>12</sup> The retirement of conventional generation capacity raises some concerns about the affordability of future electricity prices, as governments seek to find ways to compensate these electricity producers for their losses by passing the extra cost onto consumers.

<sup>13</sup> Coady et al. (2015).

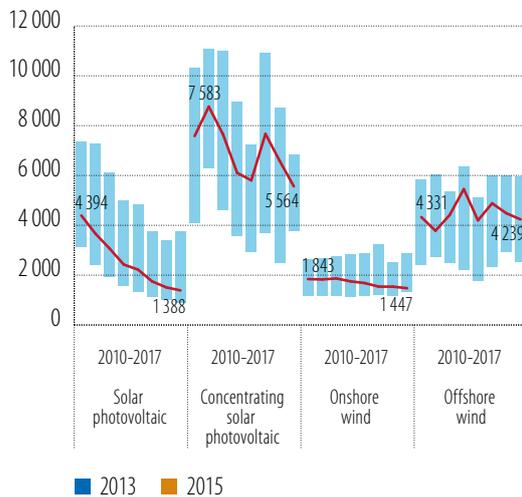
**Investors often consider narrow cost parameters and profitability indicators and miss the big picture that long-term energy investment opportunities offer.** This creates a gap between the long-term plans to move towards a low-carbon economy and society's willingness to pay for this transition. The reason is that investors look at a range of possible returns across multiple sectorial projects before deciding whether to proceed with an investment in clean energy technologies, and also require a higher rate of return compared with alternative investments due to significant upfront costs (Ecofys, 2016). In parallel, they have a short-term view and assess investment opportunities without taking into account the negative possible consequences of the lack of clean investments on climate, security of supply and economic growth potential. This financial appraisal affects less mature technologies more. In this respect, the potential for renewable deployment and energy-efficiency improvements has remained untapped due to falling returns on investments in the renewable sector, in part because of the scaling back of subsidies – returns declined by four percentage points from 2001 to 2013 (World Economic Forum, 2015) – and due to low short-term cost energy-efficiency benefits as a result of low fossil fuel prices.

**While progress in investment in CCM has been slow, the EU has taken several steps to fill the gaps between the targets set out for 2030 and the current policies.** Several measures have been adopted to raise energy performance standards and improve consumer awareness: the Ecodesign Directive, the Energy Efficiency Directive and the Energy Performance of Buildings Directive. Under the Ecodesign Directive, the proportion of appliances covered by energy-efficiency standards increased to 73% in 2015 from only 4% in 2000. Improved energy labelling is also having an impact. The Energy Performance of Buildings Directive requires all new buildings to be nearly zero-energy by the end of 2020. Approximately EUR 12.5 billion was invested in this class of buildings in 2015. In parallel, a new legislative package soon to be adopted will address the general overhaul of existing EU energy legislation and provide more clarity and stability for investors. All these measures contribute positively to investments in clean energy technologies.

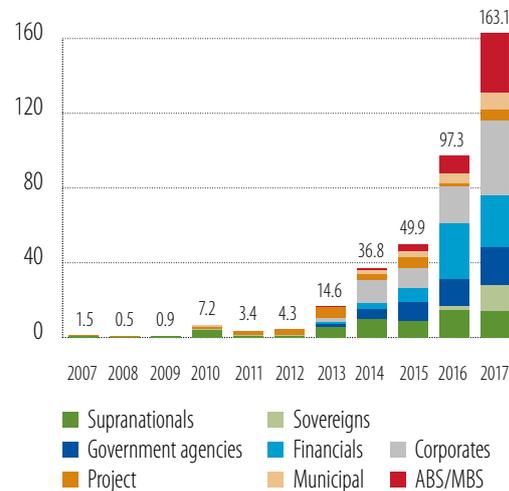
**Among the clean energy technologies, hydropower, solar photovoltaic and onshore wind have become more mature and increasingly ready to be deployed commercially now that their costs have reduced significantly.** This is less the case for biomass and geothermal. Particularly impressive has been the decline in solar PV capital cost (Figure 15), which makes it increasingly competitive at the utility scale. Onshore wind has remained one of the most competitive sources of new generation capacity, as its capital cost of electricity was as low as USD 56 per MWh in 2017 thanks to significant capital cost reductions. From the most mature technologies, hydropower plants have presented also a low levelised cost at USD 51 per MWh. Factors such as economies of scale, improvements in technology and manufacturing and excess manufacturing capacity in wind and (especially) solar have led to a drop in the capital (technology) cost per megawatt (MW) for renewable technologies. These developments have incentivised the power generation sector to shift to low-cost renewables despite some unfavourable conditions in the investment landscape.

**The increase in demand for clean energy investments has attracted new financiers and strategic investors to supply capital for companies looking to overcome financing challenges.** Multilateral development banks have entered the green market and provided finance for green investments that would not have been financed otherwise due to market failures. An increasing number of non-traditional investors are interested in clean energy investment opportunities, including individuals, venture capital, insurance companies and sovereign wealth funds. In parallel, financial instruments such as green bonds have helped to mobilise resources from capital markets for climate change adaptation, renewables and other environment-friendly projects. In 2017, USD 7.3 billion (Figure 16) was raised from project bonds that financed directly renewable projects, and USD 155.8 billion from other types of green bonds was used to provide indirect support for all clean energy technologies (renewables, energy efficiency, emission reduction, water use, etc.). While these developments are small in size, they have helped companies to face their financing challenges and get their projects off the ground.

**Figure 15**  
**Evolution of renewables total installed costs**  
(2016 USD/kW)



**Figure 16**  
**Total green bond issuance by category**<sup>14</sup>  
(2007–17, USD billion)



Source: Bloomberg New Energy Finance.

## The role of energy audits in promoting energy-efficiency investments

This section assesses the impact of energy audits on firms' energy-efficiency investment. The financing gap in Europe for reaching the EU 2030 targets is considerably wider in energy-efficiency measures than in any other type of CCM investment. The Energy Service Directive (ESD) and later the Energy Efficiency Directive (EED) advocated energy audits as an essential tool to overcome information barriers to energy efficiency and to facilitate firms' implementation of energy-efficiency measures. Findings from the literature (Basurko et al., 2013; Petek et al., 2016; Moya et al., 2016) indicate that energy audits proved to be one of the most effective measures used to diagnose, analyse and improve energy use in the industrial and building sectors. Other reports go a step further, suggesting governments subsidise energy audit programmes for companies as a policy to overcome the energy-efficiency gap (Bertoldi, 2001) and to mitigate CO<sub>2</sub> emissions, even though there might be some free-riding issues (Thollander et al., 2007; Fleiter et al., 2012a,b).

<sup>14</sup> SSA stands for supranational, sovereign and agency; ABS stands for asset-backed securities; MBS stands for mortgage-backed securities.

### Box B

#### Energy audits' scope, EU legislation and instruments for their deployment

Energy audits<sup>15</sup> have been advocated as an essential tool to overcome the information gap that is one of the main barriers to energy-efficiency investment. The EC addressed energy audits initially with Article 12 of the Energy Service Directive (ESD 2006/32/EC) and later in 2012 with Article 8 of the Energy Efficiency Directive (EED 2012/27/EC). The latter directive requires Member States to promote

<sup>15</sup> According to Article 8 of the EED, an "energy audit" means a systematic procedure to obtain adequate knowledge of the energy consumption profile of a building or group of buildings, an industrial or commercial operation or installation or a private or public service, identifying and quantifying cost-effective energy saving opportunities, and reporting the findings (see corresponding definition in Article 2(25)).

the availability of high-quality energy audits<sup>16</sup> to all final energy customers. Only larger<sup>17</sup> firms had to conclude an energy audit at least once every four years (by 5 December 2015)<sup>18</sup>, whereas for SMEs this is not mandatory; SMEs are only encouraged to undertake an energy audit and implement the resulting recommendations through various instruments.

Four types of instruments (*regulatory, voluntary, financial and information*) are established by Member States to promote the implementation of energy audits. While their aim is the same – to achieve the energy policy objectives by increasing energy efficiency – their approach differs. For example, the regulatory instruments concern organisational and technological requirements, imposed mainly on large firms. The voluntary agreements – sometimes not *entirely* voluntary (non-compliance will result in penalties ranging from EUR 10 000 in Austria to EUR 200 000 in Romania) – are between the public authorities and private entities. The financial instruments are subsidies, tax incentives, price supports or equivalent mechanisms provided by public authorities to firms, regardless of their size. Similarly, the information instruments provide information on the energy demand of these firms and on opportunities to improve their energy efficiency (via campaigns, blogs, seminars, etc.).

The comparison of these instruments is challenging in terms of effectiveness and cost savings. Generally, voluntary programmes are considered to be the least effective tools due to the absence of clear price or regulatory signals to push changes in corporate action or to stimulate demand for cleaner technologies (Tsvetanov and Segerson, 2013). They can complement more popular instruments, such as investment-based incentives (tax breaks, subsidies and loans) and mandatory programmes, when the latter take some time to enact (Gillingham et al., 2008). In terms of cost savings, the efficiency of each programme varies greatly depending on the detailed policy arrangement and the heterogeneity between firms (Anthoff and Hahn, 2010). The mandatory regulations are the least flexible instruments, but they do not ensure cost-effectiveness for firms. Unlike previous policy instruments, the information and technology programmes tackle the externalities in technological change and behavioural barriers indirectly, by promoting innovation, diffusion and adoption of energy-saving technologies.

The choice of instruments for promoting energy audits in SMEs varies across Member States. Austria, Bulgaria, Croatia, Denmark, France, Germany, Hungary, Italy, Luxembourg, Malta, Poland, Portugal, Slovakia, Spain and Sweden prefer financial instruments as a way to promote energy management systems in SMEs. Regulatory instruments appear to be the second option for most Member States (Bulgaria, Croatia, Czech Republic, Ireland, Italy, Luxembourg, Portugal, Romania and Slovenia), followed by voluntary agreements (Bulgaria, Denmark, Finland, Netherlands and the UK). In contrast, information instruments attracted little attention, as at the end of 2015 only Denmark, Germany, Slovakia and Sweden adopted this tool as a means to promote energy audits in SMEs.

16 Usually energy audits are classified into three types: the walk through audit, the standard audit and the computer simulation audit (Thumann and Younger, 2009).

17 Any company that is not an SME is considered as a large enterprise pursuant to Article 2(26) of the EED and Commission Recommendation 2003/361/EC. There are three basic criteria for the delimitation of SMEs and large companies: the number of employees, turnover and balance sheet total. However, differences can be observed across Member States (COM 2016).

18 The only countries that were still in the process of transposing the requirements into their primary legislation after 2015 were Belgium (Brussels, Wallonia), Cyprus, Estonia, Latvia, Lithuania, Luxembourg, Poland, Spain and Greece.

## State of play of energy audit implementation based on EIBIS

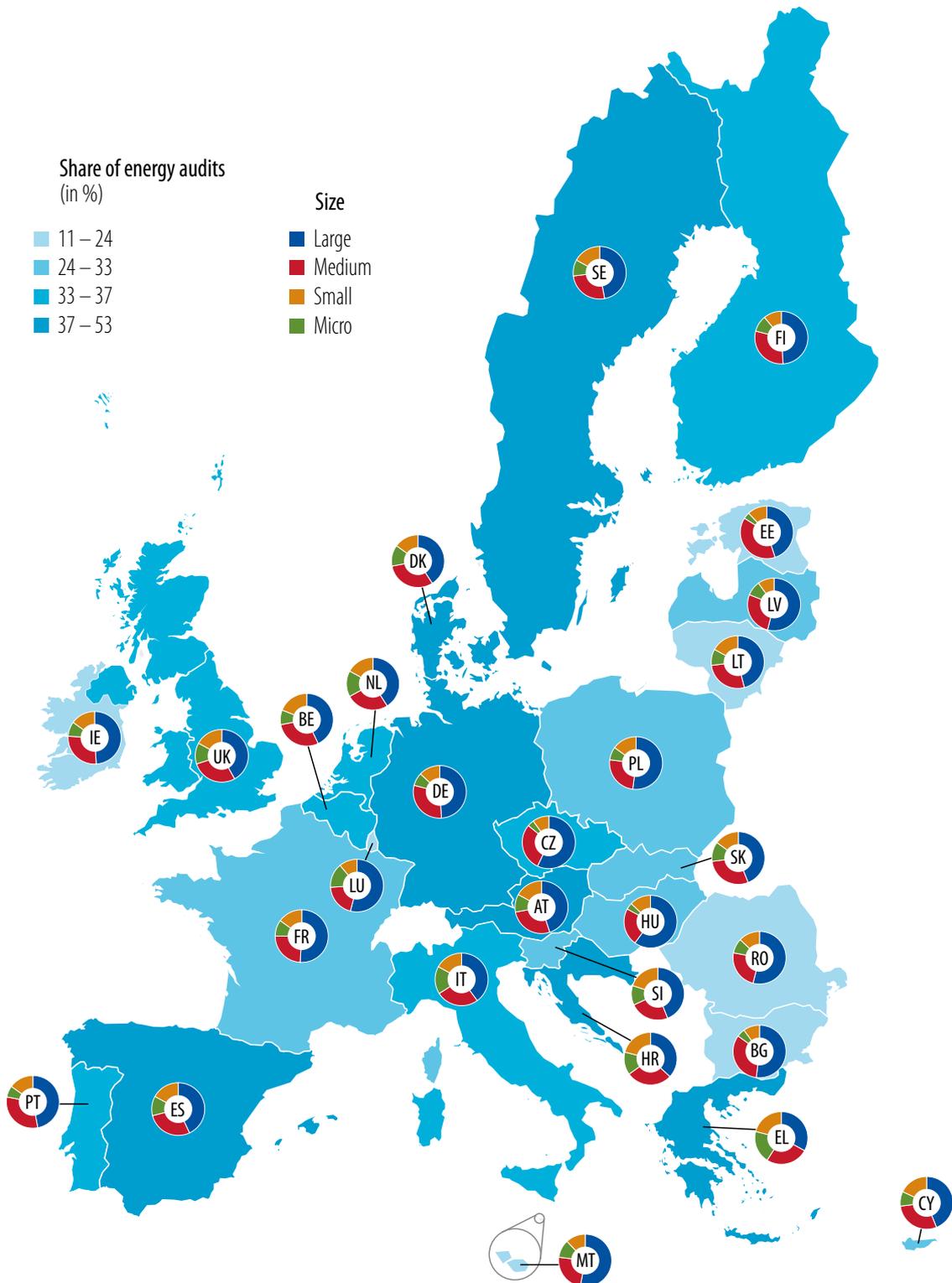
**Data from the annual EIB Investment Survey (EIBIS) for 2017 and 2018 show that there are large differences in the energy audit participation rate across EU countries.** In both surveys, Croatia had the highest participation rate in large firms and SMEs, a large difference from most EU countries. Its level accounted for 53%, almost five times higher than the implementation share in Estonia (11%), which had the lowest participation rate in Europe. Most countries were evenly distributed around the average EU participation rate of 30%. Western European countries ranked above the EU average, while southern European countries and countries from the Baltics are placed below it (Figure 17 and Figure 18).

**There are even greater differences in the energy audit participation rate versus firm size.** As expected, larger firms present higher average participation rates (64%), given that energy audits are mandatory for these firms, except where they can be substituted by energy management<sup>19</sup> systems. Firms in the UK, Spain, France, Belgium, Germany, Denmark, Sweden, Finland and Romania have the possibility of an energy management system. In SMEs the average participation rate increases with the size of firms, ranging from low (15%; micro firms) to almost 40% (medium-sized firms). Finally, greater dispersion is observed in larger firms, where the average gap between the countries with the highest and the lowest participation rate is more than 55%. By contrast, for micro, small and medium-sized firms this dispersion is close to 40%.

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<sup>19</sup> The implementation of an energy management system starts with an energy audit, but afterwards there is no need to conclude an energy audit every four years because the energy management system continuously monitors the energy consumption profile.

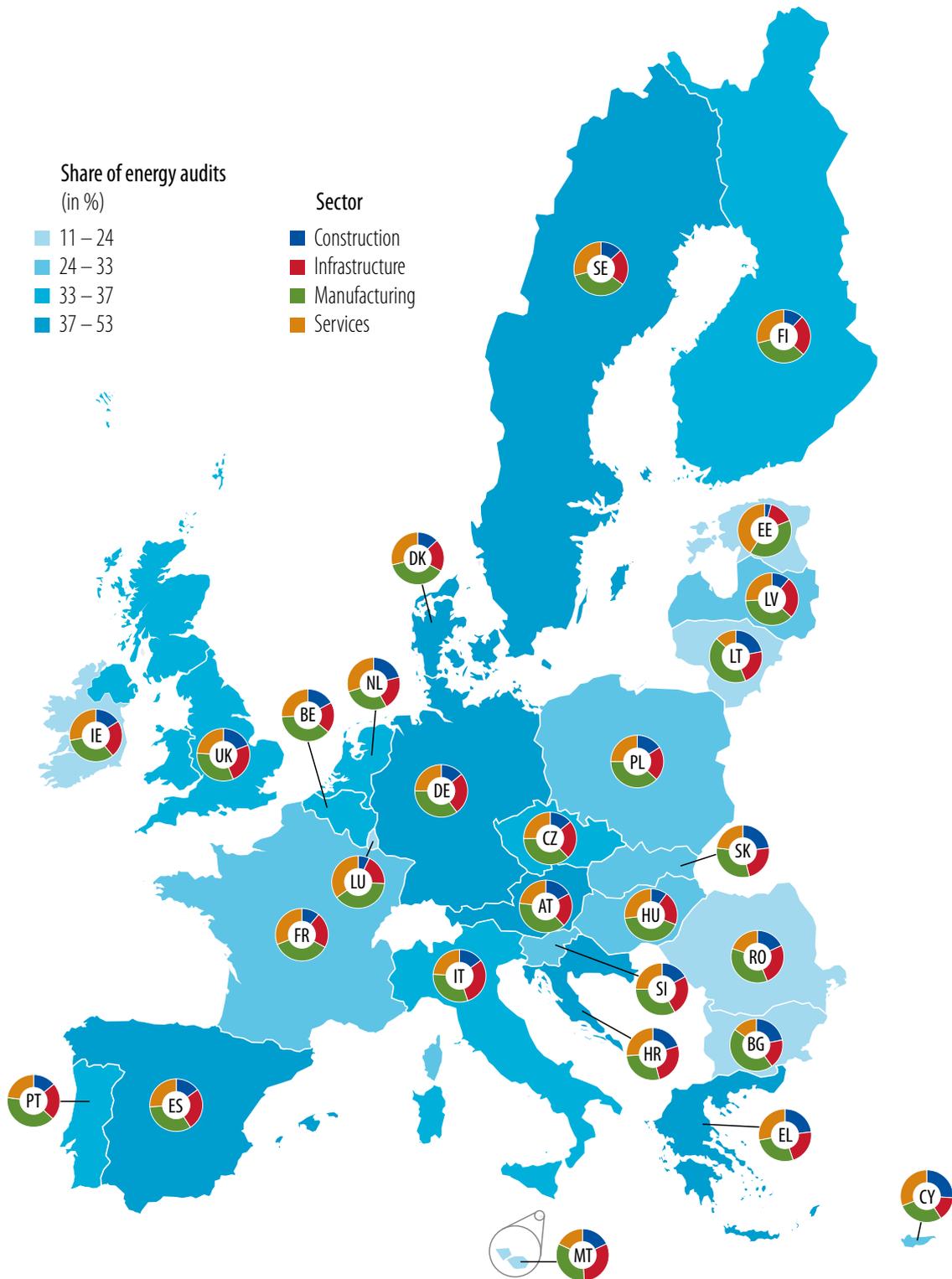
**Figure 17**  
**Share of energy audits per size of firm**



Source: EIBIS 18.

Note: The participation rate per group of firms according to sector and size was normalised in order for the sum to equal to 100%.

**Figure 18**  
**Share of energy audits per sector**

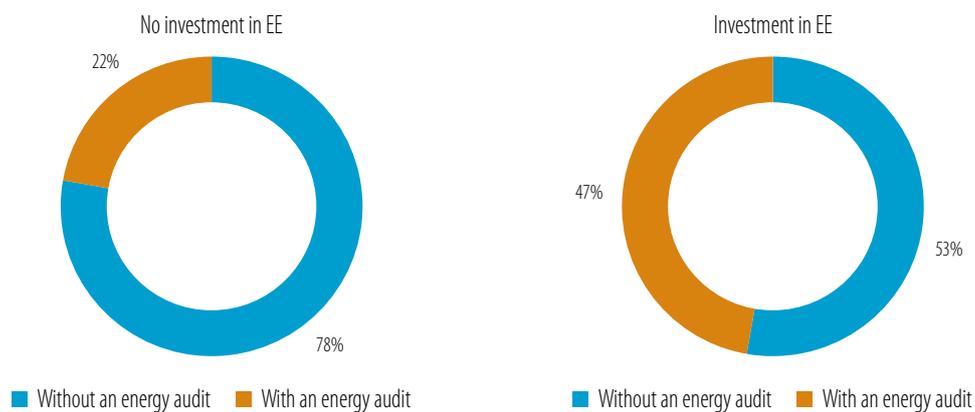


Source: EIBIS 18.

Note: The participation rate per group of firms according to sector and size was normalised in order for the sum to equal to 100%.

**Differences in the participation rate still exist when one considers the sectorial dimension.** According to the EIBIS 2017 and 2018, audit participation rates are higher in the manufacturing sector (42%), which is more energy-intensive than any other economic sector. The services and infrastructure sectors follow, with 31% and 28%, whereas the construction sector is substantially far behind, with 20%. These average shares might also be driven by the size of the firms included in each sector. For instance, the construction sector sample includes the smallest share of large firms and the largest share of small firms.

**Figure 19**  
**Interaction between energy audits and investment decisions in energy-efficiency measures**



Source: Author's calculations based on the EIBIS 18.

Note: Investment decision is a dummy variable that takes a value of 1 when firms surveyed have invested in energy-efficiency improvements and 0 otherwise, based on information from the EIBIS 18.

**The EIBIS 2018 indicates that firms with an energy audit are keener to go ahead with measures for energy-efficiency improvements.** Almost half of the firms surveyed in 2018 that had an energy audit invested in energy-efficiency measures, and only one-fifth did not invest at all (Figure 19). However, these statistics should be treated with caution, given that the implementation of energy audits from firms was not allocated randomly in the sample. For these reasons, in the following subsections, we give the results of our analysis<sup>20</sup> to identify the causal relationship between energy audits and investments in energy-efficiency improvements by reducing the selection bias.

## Determinants for conducting an energy audit

**The empirical results confirm that decisions to conclude an energy audit are driven by firm characteristics, market conditions and national policies for corporates.**<sup>21</sup> Firm size, which has been the most commonly researched parameter (Aramyan et al., 2007; Schleich 2009; Trianni et al., 2013) is the most important factor in this process based on the dominance<sup>22</sup> analysis (Figure 21). In particular, the coefficient of size indicates that, as size increases, the propensity to conclude an energy audit increases (size effect). Factors such as regulations for large firms and a high share of energy cost in the production function could be primary drivers of these decisions.

**Sectoral differences are highly significant in determining whether a firm conducts an energy audit.** Firms operating in the manufacturing and services sectors are more likely to conduct an energy audit than those in the infrastructure and construction sectors, based on their estimated coefficients (the benchmark

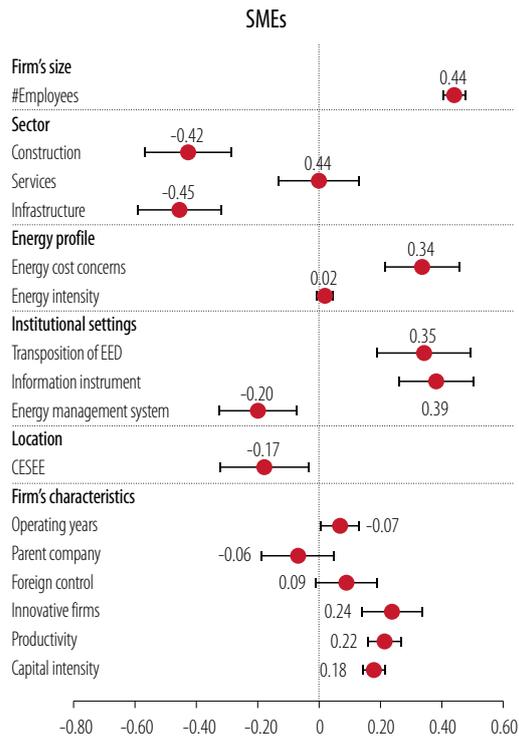
<sup>20</sup> Information on the data and the estimation methodology can be found in the Annex.

<sup>21</sup> Several variables that influence energy audit decisions according to the existing literature, such as internationalisation, financial constraints, regulations, etc., were excluded from the econometric analysis because they were statistically insignificant.

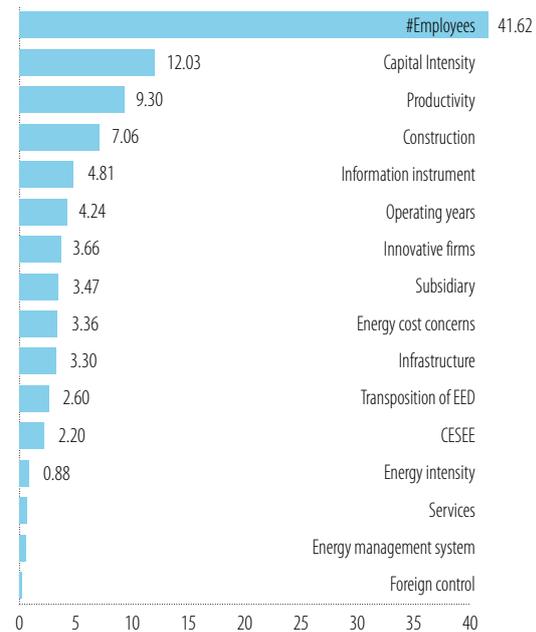
<sup>22</sup> Results are presented in the Annex.

is the manufacturing sector). This result confirms previous empirical findings for many countries (Busom, 2003; Arvanitis et al., 2002; Almus and Czarnitzki, 2003; Czarnitzki et al., 2002), which indicate that certain sectors, most prominently energy-intensive ones, are willing to identify energy service opportunities.

**Figure 20**  
Estimated coefficients of audit's participation<sup>a</sup>



**Figure 21**  
Dominance<sup>b</sup> analysis of estimated coefficients (%)



Source: Author's calculations.

- Note: a Presentation of statistically significant coefficients; the intersection of the horizontal line with the vertical line indicates that the coefficient is not statistically significant at the 99% confidence interval.  
 b Ranking of estimated coefficients based on standardised weights, which are the general dominance weight from McFadden  $R^{233}$  normed or standardised to be out of 100%.

**Higher energy costs, productivity and capital intensity appear to be additional determining factors in energy audit participation.** The analysis includes two variables to capture the energy cost effect: expectations about higher energy prices and energy intensity present positive coefficients. Similarly, positive coefficients represent the degree of a firm's productivity and capital intensity. Energy audits attract more attention in an organisation when high energy prices force it to consider every possible means of cutting energy costs to stay competitive. Regardless of the magnitude of the energy costs relative to the value added (VA), increased energy costs negatively affect results and competitiveness within an industry, leading to lower production and, in some cases, a decision to relocate abroad. On the other hand, increased energy efficiency positively and directly affects a company's overall costs, often leading to greater productivity that in turn increases profits (Worrell et al., 2000).

**Box C****Literature review on the role of energy audits in energy-efficiency measures**

Many studies have investigated the determinants of adopting energy-efficiency measures in households<sup>23</sup>, but industry and the tertiary sectors are less explored areas due to lack of data. Furthermore, most of the existing studies (Schleich, 2009; Schleich and Gruber, 2008; Sorrell, 2004; Thollander et al., 2007; Thollander and Ottosson, 2008; Trianni and Cagno 2013) have focused on why companies fail to adopt cost-efficient energy-efficiency measures (known as the “energy-efficiency gap” (Jaffe and Stavins, 1994a)). The most commonly cited barrier to energy efficiency relates to market failures, caused by high information costs and other transaction costs, hidden costs, financial and technological risks, capital market restrictions, split incentives, as well as organisational and behavioural constraints (Brown, 2001; Eyre, 1997; Howarth and Andersson, 1993; Jaffe and Stavins, 1994a,b; Sorrell et al., 2004; Stern, 1986).

Few studies have assessed the impact of energy audits as a means to overcome these information barriers. Five are the most well-known and cited, evaluating the energy audit programmes in different regions and countries: Australia, Germany, Sweden and the United States. Harris et al. (2000) assessed the impact of the Australian Energy Efficiency Action Plan (EEAP), which the Australian government had subsidised by 50%. Their findings suggest that firms decide to take almost all (80%) measures identified as cost effective by the audit, which addresses the complexity of energy-efficient investment decisions. Similarly, Anderson and Newell (2004) found that adoption rates of suggested measures by energy audits were close to 50% based on the data offered by the US Department of Energy's Industrial Assessment Center. This was also in line with the findings of Tonn and Martin (2000) for the same programme. The energy audit programmes in Germany (Schleich, 2004; Fleiter et al., 2012a; Schleich and Fleiter, 2017) and in Sweden (Thollander 2007, 2010) were also considered successful, with estimated implementation rates of 77% and 40%, respectively.

The comparison of studies is complex due to differences in the analysis. These include methodology, location, studying period, barriers, sectors and technologies considered. However, there are some common findings among the studies (Fleiter et al., 2012b). For example, from a methodological perspective, none except Schleich and Fleiter (2017) used a control group to identify the impact of the energy audit, due to data limitation. The latter study supports the notion that most of the empirical findings were based on subjective assessments of the data collected by the respective surveys. Nonetheless, all studies found a positive impact of energy audits on the adoption of energy-efficiency measures.

The empirical literature has identified certain variables that can determine the propensity to conduct an energy audit. Structural variables including size, economic sector and location seem to be important (Aramyan et al., 2007; Schleich 2009; Trianni et al., 2013), as well as firms' characteristics, such as energy intensity and energy prices (Schleich, 2004; Cooremans 2011; Velthuisen 1993; Nagesha and Balachandra, 2006). Studies have also identified relevant information such as the effort and orientation of firms in innovation (Rennings and Rammer, 2009; Horback et al., 2012), management strategy and the degree of internationalisation of the firm (Costa-Campi et al., 2015). Finally, studies based on multivariate models have considered, in addition to structural variables, aspects such as the characteristics of the market and the difficulties involved in obtaining financing for investment (Thollander et al., 2007; Fleiter et al., 2012; Trianni and Cagno 2012).

<sup>23</sup> See Sardanou (2007), Nair et al. (2010), Mills and Schleich (2012, 2014) and Astmarsson et al. (2013).

**Innovative<sup>24</sup> firms are also more likely to conduct an energy audit.** This decision might be driven not only by financial and operational objectives, but also by strong environmental concerns. Most of them include in their production function elements of energy efficiency as a means of bridging the “energy-efficiency gap”<sup>25</sup>. For innovative firms, the information provided by the energy audit plays a crucial role in overcoming the existing numerous market failures and economic, organisational and behavioural obstacles (Backlund et al., 2012), especially when the energy audit identifies measures that offer great savings, require limited capital and are financially profitable.

**The type of instruments Members States have established to promote energy audits affect the inclination to conduct an energy audit.** Results indicate that the countries that transposed the Energy Efficiency Directive (EED) requirements into their national legislation the fastest have positively influenced firms’ decisions to conduct an energy audit. Contrary to the literature, our results show that only the information instruments have a positive and statistically significant impact on energy audit decisions. Investment-based incentives, such as tax breaks, subsidies and loans and regulations have the expected sign (positive), but they are not statistically significant.<sup>26</sup> As expected, the introduction of an energy management system in some countries acts as a substitute for energy audits.

**The likelihood of energy auditing could be linked to the quality of the firm’s stock, location or ownership structure.** The decision of firms is positively associated with the age of the capital stock. To proceed with an accurate refurbishment or replacement of any type of asset, it is crucial to conduct an energy audit in order to identify the energy savings potential of feasible interventions and their related costs. The probability of an energy audit is also higher for subsidiaries of multinational firms, likely driven by the parent company’s effort to reduce costs. Finally, the results show that firms operating in the central, eastern and south-eastern European countries are less keen to conduct an energy audit.

## The estimated effects of energy audits on energy-efficiency measures

**Energy audits play a crucial role in the decision of firms to proceed with energy-efficiency improvements.** In almost all cases (across sectors and size of firms), the point estimates of the average treatment effect on the treated (ATT) generated by the matching algorithm are positive and statistically significant (Figure 22). Based on the overall sample, the odds of investing in energy-efficiency measures are 1.5 times greater for firms with an energy audit (estimated coefficient is 0.38) than the odds for those without one. This suggests that the energy audit is an effective tool for overcoming the information barriers to energy efficiency and facilitating the implementation of energy-efficiency measures in SMEs and large firms.

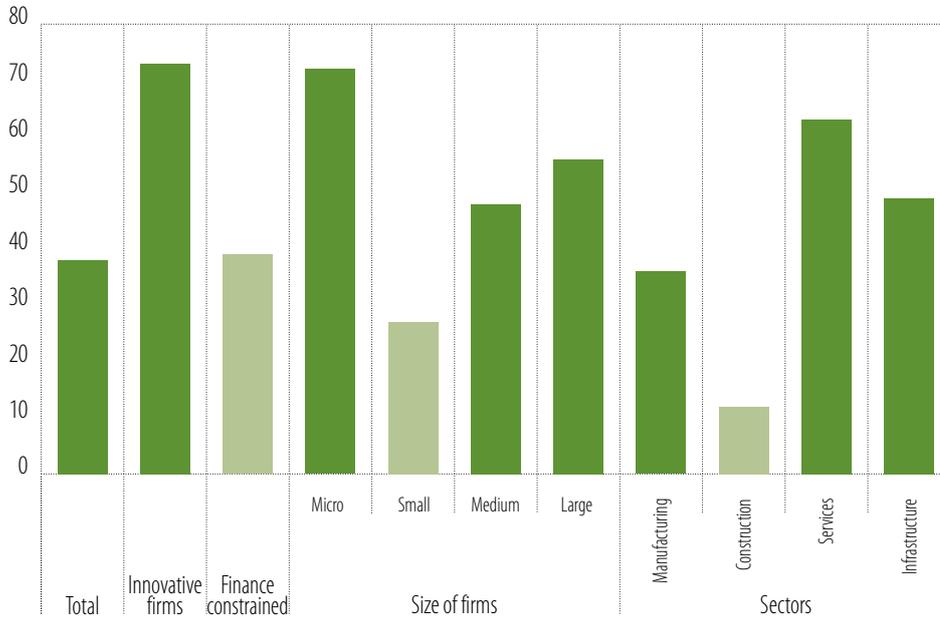
**An energy audit has a greater impact on support processes than production processes.** Given that the energy audit positively influences firms’ decisions to implement energy-efficiency measures, we investigated the impact of energy audits on the quality of buildings, machinery and equipment. The difference between the estimated effect of energy audits on the two processes ranges from 5% for innovative firms to more than 10% for medium-sized firms (Figure 23 and Figure 24). These results suggest that implementing an energy-efficient support process measure seems easier than implementing an energy-efficient production process measure. This is closely related to the discrepancy between operational and strategic actions and to the initial cost of investments. In capital-intensive sectors, capital expenditures that companies make for production purposes are substantially higher than those for support processes. In utilities, construction and manufacturing, for example, the replacement of machinery equipment costs several million euros, whereas the cost of changing the lighting as part of the adopted energy-efficiency strategy is much lower. This is why companies prefer to invest more in the support processes than the production processes.

<sup>24</sup> Innovative firms are defined as firms with substantial R&D spending (R&D spending to sales ratio is equal to or higher than 0.1%) and have introduced according to EIBIS new products, processes or services to the company.

<sup>25</sup> It is the difference between the cost-minimising level of energy efficiency and the level of energy efficiency actually realised.

<sup>26</sup> These results are not presented in the final analysis but are available upon request.

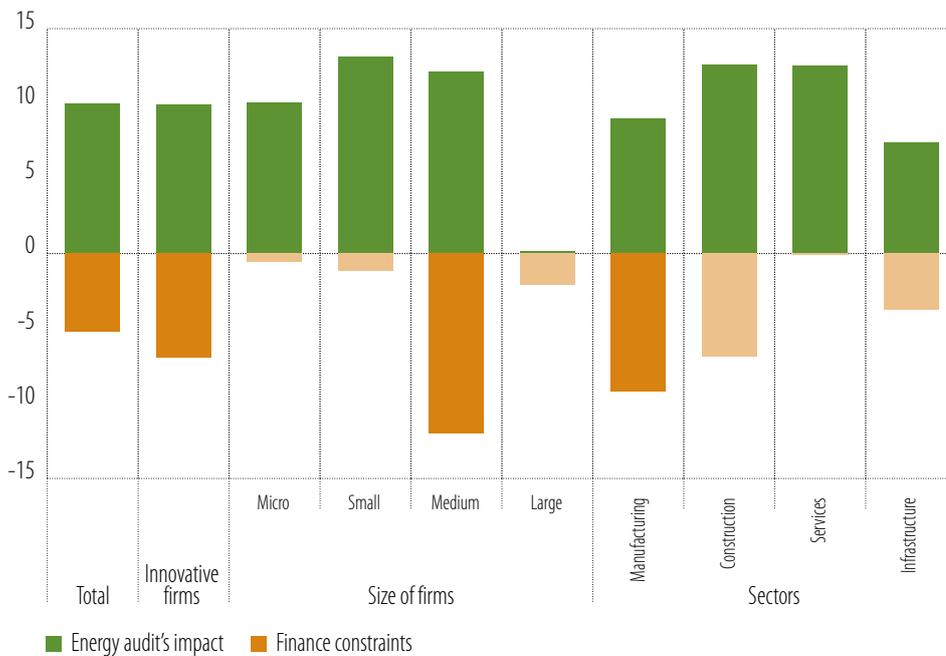
**Figure 22**  
Estimated effects of energy audits on the probability of investing in energy-efficiency improvements (%)



Source: Author's estimations.

Note: Shading indicates that the coefficient is not statistically significant at  $p < 0.1$ . Estimation results are included in the Annex.

**Figure 23**  
Estimated effects of energy audits on the quality of support processes (%)



Source: Author's estimations.

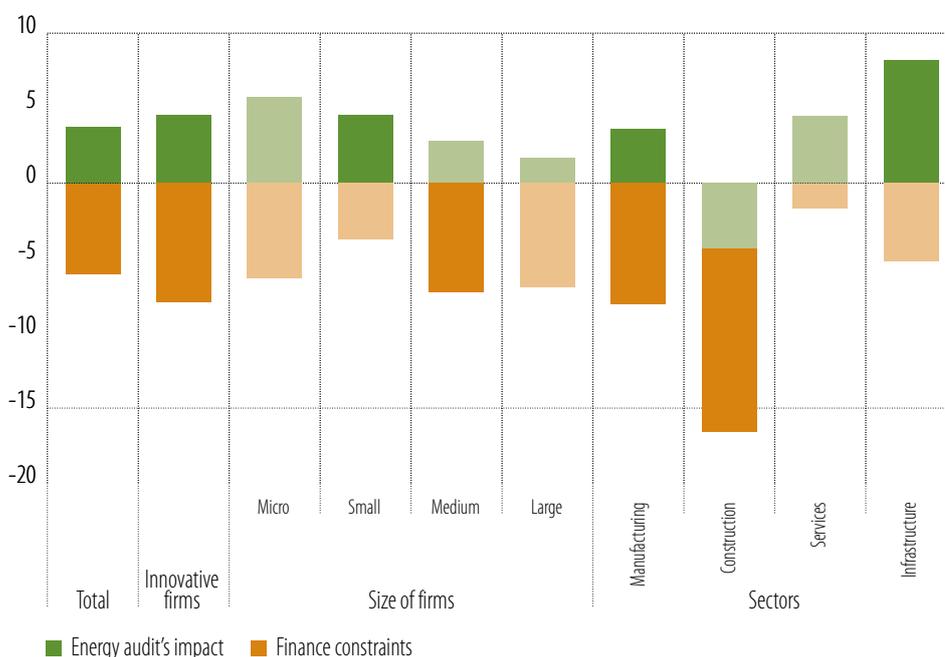
Note: Shading indicates that the coefficient is not statistically significant at  $p < 0.1$ . Estimation results are included in the Annex.

Question: What proportion, if any, of your commercial building stock satisfies high or highest energy-efficiency standards?

**Another factor in the energy-efficiency investment type is the energy intensity of the production process.** The lower the intensity, the greater the likelihood that less energy-intensive sectors, such as the construction sector, will adopt energy-efficiency measures for support processes. In non-energy-intensive firms, 70% of energy is used in support processes, compared with energy-intensive firms, where this share is less than 50%. In addition, investment in support processes, such as lighting, ventilation and compressed air production, offers great potential for energy savings (European Commission, 2006), without affecting the firm's production line. This is confirmed by most energy audit programmes, which revealed that 60–90% of the measures implemented by industrial SMEs concern support processes (Thollander et al., 2007; Fleiter et al., 2012a).

**Energy audits appear to be more beneficial for smaller firms.** The estimated effect of energy audits on the decision to invest and subsequently on the quality of buildings' energy-efficiency standards and state-of-the-art machinery and equipment is positive and statistically significant for almost all firm sizes. This impact decreases with firm size, which indicates that energy audit information is more crucial for smaller SMEs than for larger SMEs. For larger SMEs, the information asymmetry might be lower, which is why they tend to have higher adoption rates than smaller SMEs, regardless of the existence of an energy audit. There are various reasons for this: economies of scale and availability of resources could be major drivers of investment in energy-efficiency measures; resources can be either technical or financial and affect both firms' information level and transaction costs, which have been identified as major factors in organisations' decisions to adopt energy-efficient technologies (Gruber and Brand, 1991; Schleich and Gruber, 2008; Schleich, 2009; Asensio and Delmas, 2017).

**Figure 24**  
**Estimated effects of energy audits on the quality of production processes (%)**



Source: Author's estimations.

Note: Shading indicates that the coefficient is not statistically significant at  $p < 0.1$ . Estimation results are included in the Annex.

Question: What proportion, if any, of your machinery and equipment, including information and communications technology, would you say is state-of-the-art?

**Finance constraints<sup>27</sup> are an important driver of a firm's decision to invest in energy-efficiency improvements and subsequently of the quality of support and production process, for some firm sizes and sectors.** Findings suggest that finance-constrained firms that are micro-sized, innovative or belong to the manufacturing sector are associated with lower quality building energy-efficiency standards. Similarly, finance-constrained firms that are medium-sized, innovative or operate in the manufacturing or construction sector have lower state-of-the-art machinery and equipment standards. These characteristics drive the overall negative impact of financial constraints on the quality of both machinery equipment and buildings. In addition, the results show that the positive impact of energy audits on the implementation of energy-efficiency measures ceases to exist in the presence of financial constraints, especially for smaller firms and for the construction sector, which consists mainly of small firms. This indicates that not only information barriers but also financial constraints discourage firms from investing in energy-efficiency measures.

**The impact of the energy audit differs across economic sectors.** Results suggest that the industry and sector<sup>28</sup> the firm performs in have an effect on the adoption rate of the suggested energy-efficiency measures from energy audits. This impact is higher for firms in the manufacturing and services sectors, for which investing in energy-efficiency measures is almost twice as likely in the case of an energy audit. This is reflected in the higher quality standards of their buildings and to some extent in the quality of their machinery.

**This heterogeneity across sectors could be driven by differences in the importance of the energy cost share in firms' turnover.** There are two factors driving this cost share: energy intensity and the value of energy inputs. Energy intensity measures the energy consumption per unit of VA and differs substantially between economic activities. The higher the energy intensity, the greater the incentives for energy-intensive industries to adopt energy-efficiency measures (Schleich, 2004). For these organisations, energy efficiency is more likely to affect their competitiveness and to be of "strategic" importance (Cooremans, 2011). Similarly, higher energy prices result in higher energy costs and induce energy-intensive firms to focus more on energy efficiency, as they regard it as an important factor in their competitiveness. At the same time, higher energy prices improve the rate of return and shorten payback times for investments in energy efficiency, and thus they tend to be associated with higher adoption rates (Velthuisen, 1993; Nagesha and Balachandra, 2006). In general, investing in a more energy-efficient technology may turn out to be unprofitable if energy prices fall after the new technology has been implemented. Hence, there is an option value associated with postponing investments (McDonald and Siegel, 1986; Dixit and Pindyck, 1984) and postponing irreversible investment in energy efficiency may be optimal if future energy prices are uncertain, even though the expected value remains unchanged (Hasset and Metcalf, 1993; Van Soest and Bulte, 2001).

**Innovative firms are more likely to pursue improvements in energy-efficiency measures, taking advantage of energy audit information.** Our findings indicate that innovative firms are twice as likely to invest in energy-efficiency improvements after an energy audit than such firms without an energy audit. This explains why their buildings and their machinery and equipment are 10 p.p. and 5 p.p. higher than firms without an energy audit. Rennings and Rammer (2009) give a number of reasons why innovative firms tend to introduce energy-efficiency improvements. These relate mainly to their financial and operational performance. For example, innovative firms aim for higher productivity rates, investing more in new technologies, using more sources of information and obtaining greater cost savings.

In addition to cost savings, innovative firms have strong environmental behaviour and attempt to reduce their carbon footprint as one of their production function objectives (Horbach et al., 2012). This effect might be more pronounced in larger companies because they tend to be more innovative, as they can spread the risk of technology adoption across a larger portfolio and may more easily acquire external funding. EIBIS data indicate that SMEs can be considered to be more financially constrained than larger companies and that the former are twice as dissatisfied with the collateral required to secure external finance as the latter.

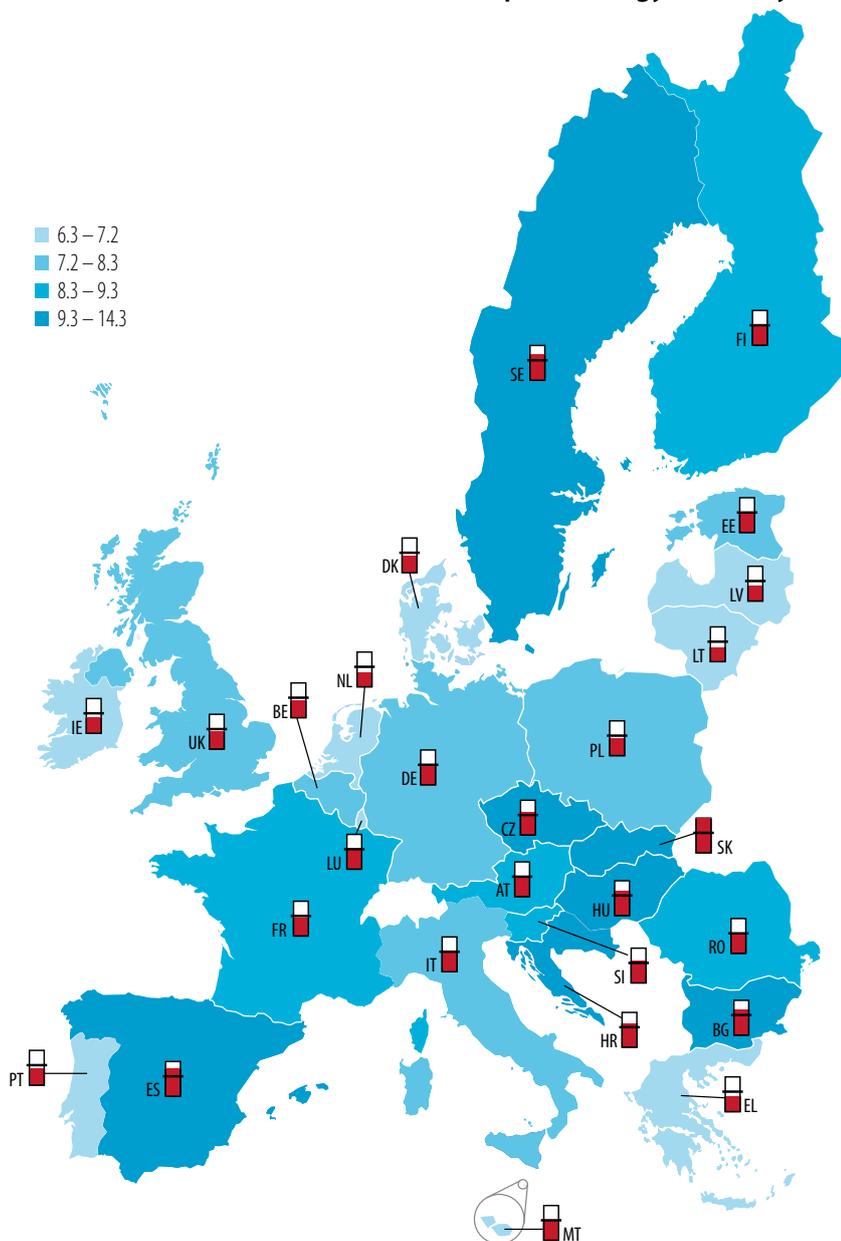
27 A firm is considered to be constrained if one of the following four conditions is satisfied: 1) the firm sought a certain amount of financing but received (or was offered) a smaller amount (quantity constrained); 2) a firm sought external finance but did not obtain it (rejected); 3) a firm sought external finance but the cost of it was too high (price constraint); 4) a firm was discouraged from obtaining external finance due to the possibility of being rejected (discouraged).

28 To investigate the effect of the economic activity, firms were classified into four main sectors – Manufacturing, Construction, Services, and Infrastructure – based on the NACE (Nomenclature générale des Activités économiques dans les Communautés européennes) classification of economic activities.

## Understanding firms' preferences for energy-efficiency investment

EIBIS 2018 data show that energy-efficiency investments are a small fraction of the firms' total investments. In 2018, the EU average proportion of total investment in measures to improve energy efficiency was around 8.6% (Figure 25). Firms in Slovakia represent the highest proportion in the EU with 14.3%, which is more than twice as large as the lowest proportion documented in Lithuania, with 6.3%. However, for most countries (24 out of 28) this proportion ranges from 7% to 11% and increases with firm size.

**Figure 25**  
Proportion of total investment in measures to improve energy efficiency (in %)



Source: EIBIS 18.

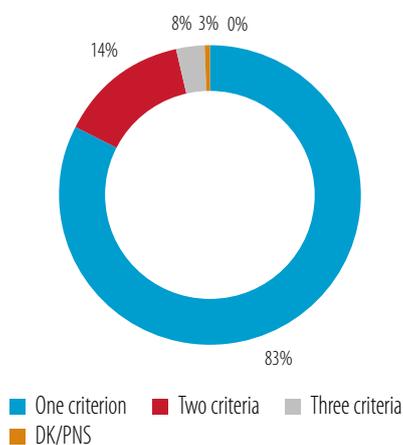
Note: The box shows each country's mean level (red) in relation to the EU mean (horizontal line).

To better understand how firms' investment behaviour relates to energy-efficiency projects, the EIBIS 2018 proposes an innovative experiment. Around 1 500 EU firms were asked to provide their preferences about the selection and implementation of energy-efficiency projects. First, these firms were provided with a range of benchmarking financial indicators that could affect investment decisions in energy-efficiency measures and were allowed to select multiple options. Second, they were asked whether or not they would go ahead with investing in an energy-efficiency project based on randomly selected financing offer and cost characteristics.<sup>29</sup> Third, they were asked whether grants or tax credits<sup>30</sup> would incentivise them to conduct an energy audit, in cases where support is or is not combined with an investment commitment.

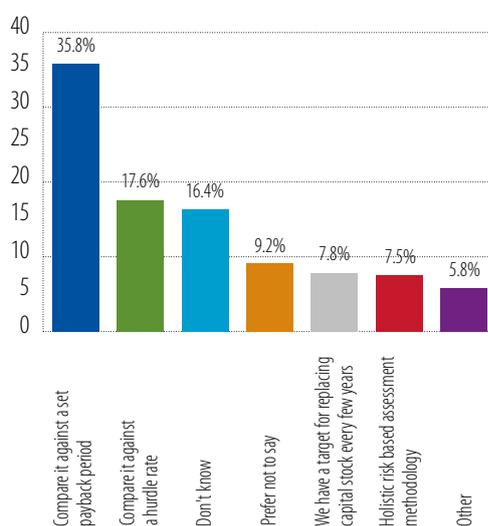
### How do firms make investment decisions about energy-efficiency measures?

Firms' responses reveal that four out of five firms use a single financial criterion to assess their investments in energy efficiency, while roughly one out of five firms use more than one criterion. The most commonly cited investment criterion is the payback period (36%), followed by the comparison with a hurdle rate and the holistic risk-based assessment methodology. This observation is homogenous across different economic sectors and business sizes. However, the share of firms unable to answer the initial question about the importance of various financial indicators in assessing energy-efficiency opportunities is relatively large, especially in smaller firms (24%). This might be considered a lack of capacity/skills to assess investment opportunities for small firms.

**Figure 26**  
Number of financial criteria firms use to assess energy-efficiency investments



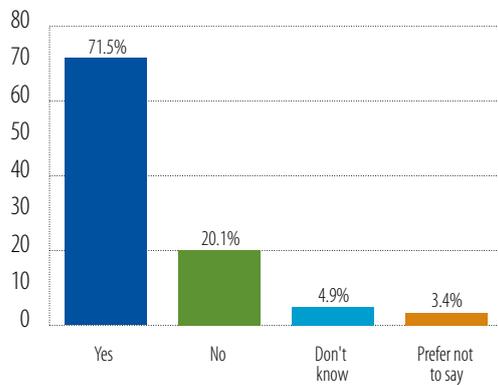
**Figure 27**  
How do you assess whether an energy-efficiency project goes ahead?



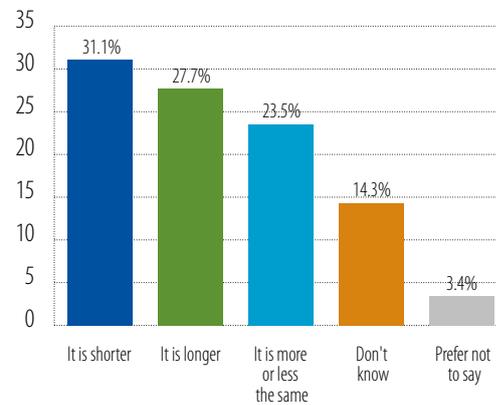
29 The randomly selected variables included investment costs, internal rates of return, amounts of loan offered, maturities, interest rates, interest rates type, collateral requirements and the existence (or not) of technical support.

30 The level of financial support that reduces the costs of the energy audit took values of 10%, 30%, 50%, 70% and 90%.

**Figure 28**  
**Is energy-efficiency investment treated in the same way as other types of investment?**



**Figure 29**  
**How does this payback period compare with other non-energy-efficiency types of investment?**



Source: EIBIS, online module, 2018.

Note: DK and PNS stand for "do not know" and "prefer not to say" responses, respectively.

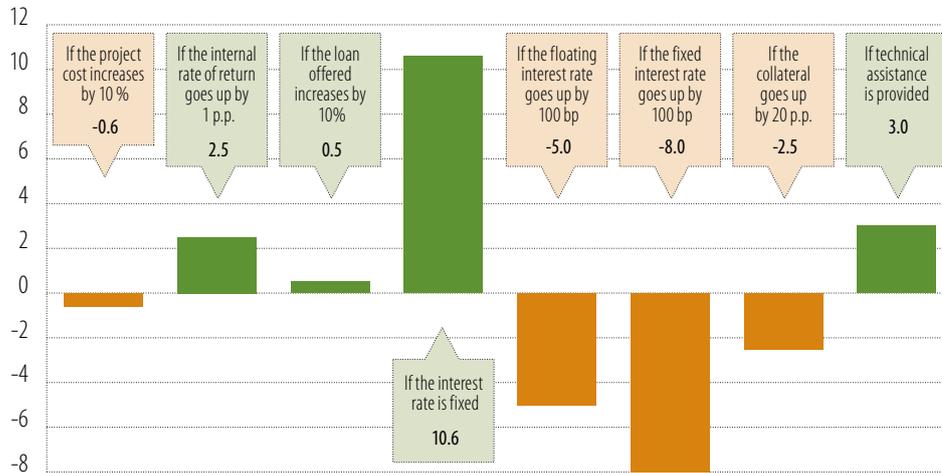
**Over 70% of the firms surveyed treat energy-efficiency investments in the same way as other types of investments.** This observation is homogeneous across different sectors and firm size, with the exception of smaller firms, where this share is much higher (80%). Less than one-third of the firms surveyed, which treat energy-efficiency investments differently than other type of investments, prefer to set a longer payback period for energy-efficiency opportunities and are willing to accept a lower return on their investment compared to other types of investments. The majority of firms surveyed are aiming for higher or similar returns to other types of investments. This means that they are looking for higher returns in order to divert resources from core business investments.

## What are the triggers for firms to go ahead with energy-efficiency projects?

**The propensity to invest in energy-efficiency projects is considerably affected by common approaches to project selection, such as the internal rate of return and the payback period.** The standardised weight of this coefficient is the highest among along explanatory variables included in the dominance analysis (Figure 31). These two approaches relate to each other, by definition, given that an increase in the internal rate of return implies a decrease in the corresponding payback period. Empirical findings<sup>31</sup> suggest that a one percentage point (p.p.) increase in the internal rate raises the probability of investing by 2.5 p.p. Similarly, a one-year increase in the payback period decreases the probability of carrying out an energy-efficiency project by 1.4 p.p. The threshold of the internal rate of return (hurdle rate) above which firms would invest in the energy-efficiency project was estimated at 8% (pre-tax, nominal).

31 The probability of firms going ahead with an investment in energy efficiency was assessed based on a conditional fixed-effects logistic regression.

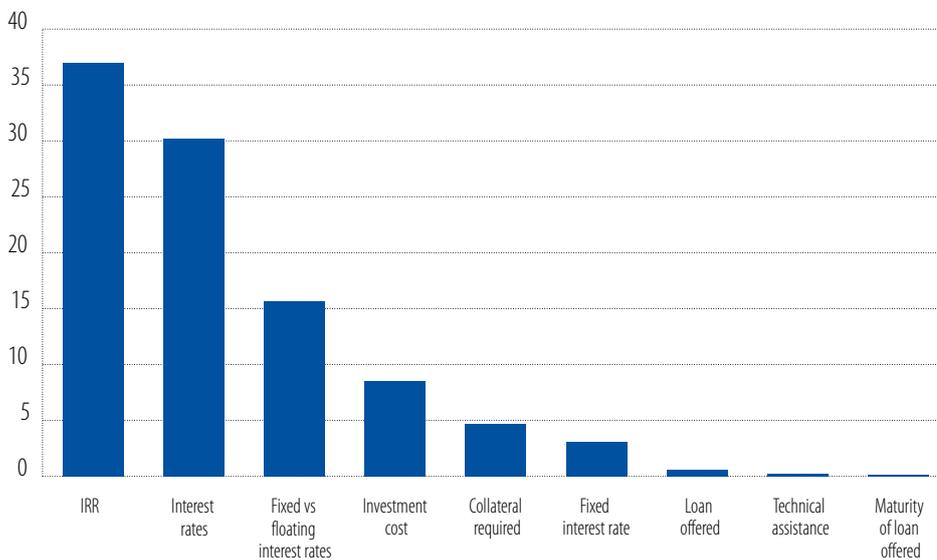
**Figure 30**  
Changes in the probability of investing in energy-efficiency projects based on different scenarios (p.p.)



Source: Author's calculations

Note: Ranking of estimated coefficients based on standardised weights, which are the general dominance weights from McFadden  $R^{233}$  normed or standardised to be out of 100%.

**Figure 31**  
Dominance analysis of predictors (%)



Source: Author's calculations

Note: Ranking of estimated coefficients based on standardised weights, which are the general dominance weights from McFadden  $R^{233}$  normed or standardised to be out of 100%.

**Loan interest rates are a second factor in firms' decisions to proceed with energy-efficiency projects.** In the current cycle of low-interest rates, firms appear to prefer fixed over floating interest rates, indicating that the expectation of rising rates and predictable payments are important factors in their investment decisions. If the interest rate is fixed, the probability that they go ahead with the project is 10.5 p.p. higher than if it were floating. With respect to the individual interest rates' impact, if the fixed or floating interest rates go up by 100 basis points, the probability that the firm will invest decreases by 8 p.p. and 5 p.p.,

respectively. The reason why a decrease in the fixed interest rate is larger than for the variable interest rate could be that firms care more about the long run and that they are less risk-averse.

**The cost of energy-efficiency projects is a third factor in firms' decisions to invest.** If the project cost increases by 10%, the probability of investing decreases by 0.6 p.p. This is consistent with the existing literature (US Department of Energy, 1996; Anderson and Newell, 2004), which suggests that projects above a certain cost may not be adopted, regardless of their benefits. Budget constraints or different management controls depending on project cost, for example, could lie behind this rationale.

**Collateral required is a fourth factor when considering investing in energy-efficiency projects.** Results suggest that if the collateral required (which is a percentage of the assets' value) goes up by 20 p.p., the likelihood of firms investing will be reduced by 2.5 p.p. Firms' collateral scarcity probably limits their ability to find the necessary capital resources to proceed with their investment projects in energy efficiency and they decide to abandon or postpone them regardless of their benefits.

#### Box D

##### **Motivation and design of the experiment: effect on firms' preferences for energy-efficiency investment**

The aim of the experiment is to provide useful information for policy making in the design of loan offers, with a view to promoting energy-efficiency investments. Understanding how firms value different financing options and how the loan and project cost characteristics affect final investment decisions is of crucial relevance for promotional banks such as the EIB. To that end, through different simulations this experiment quantifies the impact of these characteristics on the firms' willingness to pay for energy-efficiency opportunities.

Each participating firm is presented with eight hypothetical cases, with different combinations of characteristics of the investment project and financing offer, all drawn randomly. Some combinations are more favourable than others. Based on the combination provided, firms are asked to decide between five possible outcomes: "definitely go ahead", "probably go ahead", "might or might not go ahead", "probably would not go ahead" or "definitely would not go ahead" with the investment project based on its characteristics and on the financing offer being made.<sup>32</sup>

The investment project presented is assumed to be the result of an energy audit. Its characteristics include the total investment cost, annual cost saving in terms of energy usage, the corresponding internal rate of return and the corresponding payback period. The total investment cost is calculated from the annual cost saving, which is itself based on the annual energy spend announced by the firm in a previous screen. The annual cost saving is 5%, 10%, 15%, 20% or 25% of the total annual energy spend. The total investment cost is a four, five, six, seven or eight times multiple of the annual cost saving. For each of the five multiples, a specific internal rate of return and payback period are attributed. The greater the internal rate of return, the shorter the payback period. The latter is closely related to the total investment cost multiplier.

The characteristics of the financing offer are the amount of the loan, the maturity, the interest rate and its type, the collateral requirement, and whether there is technical assistance. All values that are neither rates nor years are measured in the national currency of the firm interviewed. The loan amount is either 30%, 50%, 75%, 100% or 120% of the total investment cost. The maturity is either 50%, 75%, 100%, 125% or 150% of the payback period. The interest rate is either fixed or floating and normalised for each country using relevant mid-market values. In terms of collateral, either none is required, or it has to equal assets to a value of 20%, 40%, 60%, 80% or 120%. Finally, there is either no technical assistance offered, or help with the planning and implementation of the project.

<sup>32</sup> For simplicity, the econometric analysis considered that the first two possible answers correspond to a "yes", and the last three answers to a "no".

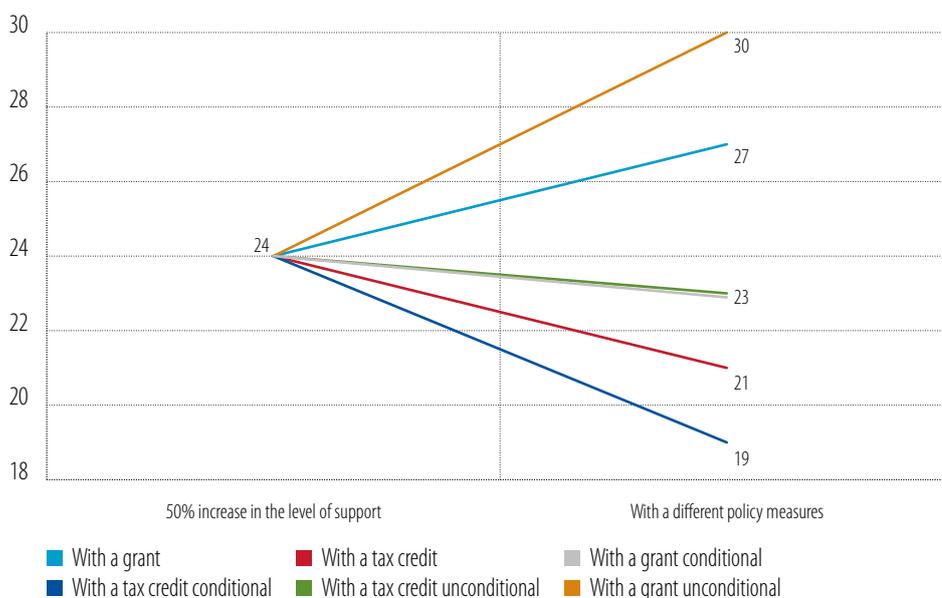
**The loan offer amount is the fifth factor in firms’ decision to invest in energy-efficiency projects, while maturity of the loan counts less.** Results indicate that if the loan amount offered increases by 10%, the probability of investing increases by 0.53 p.p.<sup>33</sup> In general, energy-efficiency investments are not included in a firm’s strategy as a core business investment and additional capital resources are therefore needed in order to proceed with these projects as the availability of capital is tight. By contrast, firms seem to be indifferent to the years until the loan’s maturity and whether these exceed the payback period.

**Technical assistance could positively affect firms’ propensity to invest in energy-efficiency projects.** Technical assistance is defined as help with the planning and implementation of the project to ensure a timely and efficient execution without any extra cost. Firms’ responses revealed that a project and financing offer that includes technical assistance increases their likelihood to invest by 3 p.p. Technical assistance improves the understanding of the fundamentals of the energy projects and hence helps to lower the perceived technical and financial risks of energy-efficiency investments. This is done by standardising the process of project appraisal and loan processing.

### How effective are financial interventions in promoting energy audits?

**Firms are more likely to go ahead with energy audits when they receive financial support (especially grants).** When the level of support increases by 50 p.p. (i.e. that their energy audit costs are reduced by 50 p.p.), our empirical analysis shows that the propensity to conclude an energy audit increases by 24 p.p. (Figure 32). The effect of the financial support is even greater when it concerns a grant (27 p.p.) compared with a tax credit (21 p.p.). Their preferences might be driven by the fact that a tax credit is conditional on making profits and not operating at losses, while a grant is more easily accessible to all firms and does not come with any prerequisite. Another reason could be that the grant cannot be recalled once it is transferred to the recipient, while the tax credit can be cut off if the recipient does not adhere to potential pre-agreed conditions.

**Figure 32**  
Estimated effects of financial instruments on energy audits’ deployment (p.p.)



Source: Author’s calculations.

33 The project cost and the amount of loan offered have been normalised according to the firms’ annual energy spend and project cost, respectively.

**When the level of support is combined with an investment commitment, firms are less keen to go ahead with carrying out an energy audit.** Under conditional support, our **results suggest** firms appear to be indifferent regarding the types of the financial instrument offered to them. By contrast, when the support is not linked to any investment commitment, firms are in favour of grants instead of tax credits for carrying out an energy audit. This difference in the willingness to go ahead with an energy audit depending on whether the financial support is conditional or unconditional might be considered an indication of moral hazard.

## Conclusion and policy implications

**EU investments in climate change mitigation technologies declined until 2014 and then increased moderately.** Several factors appear to have affected investment decisions in CCM, including the recent economic downturn, the declining returns in the sector, the lack of effective market mechanisms, regulatory failures, low fossil fuel prices and technological developments. These created a less predictable and stable framework and sent mixed signals to existing and future investors.

**Efforts should be stepped up in order to meet the 2030 objectives, despite the considerable progress made towards realising the 2020 objectives.** Months of negotiations between the European Commission (EC), the Council and the Parliament led to new targets for 2030, beyond the level originally proposed by the EC. It is evident from the discussions and the EC's analysis that energy efficiency is the centrepiece of the long-term decarbonising path, contributing to enhanced security, sustainability and competitiveness. Investments in this area should be approximately four times higher than the current level, which means that countries will have to step up their efforts to unleash the energy-efficiency potential of the economy.

**Energy audits are the first step towards energy-efficiency improvements.** Audits can help firms to assess their energy consumption, understand the potential for energy savings and suggest measures (investments or behavioural changes) to improve energy performance. Energy audits provide tailor-made recommendations and help to overcome the information gap that is one of the main barriers to energy-efficiency investments. The results of the empirical analysis indicate that this information is more crucial for small firms and for investments in support processes, on the condition that firms are not finance-constrained.

**Financial support and information campaigns appear to be useful instruments in incentivising energy audits, promoting investment in energy efficiency.** Empirical findings indicate that financial instruments such as grants are important in promoting energy audits, but they should be combined with an investment commitment to avoid free-riding effects. Information instruments also play a crucial role in encouraging effective energy audits, and Member States should develop programmes that raise awareness among firms about the potential benefits of energy audits. In parallel, they should ensure that professional energy audits are widely available, for example, by encouraging training programmes to guarantee enough qualified persons are available to undertake such audits.

**Access to CCM financing is important in promoting investments in energy-efficiency measures.** Our analysis shows the decision-making process of firms is affected mainly by factors such as the project's internal rate of return, interest rates and collateral required for loans. Our results indicate that higher interest rates and finance constraints in terms of the amount of loan offered and collateral required significantly reduce firms' willingness to undertake energy-efficiency projects. Furthermore, most firms treat investment in energy efficiency in the same way as other types of investment and usually ask for returns that are higher or similar to other investments. To that end, policymakers should turn their attention to small and medium-sized enterprises, enabling them to obtain easy access to CCM financing in order to make energy-efficiency investments more attractive.

**Boosting private financing and a targeted use of public funds are crucial in closing the investment gap in CCM.** Existing EU funding schemes and programmes act as a catalyst for investment in CCM, but they are insufficient to finance all the investments needed to meet the long-term climate objectives. Financial instruments such as green bonds are gaining momentum and help to mobilise resources from capital markets for CCM projects by bridging this gap to some extent. Green bonds appear to be an opportunity for various participants who can offer green investment products to benefit from the increasing support by European and national legislators to move towards a greener economy.

**The right price signals need to be sent to increase consumer awareness and promote clean energy investments.** Relatively low fossil fuel prices and existing market mechanisms (emissions trading schemes and wholesale markets) fail to provide the right investment signals for the take-up of renewables and,

to some extent, energy-efficiency measures. To that end, including the negative externalities related to energy use in prices, by removing environmentally harmful subsidies, strengthening the carbon price and aligning the current market design with the objectives of low-carbon transition would make investments in CCM more economically attractive. In parallel, it would help investors to change their views about CCM investments and reduce the investment gap by increasing society's willingness to pay for the energy transition to a low-carbon economy.

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**Drop in cost of debt finance for EU firms**  
between 2008 and 2018:

**400** basis points

**5%**

of **EU firms report being finance-constrained**  
down from **7%** in 2017

**Innovative firms are**

**62%**

more likely to be  
**finance-constrained**

**95%**

of **EU households**  
have financial assets,  
but less than **10%**  
have equity shares

**EU stock market capitalisation to GDP is**

**80 p.p.**

**lower** than in the **US**

**Equity risk premium**  
in the **EU is** still around

**200** basis points

above its **pre-crisis level**

PART II

# Investment finance



## Chapter 5

### Credit conditions and corporate investment

**In 2018, the EU is continuing to recover. The output gap has closed in almost all countries, but this comes on the back of uniformly low potential growth.** Investment is growing at a strong pace, but ten years of underinvestment has left a backlog. Real corporate investment is below pre-crisis levels in several economies, partly because of low returns and low potential output. While the economic momentum supports internal financing capacity and reduces the need for external finance, the corporate sector remains a net saver.

**Headwinds remain, associated with possible asymmetric effects of the monetary policy normalisation and with trade tensions.** The normalisation of monetary policy may have asymmetric consequences, as some economies and corporations are more exposed to tighter monetary and financial conditions. Economic activity relies on the very accommodative monetary policy. The path to monetary policy normalisation in the euro area was clarified in the middle of the year. Beyond the risk associated with the tightening cycle, the EU faces heightened international trade tensions.

**Most financial wounds have healed but some scratches continue to be treated.** The banking sector has strengthened its ability to pass-through the monetary policy stimulus: both bank lending rates and corporate debt burdens are very low. Access to finance shows strong signs of improvement and is not the main issue for most corporates overall. Various financial indicators related to corporates and banks are improving but remain diverse across economies. Overall, firms in the periphery and cohesion groups still face a less favourable situation. Analysis suggests that, to some extent, this reflects difficulties in the supply of external funds rather than borrower characteristics.

**Productivity growth is lagging behind the normal cyclical rebound.** There is evidence of misallocation of resources, as measured by the dispersion of firm-level productivity, particularly in some periphery and cohesion countries. Financially constrained firms with high productivity and growth prospects co-exist with underperforming firms. Policies to alleviate financial constraints should discriminate between these two populations. Financial support should aim at strengthening promising firms especially those innovating.

**The financial sector does not yet serve some of the most promising companies well.** As well as the cost of access to finance, the difficulty in complying with the collateral requirement is an important factor in explaining that young, small, more innovative corporations and those investing more in intangibles are more likely to suffer. Moreover, firms have reported impediments to investment related to the macro-financial and business environment that hamper investment capacity, especially for firms with a weak internal finance capacity. It is key to continuing to develop policies to strengthen the financial sector, making it more likely to support growth and innovation, while screening the firms on their prospects and capacity to remain viable.

## Introduction

**This chapter reviews and analyses developments in credit conditions and investment finance which have occurred since the middle of 2017.** The focus is on non-financial corporate investment, in the European Union (EU) as a whole as well as the three economic regions: cohesion, periphery, and the other economies. In addition to hard data collected through national accounts, integrated accounts, and banking or financial sources, the chapter uses survey-based data, such as the 2018 EIBIS, to assess investment dynamics and their macroeconomic implications.

**In 2018, EU is continuing to recover, and the output gap has closed in the three regions considered by this report – see Chapter 1.** In some economies however, real corporate investment is still below its level ten years ago. Economic activity relies on the very accommodative monetary policy. Ensuring a smooth normalisation is important as economies are asymmetrically exposed. The EU economy is healing, but the EU corporate ecosystem is still feeling the consequences of the crisis. Looking forward, it is important to guarantee that corporations can access finance in conditions that support technological transformation and competitiveness. This is especially key after years of low productivity growth in the EU and slowdown in the EU convergence process. Indeed, potential output growth has declined over the last ten years.

The chapter consists of five sections. The first section reviews the macro-financial environment. The second focuses on balance sheet adjustment and corporate investment. The third analyses the financial and financing conditions of SMEs. Section 4 elaborates on the relationship between bank credit and the corporate ecosystem. The fifth section concludes and draws policy implications.

## The macro-financial environment

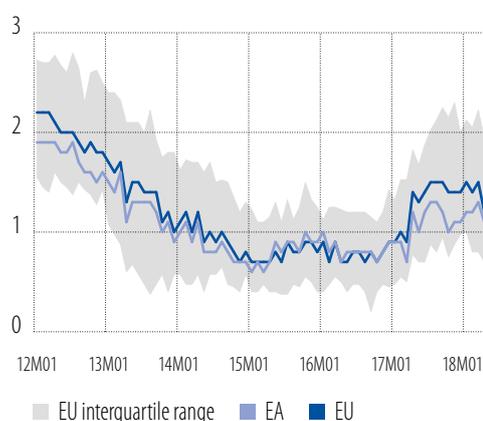
**Ten years after the bankruptcy of Lehman Brothers in 2008, GDP in the European Union was around 10% higher in real terms.** As explained in Chapter 1, the synchronised global upswing helped strengthen EU economic activity. In 2018 the EU upturn entered its sixth year, and its economic expansion has become increasingly broad based. In the euro area, the prospects for monetary policy normalisation are clearer. However, the risk of financial stress recently resurfaced in some Member States.

## Nominal developments

**Harmonised Indices of Consumer Prices (HICP) inflation recovered sharply in mid-2018 on the back of energy and food prices,** and euro area annual headline inflation reached 2.1% in July. However, this was largely based on the rise in energy and food prices. Indeed, excluding these components, over the first half of 2018, HICP remained well below 2.0% on average. Moreover, core inflation had increased moderately since the beginning of 2015 (Figure 1).

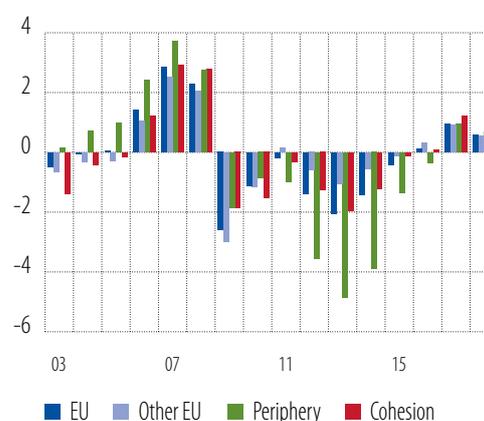
**The slow pick-up in inflation reflects structural factors.** Inflation has only moderately picked up over the last five years. Several possible structural factors have been proposed in the literature to explain this puzzle (Ciccarelli and Osbat, 2017), including the drift due to production cost in low-wage countries and increased competition from online shops making it easier to track lower prices through internet search engines. Despite differences in economic momentum, the subdued inflation response was shared across the major developed economies. Indeed, even in the US, which has long seen strong economic growth, inflation is well contained.

**Figure 1**  
**HICP excluding energy and unprocessed food (annual growth, %)**



Source: *ECON calculations based on Eurostat.*  
Note: *Last record June 2018.*

**Figure 2**  
**Output gap (deviation from potential, %)**



Source: *ECON estimates based on IMF.*  
Note: *Last record, 2018.*

**Cyclical factors tend to dominate.** Estimates point to the disappearance of slack in the EU and the three regions since 2017 (Figure 2). In the EU, in 2018, actual output was estimated to be marginally above the potential output in the other EU economies and in the periphery group, and more significantly in the cohesion group. Measures of economic slack are known to be relatively uncertain (Szörfi and Tóth, 2018), but, looking forward, a high output gap should support some stronger price inflation.

## Monetary and financial conditions

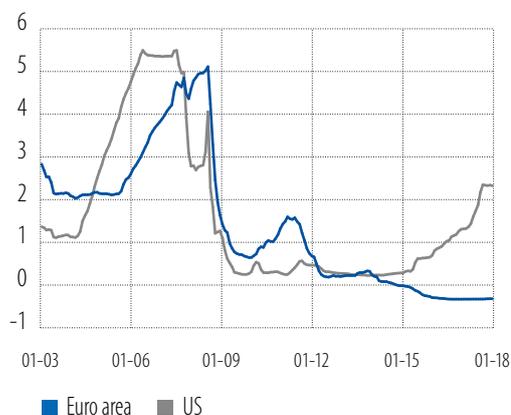
**Short-term interest rates remained exceptionally low, reflecting subdued inflationary pressures** (Figure 3). Short-term interest rates have remained negative in the euro area for over two years. In contrast, the US Federal Reserve has embarked on a tightening cycle since end-2016, raising the effective federal funds rate eight times, from 25 basis points to 225 basis points.

**Short-term interest rates are only one element of the monetary policy stance in the euro area.** Assessing the current stance of monetary policy is complicated, given the various policies implemented. It is determined by the combination and interaction of policy rates, asset purchase programmes and forward guidance, and complemented by the Targeted Longer-Term Refinancing Operations (Praet, 2018a).

**Estimates suggest that financial conditions were softer than their historical average between 2003 and the second half of 2016.**<sup>1</sup> Since the second half of 2017, overall financing conditions have continued to soften marginally (Figure 4). The supporting financing conditions help to increase activity by compressing bank lending spreads and, all else being equal, reducing the cost of borrowing.

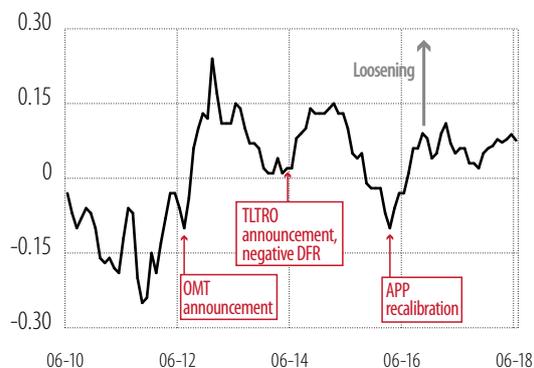
<sup>1</sup> The financial condition indicator is the common component of a large set of series on quantities and financial costs related to EU economies and available monthly. In a first step, the series are filtered from their reaction to monetary policy and activity. In the second step, principal component analysis is used to summarise the information contained in the dataset (Darracq-Parriès et al., 2014). The index is dimensionless, of zero mean over March 2003-June 2018.

**Figure 3**  
Money market rates (% p.a.)



Source: Thomson Reuters Datastream.  
Note: Last record, June 2018. Three-month money market rates are used.

**Figure 4**  
Financial conditions index (FCI)



Source: Author's estimation based on Darracq-Parriès et al. (2014).  
Note: See footnote 1.

**The ECB announced a process of monetary policy normalisation (ECB, 2018d) in June 2018.** This includes a reduction in the pace of purchases from September 2018 until the end of net asset purchases in December. The ECB also announced it was maintaining the size of its asset portfolio at its December 2018 level for a prolonged period, through the reinvestment of maturing assets. It also committed to keep its policy interest rates at mid-2018 levels, at least until the summer of 2019.

**The real economy can react drastically to a sharp tightening in financial conditions.** In 2018, some tensions were recorded when the new Italian government was formed; the stress in financial markets lasted long enough to spread to the real economy.<sup>2</sup> However, the episode was a reminder of the fragility of market confidence and how uncertainty and tightened financial conditions can be detrimental to investment.<sup>3</sup> Box A illustrates the links between the real economy, particularly smaller enterprises, and the financial conditions by developing a counterfactual scenario of the absence of sovereign debt crisis.

<sup>2</sup> Still, the spread on the ten-year sovereign bond in Italy compared to Germany rose from 60 basis points in the first four months of 2018 to 135 basis points over May-June.

<sup>3</sup> Indeed, in the EIBIS, uncertainty is mentioned as one of the main impediments to investment (Chapter 1).

### Box A

#### Are smaller corporations more affected by changes in credit conditions?

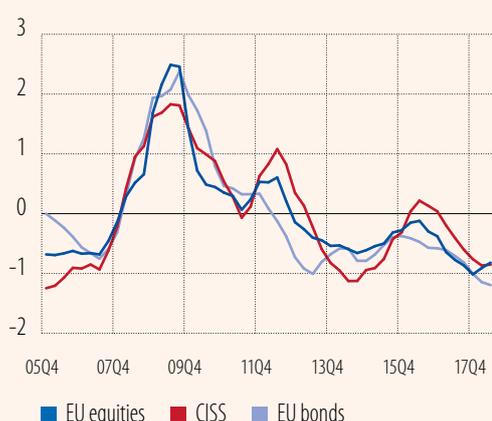
The pricing of risk in the financial markets is at historically low levels (Figure A.1) and, in Europe, financial conditions are relatively loose (Figure 4). In a context of gradual monetary policy normalisation and given the looming political risks, the repricing of riskier assets and a tightening in financial conditions cannot be excluded. In this box, we use a FAVAR model estimated with Bayesian techniques to illustrate the implications of tightened credit conditions for corporate investment. We show how the tightening in credit conditions recorded during the sovereign debt crisis was detrimental for the euro area economy and how SMEs were more affected.

The model is composed of two blocks. The first block contains 41 variables related to the financial sector (volatilities, spreads, issuance activity, exchange rate and stock prices). Based on these series,

a factor is extracted (Figure A.2). The second block consists of a macroeconomic model comprising real GDP excluding corporate investment, corporate investment and corporate loans in real terms (the series are indexed to 100 in 2008:Q1). In addition, we include the three-month Euro Interbank Offered Rate (Euribor) as a proxy of the monetary policy rate, the price-to-book ratio of non-financial corporates' stocks, the bank lending spread on large loans (with reference to the three-month Euribor), and the size spread (i.e. the difference between the bank lending rate on small and large corporate loans as a proxy for the spread on SME loans). The financial factor is embedded in this block and the model is estimated in one step using Bayesian techniques.<sup>4</sup>

Figure A.2 shows that the Credit Condition Indicator (CCI) tightened significantly on two occasions: after the Lehman collapse and during the sovereign debt crisis.<sup>5</sup> Since then, on the back of very accommodative monetary policy, confidence has been restored and financial conditions have become looser than average. The movements are comparable to those recorded in the volatility measures (Figure A.1).

**Figure A.1**  
Measures of volatility



Source: ECON calculations based on Thomson Reuters Datastream and ECB.  
Note: Last record, 2018:Q2. The indicators are demeaned and rescaled over the period. CISS is the Composite Indicator of Systemic Stress.

**Figure A.2**  
Estimated credit conditions indicator



Source: Authors' estimations. See Maurin, Andersson and Rusinova (2018).  
Note: An increase portrays a tightening in credit conditions. The range portrays the 20–80% distribution. Last record is 2018:Q2.

However, credit conditions are influenced by several factors, including credit supply conditions and monetary policy and demand conditions. We use sign restrictions to disentangle the role of credit supply shocks.<sup>6</sup> In Figure A.3 we portray the reaction to a credit supply shock: corporate investment and corporate loans contract, with the impact on loans being more protracted and the effect remaining significant for four years. In addition, both the bank lending spread on large loans and the size spread widen. The effect on the size spread is very substantial. During the first year after the shock, it amounts to about two-thirds of the effect on large loans. In other words, the cost of bank borrowing for non-financial corporates increases, especially for SMEs.

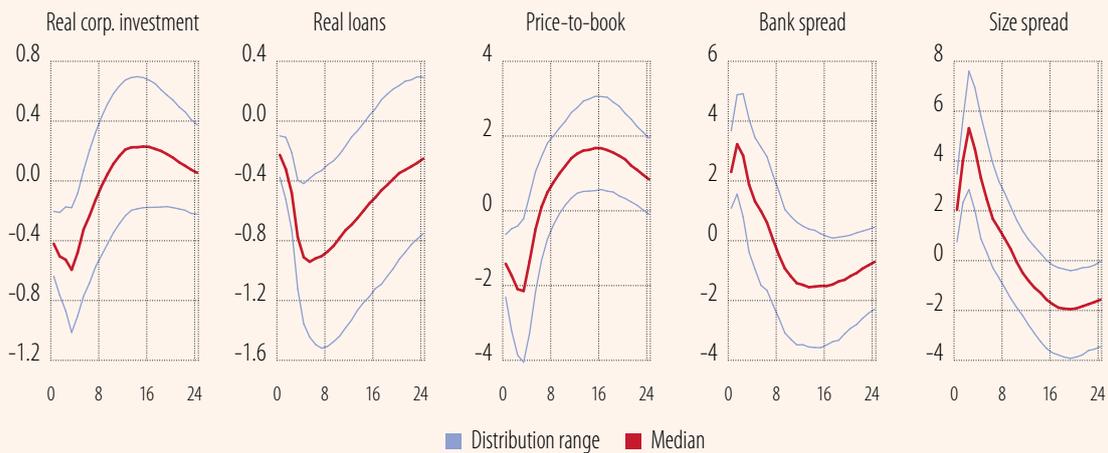
4 The estimation period covers 1999:Q1–2018:Q2. The VAR is estimated with four lags and a constant. We use an inverse Wishart-normal prior implemented with dummies. The hyperparameters are set at values in line with those used in the literature. The results reported are based on 20 000 replications and the first 10 000 draws are burned.

5 The Credit Condition Indicator plotted in Figure A.2 is estimated using different techniques from the Financial Condition Indicator portrayed in Figure 4 (see footnotes 1 and 4). The dynamics are similar, however.

6 For a presentation of identification with sign restrictions, see Rubio-Ramirez et al. (2010).

The model and the identified shocks allow us to develop a scenario showing what would have happened to euro area corporate investment in the absence of the sovereign debt crisis, had credit conditions remained unchanged from 2010:Q2 until 2012:Q2 and evolved as estimated after that.

**Figure A.3**  
**Response to a credit shock** (deviation from baseline)



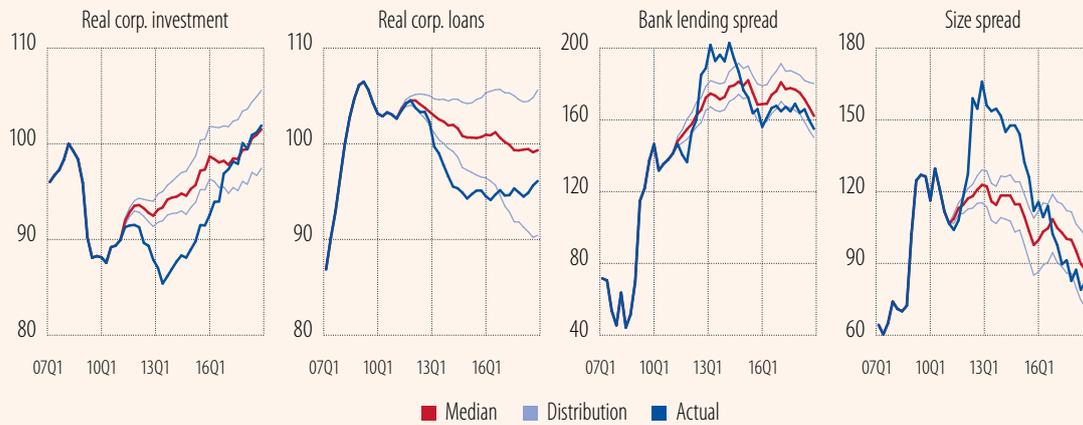
Source: Maurin et al. (2018), forthcoming.

Note: The x-axis portrays the number of quarters after the shock. The red line represents the median estimate, while the thin blue lines represent the range 20–80%. The reactions of real corporate investment and real loans and price-to-book ratio are reported as a percentage deviation from the baseline. The reactions of the spreads are reported in basis points.

The results shown in Figure A.4 confirm that the impact of the crisis has been over for some time. Indeed, the counterfactual trajectories for investment, bank lending spread and size spread reached the evolution actually recorded. However, in the wake of the sovereign crisis, corporate investment was reduced by up to 10% of that in 2013 until the middle of 2016. The adverse impact on loans remains, as the economy is still in a deleveraging phase. Corporate balance sheet adjustment would have taken place anyway, but at a slower pace. The decline would have been half the fall recorded from the peak to the beginning of 2018, i.e. around 5%. Finally, from 2010 until the beginning of 2016, the cost of borrowing would have been lower by 20 basis points on average for large loans, and 50 basis points for small loans, as the effect on the size spread reached 30 basis points. Hence, SMEs, which contract smaller loans, have been more strongly affected by the tightening in financial conditions.

The scenario illustrates how important sound and stable credit conditions are for the real economy, especially for SMEs, which are more dependent on one financial source. Indeed, the countries hit hardest by the crisis are those most populated by SMEs (Figure 22).

**Figure A.4**  
**Counterfactual simulation of the absence of sovereign debt crisis**



Source: Maurin, Andersson and Rusinova (2018).

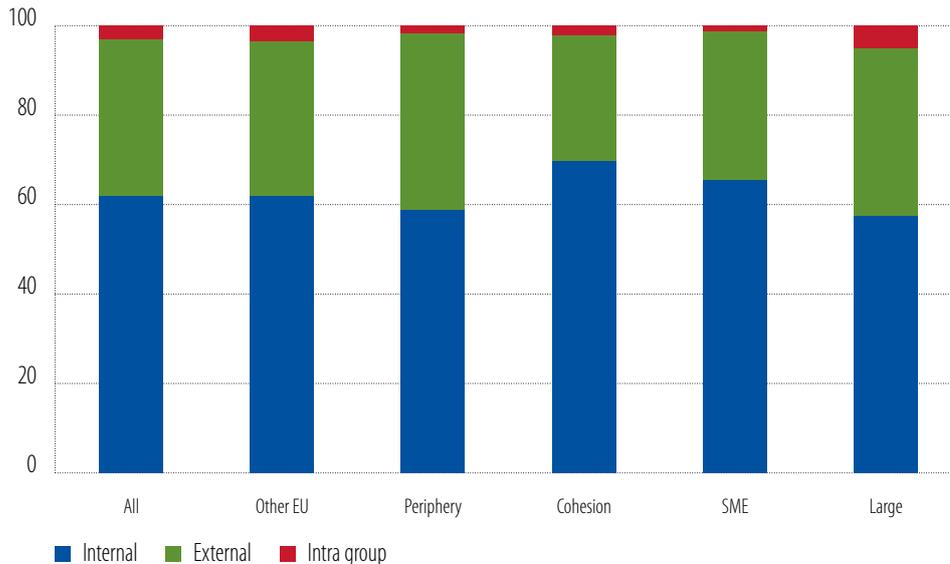
Note: The charts report the counterfactual evolution of the observables, had financial conditions remained constant at their level in the middle of 2010 up to the end of 2012. The conditional forecast is computed assuming that only the credit supply shock adjusts to ensure the new path for the CCI. The remaining shocks are those identified from the estimation of the SVAR. The estimated median of the counterfactuals is plotted as a solid red line. The thin blue lines report the distribution of the counterfactuals inside the 20<sup>th</sup> and 80<sup>th</sup> deciles. Real loans and real corporate investment are indexed at 100 in 2008:Q1. The spreads are expressed in basis points.

## Balance sheet adjustment and corporate investment

### Saving glut and debt overhang

**Figure 5**

**Source of finance (%)**



Source: *EIBIS 2018*.

Base: *All firms that invested in the last financial year (excluding don't know/refused responses)*.

Question: *What proportion of your investment was financed by each of the following?*

#### **Firms tend to finance their investment activities predominantly through internal sources (Figure 5).**

While internal funds or retained earnings such as cash or profits account for 62% of total investment of the average firm, external sources also contribute (35%). A small part of the investment capital is sourced through intra-group funding such as loans from a parent company (3%); this is most used among larger companies (where intra-group funding accounts for, on average, 5% of total firm funding). The fact that firms meet the bulk of their financing needs through internal sources is not particular to the firms in our sample, but rather a general characteristic of firms' financing mixes.<sup>7</sup>

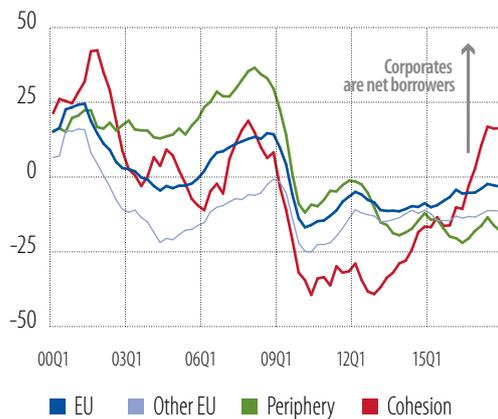
**Entrepreneurial income accelerates as the economic momentum increases.** Regarding the availability of internal finance, it is interesting to note that, during the recovery and in a context of moderate cost increases, stronger demand enabled companies to increase their volume of sales as well as their margins. This resulted in increased gross entrepreneurial income and therefore more internal financing capacity. All else being equal, this should support investment, especially given the role played by internal resources in investment finance.

**Contrasting with historical patterns, the EU corporate sector remains a net saver. European firms have improved their financial position by reducing debt and accumulating financial assets, partly cash.** The amount of investment is below the financing capacity of the corporate sector as a whole (Figure 6). The sector provides savings to the rest of the economy or the rest of the world. This contrasts

<sup>7</sup> See the seminal works by Majluf and Meyers (1984), and Berger and Udell (1998). The economics of small business finance: The roles of private equity and debt markets in the financial growth cycle. *Journal of Banking and Finance*, 22, 613–673. Other business surveys lead to similar results for the UK, Saleheen et al. (2017) and ECB (2016) Report on the results of the Survey on the Access to Finance of Enterprises in the Euro Area – April to September 2016, <https://www.ecb.europa.eu/press/pr/date/2016/html/pr161130.en.html>.

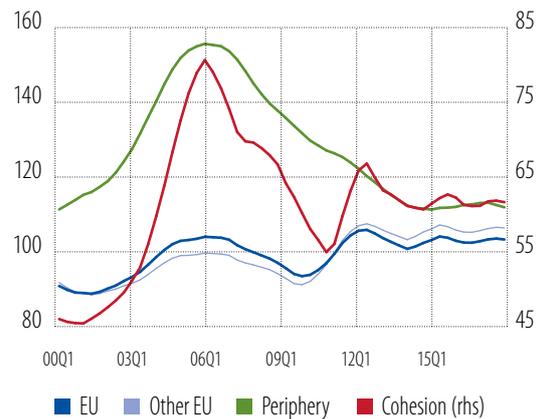
with the traditional sectoral view, according to which households are net savers while firms are net investors. However, for the cohesion and periphery economies, excess savings by firms have been diminishing since the end of the sovereign debt crisis.

**Figure 6**  
Net borrowing over investment (%)



Source: ECON calculations based on Eurostat.  
Note: Last record, 2018, partially forecast. Non-financial corporate sector only. The lines indicate the ratio between the net borrowing of the non-financial corporate sector and its investment.

**Figure 7**  
Corporate indebtedness (% GDP)



Source: ECON calculations based on Eurostat.  
Note: The lines relate to the non-financial corporate sector as a whole, and the accounts are unconsolidated.

**Access to external finance being easier, it can no longer explain why corporates remain excess savers.** Corporates most likely continue to save owing to the ongoing deleveraging process. Indeed, some deleveraging has taken place in the EU, mostly in periphery economies (Figure 7). In this group of countries, the ratio of corporate debt to GDP declined by around 25 percentage points (p.p.) of GDP from 2012 until the first half of 2018. It now stands at similar levels to those reached in the other economies.

**The pre-crisis period was characterised by a debt-financed investment boom that ultimately proved unsustainable.** When asset prices collapsed during the crisis, non-financial corporations' leverage shot-up, especially in vulnerable countries (Figure B.1). The increase in leverage was accompanied by a decline in investment, which was more pronounced in the more highly levered economies. Box B analyses the relationship between debt overhang and corporate investment for listed firms.

**Box B**

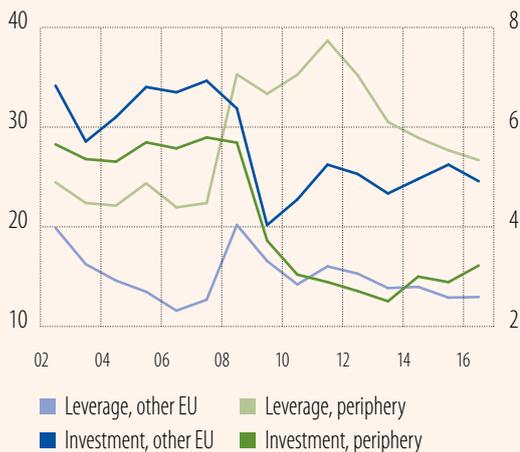
**Debt overhang and corporate investment: an analysis based on listed firms**

The link between leverage and investment sheds some light on whether legacy debt has been a problem. Corporate indebtedness is too high if firms forgo positive Net Present Value projects because of debt overhang. The shareholders of highly indebted firms may not find it in their interest to implement such projects, because the benefits mainly accrue to existing creditors. Upon default, creditors take over the firm and shareholders therefore do not internalise investment returns materialising after the default date.

In the other countries, median levels of the debt overhang distribution are close to zero across all periods. Only during the acute stage of the financial crisis did a significant minority of firms

experience an increase in leverage (Figure B.1)<sup>8</sup>. However, during the sovereign debt crisis, the debt overhang distribution did already return to its pre-crisis level.

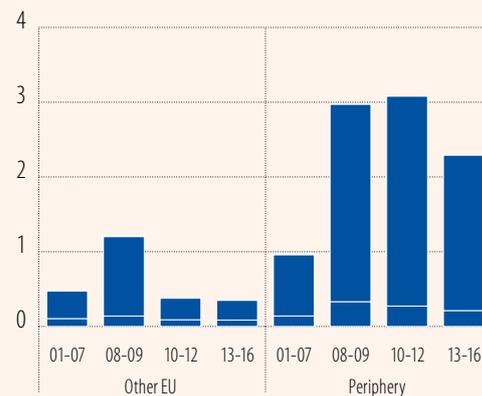
**Figure B.1**  
Leverage (lhs) and investment (rhs)  
by groups of country



Source: EIB calculations based on Worldscope.

Note: Debt/market value of total assets (lhs) and capital expenditure/capital (rhs), where the capital stock is given by the sum of debt and book equity.

**Figure B.2**  
Debt overhang across time and  
country groups



Source: EIB calculations based on Worldscope.

Note: The boxes represent the interquartile distribution of debt overhang. The lines represent the median. See footnote 8.

We develop an investment model to assess the impact of debt overhang on investment up to 2016. The model is estimated on listed firms only. In dynamic investment models, the shadow price of capital, marginal  $q$ , is a sufficient statistic for investment. If the production function displays constant returns to scale and the firm is a price taker in all markets, the unobserved marginal  $q$  can be replaced with Tobin's average  $Q$ . For firms with long-term debt, it can be shown that marginal  $q$  is equal to average  $Q$  minus the capital-normalised value of existing lenders' claim on recoveries in default (Hennessy, 2004; Hennessy et al., 2007). The underinvestment problem arises because shareholders do not internalise the value of recoveries in their investment decision. In dynamic investment models, adjusting the capital stock is costly and it is popular to assume quadratic adjustment costs as they yield an investment equation that is linear in  $Q$ :

$$\frac{I}{K_{i,t}} = \beta_0 + \beta_1 \cdot Q_{i,t} + \beta_2 \cdot \frac{R}{K_{i,t}} + \mu_{i,t} \quad \text{EQ.1}$$

Equation (EQ.1) is a standard investment regression augmented by the debt overhang term ( $R/K$ ).  $R$  represents the current market value of default recoveries, and  $K$  the capital stock given by the sum of debt and equity.<sup>9</sup> This approach has the advantage of tightly linking the estimated equation to a theory, but it comes at the cost of restrictive assumptions, some of which may not be met in practice.

A significant share of firms in vulnerable countries show elevated levels of debt overhang up to 2016 (Figure B.2). The distribution of  $R/K$ , the indicator of debt overhang, already had a more pronounced right tail prior to the crisis. Unsurprisingly, the situation deteriorated during the financial crisis and the

<sup>8</sup> Debt overhang is given by the product of 15 years' cumulative default probabilities, sector-specific recovery ratios, and the ratio of long-term debt to capital, where capital is given by the sum of debt and book equity.

<sup>9</sup> The debt overhang proxy is obtained as the product of sector-specific recovery ratios from Altman and Kishore (1996), the ratio of long-term debt to capital and 15-year cumulative default probabilities from S&P.

weakness persisted through the sovereign debt crisis. Figure B.2 suggests that in 2016 debt overhang levels were still considerably higher than before the crisis. Moreover, firms in vulnerable countries continued to be perceived as more fragile than those in the core countries.

Firms suffering from debt overhang invest less. Table 1 presents the estimation results of Equation (EQ.1) estimated for euro area listed corporates. Consistent with theory, the coefficient on the debt overhang correction is negative and statistically significant at the 1% level. The result does not depend on using a particular estimation technique and appears economically significant. A one standard deviation increase in  $R/K$  is associated with a 0.6 percentage point lower investment. This corresponds to about 8% of the unconditional sample mean.<sup>10</sup>

**Table 1**  
**Estimation results of the investment rate equation (EQ.1)<sup>11</sup>**

	FE	AB	EJW
$Q$	0.017*** (0.00)	0.018*** (0.00)	0.068*** (0.00)
$Q^*$ issued equity	0.001 (0.60)	-0.003 (0.29)	-0.017*** (0.00)
Debt overhang	-0.257*** (0.00)	-0.195*** (0.00)	-0.154*** (0.00)
KZ	-0.003*** (0.00)	0.017 (0.32)	0.002 (0.13)
Cash flow	0.008* (0.06)	0.010 (0.13)	0.008* (0.06)
Investment [ $t-1$ ]		0.371*** (0.00)	
$N$	15 647	12 598	15 127

*Note:* Column (1) presents fixed effects (FE) estimates. Column (2) shows dynamic panel estimates. Column (3) has estimates that correct for measurement error in  $Q$  based on linear cumulant equations (Erickson et al., 2014). \*\*\*, \*\* and \* denote statistical significance at the 1%, 5% and 10% levels respectively. See also Betz and De Santis (2018).

Different tools are required to assess the balance sheet strength of non-listed corporations. The above analysis relies on a measure of Tobin's  $Q$ , which is available only for listed firms. Focusing only on listed firms may give an overly optimistic picture of corporate financial health, as balance sheet problems may be concentrated among non-listed firms.

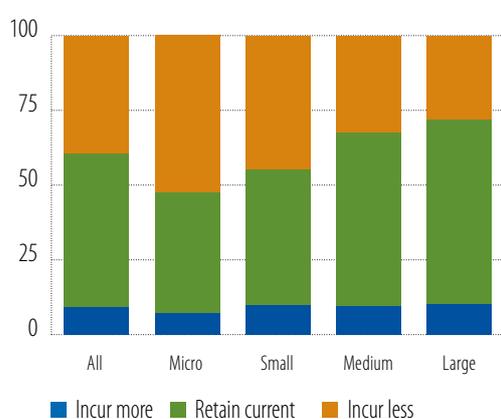
<sup>10</sup> Given a standard deviation of  $R/K$  amounts to 2.5%, coefficient in column (1) implies about a 0.6 percentage point lower investment. The sample mean of  $I/K$  equals approximately 7.8%.

<sup>11</sup> Data on listed firms in 19 euro area countries come from Worldscope and cover the years 2001–16. Financial firms and utilities are excluded from the sample. The dependent variable is capital expenditure scaled by book equity and total debt. Issued equity is equal to one if net proceeds from share sales exceeded 2.5% of last period total assets. Debt overhang is the imputed value of expected lender recoveries in case of default. KZ refers to the Kaplan and Zingales (1997) index of financial constraints. A higher value of the index indicates a higher likelihood of being financially constrained. All specifications include country-year fixed effects for the four largest euro area economies. Standard errors allow for clustering at the firm level.

To investigate the relationship between debt overhang and investment for non-listed firms, we use a specific question from a recent Survey on Access to Finance of Enterprises (SAFE).<sup>12</sup> The answers relate to the period October 2016–March 2017. Hence, the analysis conducted reflects past developments. The specific question asks firms whether they are comfortable with their capital structure.

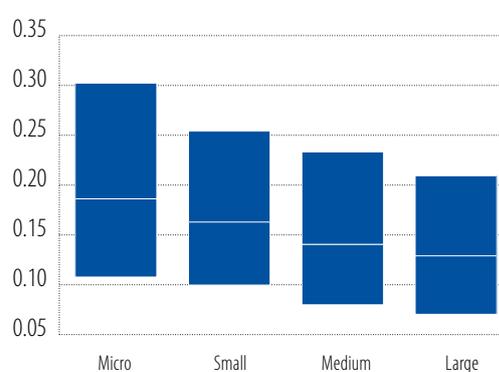
**Smaller firms are more likely to desire a lower level of debt.** Figure 8 plots the response to the ad hoc question conditional on firm size. Strikingly, about 40% of firms preferred a lower level of debt than they currently had. Around 50% of micro firms preferred a lower level of debt, a share decreasing with firm size. Conversely, the share of firms that would rather incur more debt appeared largely unrelated to size. It turns out that many of the firms that would like to take on additional debt were credit-constrained according to the SAFE, i.e. these firms either had a loan application rejected or were discouraged from applying.

**Figure 8**  
Leverage preference



Source: EIB calculations based on SAFE, Bureau van Dijck.  
Note: Based on the ad hoc question of the SAFE conducted in October 2016–March 2017.

**Figure 9**  
Volatility of capital structure



Source: EIB calculations based on SAFE and BvD.  
Note: The boxes represent the interquartile range of the firm-specific leverage ratio. The horizontal bar indicates the median. Higher values indicate a more volatile capital structure.

**Smaller firms may be less comfortable with a given level of debt because they have lower risk bearing capacity.** Figure 9 exploits ten years of balance sheet data to obtain the interquartile range of a firm's net debt ratio. The greater the interquartile range, the more volatile a firm's capital structure is. Figure 9 then uses boxplots to summarise the distribution of the net debt interquartile range conditional on firm size category. The boxplots indicate that smaller firms have to cope with greater swings in their capital structure. This could result from more volatile revenue streams; alternatively, individual investments and the associated financing needs loom larger in a small firm's balance sheet. The higher associated risk should result in a higher cost to access external finance, as the risk premium is higher.

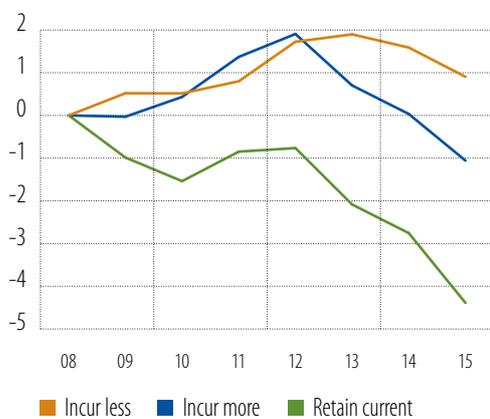
**Firms content with their capital structure have already successfully deleveraged.** Figure 10 displays cumulative changes in firms' net debt ratio since 2008. While 45% of firms in the periphery wanted to incur less debt, this was the case for only 36% of firms in the other economies. At the end of 2016, remaining deleveraging needs appeared greater in peripheral economies. Firms that were content with their current level of debt had reduced their ratio of net debt to total assets by four percentage points on average. Conversely, firms that preferred less debt had a higher average debt-to-asset ratio in 2016 than in 2008. Given that almost 40% of firms wanted to incur less debt, this suggests that the process of

<sup>12</sup> The question is: "Considering the current level of debt of your enterprise, what do you think would be best for your enterprise? Your enterprise should (a) incur more debt, (b) retain the current level of debt or (c) incur less debt".

balance sheet repair was not yet complete at the end of 2016. At the same time, it seems that firms that wanted to take on more debt were in fact forced to deleverage. These firms exhibit a marked decline in their debt-to-asset ratio from 2012 to 2015.

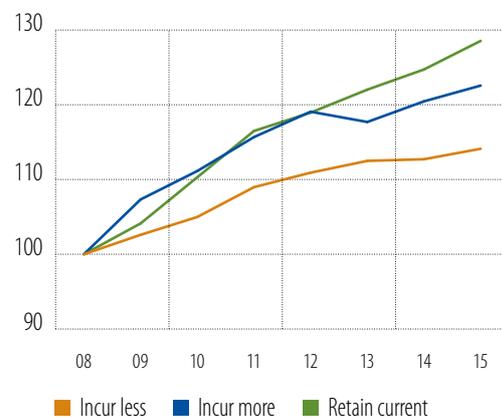
**Deleveraging has been accompanied by robust employment growth, particularly from firms satisfied with their capital structure.** Figure 11 shows employment growth relative to 2008, conditional on capital structure preference. Firms that were content with their level of debt in late 2016 increased their number of employees by almost 30% compared with 2008. Firms that would have preferred less debt increased employment by 15% over the same period. Hence, firms satisfied with their capital structure in late 2016 did relatively well throughout the crisis.

**Figure 10**  
Change in the net debt ratio by types of firms (deviation from 2008, p.p.)



Source: SAFE, BvD, EIB calculations.  
Note: Last record is 2015.

**Figure 11**  
Survey response and employment growth (2008=100)



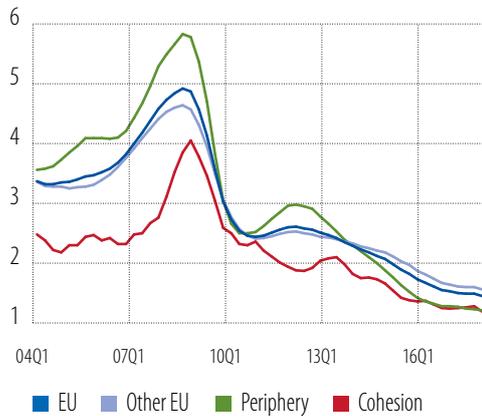
Source: SAFE, BvD, EIB calculations.  
Note: Last record is 2015. The level of employment is based at 100 in 2008.

## Corporates' borrowing costs and sources of external finance

**Together with the reduction in indebtedness, the decline in the composite cost of nominal debt alleviates the debt burden.** The share of gross interest payments over GDP has been decreasing since the middle of 2012 in each region (Figure 12). From the peak at the start of 2009 to the level at the start of 2018, the decline was especially pronounced in the periphery economies, reaching 4.5 percentage points of GDP. Starting from a much higher ratio in the periphery and a lower one in the cohesion economies due to the much lower level of corporate debt, indebtedness burdens became relatively similar for firms in the three country groups. At the beginning of 2018, firms' debt payment burdens were well below their average since the beginning of 2003, especially for the other economies and the periphery.

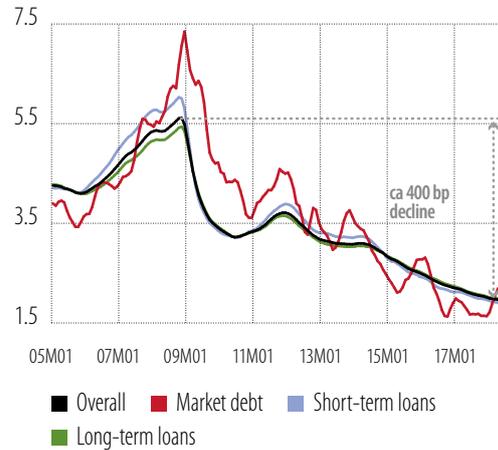
**Changes in the cost of debt were a major factor in this trend.** Figure 13 shows the decline in the composite nominal cost of short-term debt financing for EU firms. This is a very important component of external financing. Short-term bank lending rates were at historically low levels in 2018; this is also true for long- and short-term loans. Indeed, the overall cost of financing has decreased by about 400 basis points since the beginning of 2009. The low level of the overall cost of external financing should support both bank lending and debt issuance.

**Figure 12**  
**Indebtedness burden** (interest paid over GDP, %)



Source: ECON calculations based on Eurostat.  
Note: Owing to data limitations for Italy, periphery includes Cyprus, Portugal and Spain only. Four-quarter moving average reported. Unconsolidated accounts.

**Figure 13**  
**Overall cost of external financing** (% p.a.)



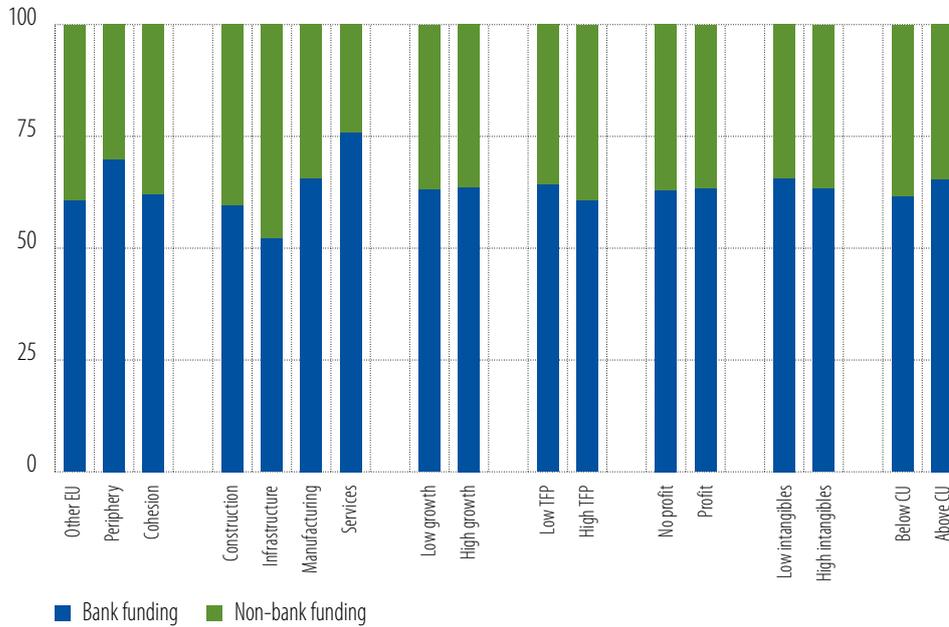
Source: ECON calculations based on ECB.  
Note: Data up to June 2018. Three-month moving average reported.

**Bank loans are the main external financing source in Europe, with little variation across firm types (Figure 14).** Bank loans and other types of bank finance account for more than half of firms' external financing (55%) on average. Leasing or hire purchases are also used to a considerable extent (24%). Capital markets, both external equity and debt, are used by an extremely small proportion of firms, making up on average 0.6% and 1.5% of external finance, respectively. Grants, including from public sources, account for around 5% of firms' external financing (ranging from 0.9% in the Netherlands to 16% in Romania and 18% in Hungary). The heavy reliance on bank finance is relatively homogenous across regions. Despite differences in business models and capital intensity, the split between bank loans and other types of external finance shows little variation across sectors and firm types, with the exception of the infrastructure sector, which tends to rely more on bonds and grants. Indeed, the EU financial system is bank-based (see Chapter 6).

**Since their most recent peak at the beginning of 2012, bank lending rates declined by more in the periphery than elsewhere (Figure 15).** When the sovereign debt crisis unfolded, the cost of borrowing in the periphery increased by more than in the other economies. Since then, the non-standard measures implemented by the ECB have succeeded in restoring the transmission of monetary policy (EIB, 2016). The spread between the two regions shrank and the rates became much more comparable. In June 2018, the cost of short-term bank borrowing stood at 20 basis points below its level in June 2017. Since mid-2017, the decline has also been more pronounced in the periphery than in the other regions (respectively 33 and 13 basis points).

**The decline in bank lending rates is associated with a subdued recovery in bank loans and the EU corporate debt market is catching up, supported by the ECB's CSPP.** Since the second half of 2017, the recovery in bank loans has nonetheless gained momentum, especially in cohesion and periphery areas (Figure 16). Over the same period, the stock of corporate bonds has grown at a higher rate. Corporate bonds represent a smaller source of finance than bank loans, and remain concentrated across countries and firms (EIB, 2016). However, as shown in Box C, stronger debt market activity can benefit the entire corporate system, as it frees up banking resources.

**Figure 14**  
Firms' external sources of investment finance (%)

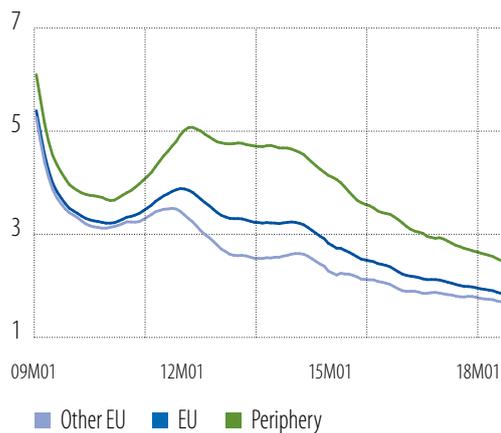


Source: EIBIS 2016-18.

Note: All firms that used external finance in the last financial year (excluding don't know/refused responses).

Question: Which of the following types of external finance did you use for your investment activities in the last financial year?

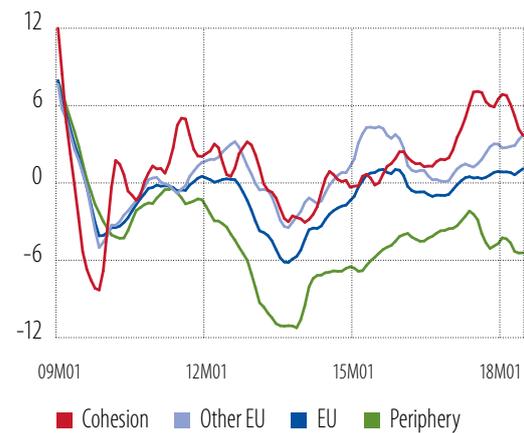
**Figure 15**  
Bank lending rates on short-term corporate loans (% p.a.)



Source: ECON calculations based on ECB.

Note: Data up to June 2018. Three-month moving average. Owing to limited data availability, the aggregate for cohesion is not available.

**Figure 16**  
Corporate bank loans (annual growth rate, %)



Source: ECON calculations based on ECB.

**The current low interest rate environment may favour the optimisation of firms' financial liability structure but also incentivises buybacks.** On the one hand, companies have continued to increase the average maturity of their indebtedness. Indeed, the share of short-term loans and debt in the total has declined to historically low levels. This partly reflects the flat yield curve that gives firms an opportunity to strengthen their funding structure by substituting long-term financing resources for short-term ones. On the other hand, low interest rates also induce firms to lever up and increase payouts to shareholders.<sup>13</sup> Such leveraged share buybacks and productive investment compete for funds; indeed, the former may crowd out the latter.<sup>14</sup>

13 The proposition finds some support in the empirical literature (Blundell-Wignall and Roulet, 2003).

14 Indeed, Archarya and Plantin (2018) show that below an endogenous lower bound, monetary easing generates only limited capital expenditures.

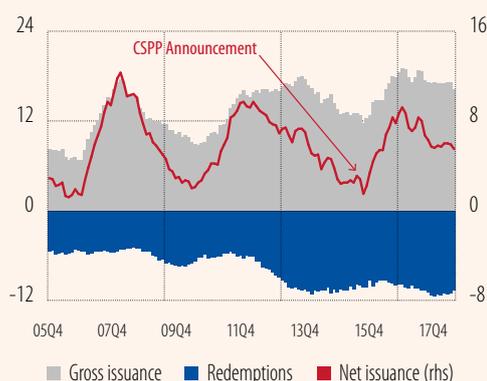
### Box C

#### Corporate bond market stimulus and access to finance for bank-dependent firms

As large corporate firms may substitute bank loans with relatively cheaper bonds, CSPP<sup>15</sup> may create spare capacity in banks' balance sheets that they can use to lend to bank-dependent firms, particularly SMEs, benefiting indirectly from the programme. Can an active corporate bond market also benefit firms that themselves do not issue bonds?

This question is addressed using the SAFE. The SAFE provides a representative sample of non-financial firms in the euro area, which has two advantages. First, it is possible to separate credit supply from credit demand, and the variable of interest is the shift in banks' credit supply to SMEs. Second, the survey is run twice a year, usually in April and October. As a result, the analysis can be carried out within a time window ranging from the year before and the year after the announcement of CSPP, mitigating the impact of confounding factors.

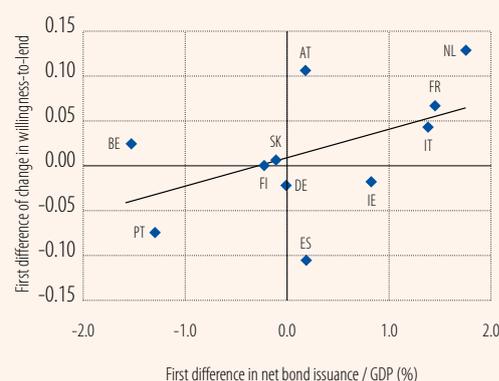
**Figure C.1**  
Issuance of longer-term non-financial corporate debt (% per year)



Source: ECON calculations based on ECB.

Note: Calculations based on outstanding amounts. Monthly data up to June 2018. CSPP: Corporate Sector Purchase Programme.

**Figure C.2**  
Net corporate bond issuance and banks' willingness-to-lend (changes in net percentages)



Source: Authors' estimations.

Note: The first difference is computed as one year after minus one year before the CSPP announcement.

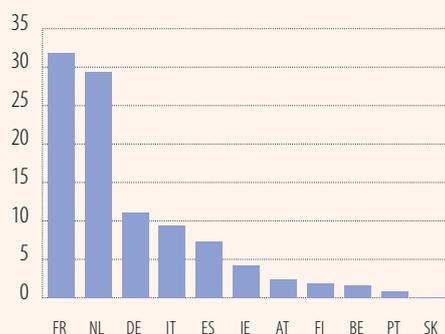
15 In March 2016, the European Central Bank (ECB) announced its programme of outright purchases of corporate bonds, CSPP. The programme aims at easing financing conditions in the real economy and stimulating the provision of new credit. To this end, the Eurosystem purchases investment-grade euro-denominated bonds issued by non-bank corporations (i.e. non-financial corporations and insurance corporations) established in the euro area.

Increased bond issuance is associated with stronger improvements in willingness-to-lend. To the extent that CSPP has stimulated corporate bond issuance, for which there is clear evidence (Figure C.1),<sup>16</sup> it can be argued that CSPP purchase flows have improved the credit supply to bank-dependent firms (Figure C.2). The empirical evidence supports the conclusion that the programme made a positive contribution to the provision of financing to bank-dependent firms, including SMEs, even after controlling for confounding factors.<sup>17</sup>

Larger bond markets appear to be more responsive to CSPP. A positive relationship exists between the relative corporate bond market size in 2015 and the change in net bond issuance scaled by GDP following the CSPP announcement. Figure C.3 shows the country shares of bonds outstanding as of 2015, before the announcement of the CSPP. France and the Netherlands have the largest markets, accounting for about 60% of corporate bonds outstanding in the euro area. Figure C.4 shows that net corporate bond issuance saw stronger growth in bigger markets one year after the CSPP announcement.

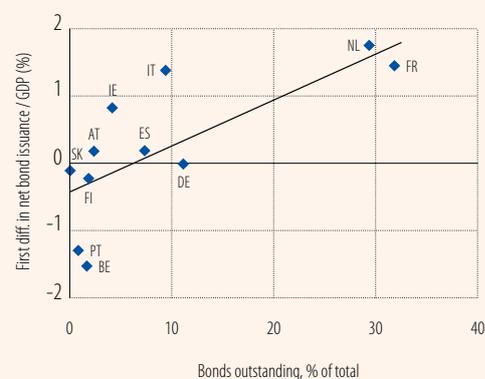
A bigger bond market, in terms of capitalisation, may make corporate QE more effective for two main reasons. First, a bigger market is likely to be composed of a larger number of participants. These firms traditionally issue bonds, so they may respond more promptly to monetary policy stimulus by substituting bank loans with corporate bond issuance. Second, a larger market may reflect a good institutional framework that in turn may prompt more firms to enter the bond market.

**Figure C.3**  
**Bonds outstanding in 2015**  
(% of total)



Source: Authors' calculations based on ECB.

**Figure C.4**  
**First difference in net corporate bond issuance and country share of bonds outstanding in 2015**



Source: Authors' estimations

Note: The first difference is computed as one year after minus one year before the CSPP announcement.

CSPP stimulated net corporate bond issuance. The reduction in loan demand from corporates active in the bond markets also benefited non-issuing firms. The effect was stronger in countries that had a larger corporate bond market prior to the CSPP announcement.

<sup>16</sup> ECB (2018c).

<sup>17</sup> Betz and De Santis (2018) present the corresponding econometric evidence. The explanatory variable of interest is the volume of Eurosystem net purchases of corporate bonds. Firm-level controls include size, age and changes in the firms' capital position, credit history and outlook as well as firm-specific fixed effects. Country-level covariates include one-year-ahead forecasts of GDP growth and inflation.

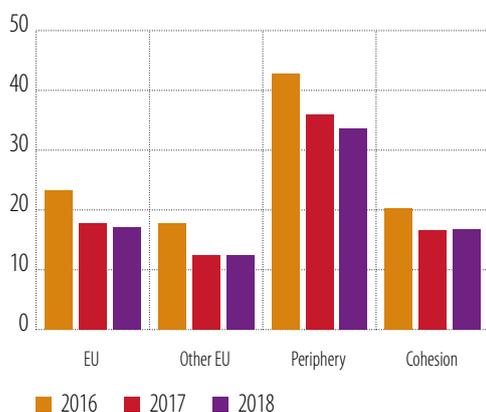
## Need for external finance and access to finance

**Firms' overall access to finance improved from the previous year but remains highly heterogeneous across countries. A small fraction of corporates are financially constrained.** Overall access to finance is not among the most prominent impediments to firm investment in the EU (Chapter 1). In the last financial year, the share of firms with constrained external finance declined from 7% to 5% on average. Funding conditions across countries remain markedly diverse, with several cohesion and periphery countries at the higher end of the distribution in terms of finance constraints. At one end of the spectrum, less than 2% of firms in Austria are financially constrained and, at the other end, more than 13% of firms in Latvia are financially constrained (Figure 18, x-axis).

**The number and intensity of obstacles perceived by firms tend to be related to firms' specific characteristics: "weaker" firms tend to report more impediments (Alves, Dejuan and Maurin, 2018).** Alves et al. show that at the EU level there is indeed a clear relationship between firms' characteristics and the sum of obstacles. Moreover, the direction of the relationship is intuitive: both a higher ROA and a stronger cash position are accompanied by fewer reported impediments. Conversely, a stronger leverage is associated with more impediments. The direction of these relationships remains common to all the country groups.

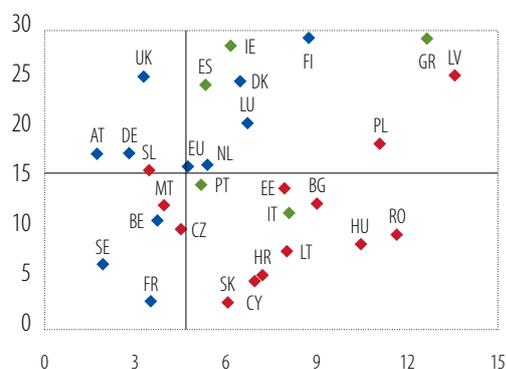
**The analysis suggests that variations in the share of firms perceiving finance as a major obstacle to investment need to be filtered out from the specific firm developments.** Despite continued improvement, access to finance remains more of an issue in cohesion and periphery countries in particular (Figure 17). While this may suggest stigmas, it also shows the need to discriminate types of firms reporting financial constraints. Filtering out the signal received from specific firm developments is a pre-condition to the design of targeted policy intervention.

**Figure 17**  
Finance as a major long-term obstacle



Source: EIBIS 2016, EIBIS 2017 and EIBIS 2018.  
Note: Percentage of firms.  
Base: All firms.

**Figure 18**  
Financing cross



Source: EIBIS 2018.  
Note: Percentage of firms.  
Base: All firms. x-axis: proportion of financially constrained firms. y-axis: proportion of firms indicating that the main reason for not applying for external finance was that they were "happy to use internal finance/didn't need finance". Levels reported.

**Looking at access to finance in conjunction with the ability to rely on internal funds suggests that, in the cohesion group, there are fewer possibilities to circumvent the tighter access to finance.** Figure 18 plots the share of firms that did not seek external finance because they felt that they had enough internal funds to finance their investment activities (y-axis) against the changes in the share of firms that were

constrained in terms of external finance.<sup>18</sup> The figure shows significant differences across countries, in terms of both access to external funds and internal-cash-generating capabilities. Firms in the south-east quadrant are likely to suffer more, as they are unhappy with their reliance on internal funds and with their access to external finance. This quadrant is mostly occupied by firms in the cohesion group. Conversely, firms in the north-west quadrant face a better financial environment. This quadrant is only occupied by firms in the other economies group.

**Often highly productive/viable firms are subject to financing constraints.** An efficient allocation of resources requires that capital flows to the most productive investment opportunities; theoretically, the efficient allocation of capital is supported by a return distribution over investment opportunities that incentivises the flow of resources to the most productive firms. Therefore, more productive firms should face fewer difficulties when trying to mobilise external financing than less productive firms. However, in the presence of market failures (such as asymmetric information between borrowers and lenders) and financial frictions, the allocation of financial resources can also be driven by other factors. In such conditions, a decoupling between firm-level fundamentals and access to finance can occur.

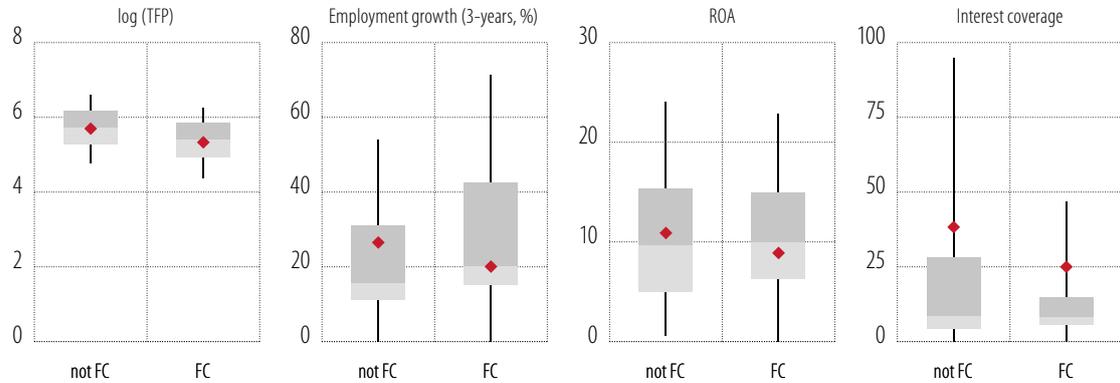
**Worse access to finance could explain weak productivity growth.** Several studies confirm that misallocation of resources has been identified as a bottleneck for productivity growth. Gorodnichenko et al. (2018) propose a simple theoretical framework, linking the within-sector dispersion of marginal products of capital and labour to efficient allocation of resources. Under a perfect allocation, the marginal products should be equal across firms operating in the same sectors. High dispersion can be related to distortions to the production sector and whether resources flow to the most productive investment projects. Gorodnichenko et al. argue that rising misallocation of resources in European countries could be a culprit for the productivity slowdown.

**On average, unconstrained firms tend to perform better than their constrained peers (Figure 19).** Indeed, financially unconstrained firms are more productive, have higher returns, grow more and are less burdened by debt. The difference remains contained, however. Conversely, the dispersion among financially constrained firms is quite substantial. For each indicator, a significant portion of the distribution of financially constrained firms overlaps with the distribution of financially unconstrained firms. Figure 19 shows that – despite being hampered – a significant share of financially constrained firms outperform their non-financially constrained peers in terms of total factor productivity, employment growth, profitability and interest coverage. This suggests that these firms are constrained for reasons other than their fundamentals and beyond their control, such as the structure of the financial system or the strength of the banking sector. The co-existence of promising companies with companies suffering from weaknesses in a context of heightened financial access calls for targeted/specific policies.

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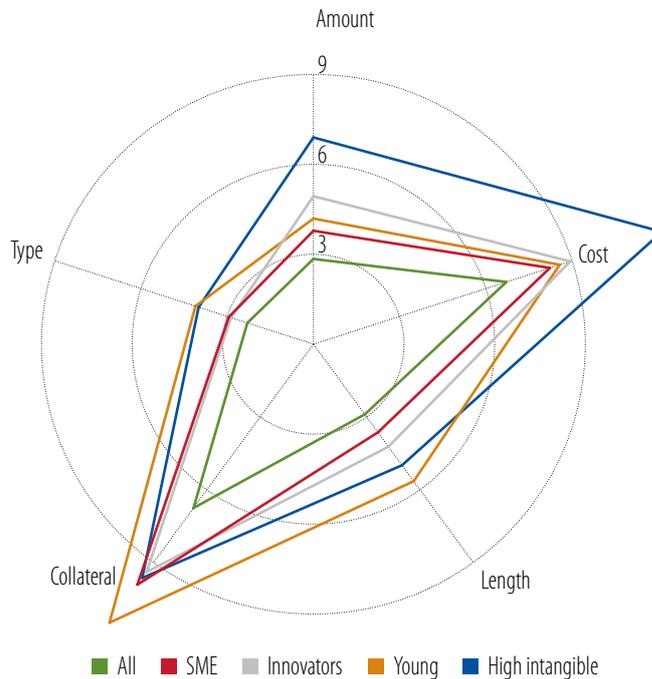
<sup>18</sup> That is, firms that applied for external finance for their investment activities and were rejected received less than what they asked for, did not take up the offer because they felt that it was too expensive or did not apply in the first place because they were afraid of being rejected.

**Figure 19**  
**The nature of financially constrained firms (2016)**



Source: Matched EIBIS/ORBIS database.  
 Base: All firms. The box indicates the interquartile range, the horizontal bar the median, the red diamond the mean and the vertical line the 10–90% distribution. Interest coverage is defined as: EBITDA-to-interest-paid ratio; the return on assets has been constructed as the ratio of EBITDA to total assets. Total factor productivity is the result of a sector-by-sector ordinary least squares regression of value added on total fixed assets and hours worked with country fixed effects.

**Figure 20**  
**Most exposed type of firms**



Source: EIBIS 2018  
 Note: All firms that were offered/received external finance.  
 Question: How satisfied or dissatisfied are you with ....?

**Moreover, access to finance remains a concern for some types of firms.** Differences are particularly significant with smaller firms (8%), younger firms (7%) and firms heavily invested in innovation and/or intangibles (6%) facing significantly higher barriers to accessing external funds than firms overall.

If, additionally, we distinguish between types of firms<sup>19</sup> – looking separately at smaller firms, younger firms, firms that invest heavily in innovation and intangibles – we find that concerns regarding all aspects of external finance are greater, particularly regarding the two main areas of concern: collateral requirements and cost of funding. For firms that invest heavily in intangibles, the amount that is available to raise is also a concern (Figure 20).

**Collateral requirements and the cost of funding remain the main areas of concern.** Figure 21 shows the share of firms dissatisfied with: the type of finance received; the collateral requirement linked to their funding; the length available; the cost of finance or the amount of finance received. It shows that, across all countries, firms are most dissatisfied with the collateral requirements associated with receiving funding.<sup>20</sup> This is most true for firms in Greece, Croatia and Slovakia (with between 15% and 20% of firms saying that they are either fairly or very dissatisfied with the collateral requirements linked to their funding). A relatively large share of firms are also unhappy with the cost of receiving external finance, particularly in Greece, Lithuania, Latvia and Croatia (Figure 21).

**Figure 21**  
 Dissatisfaction with type of finance offered/received (%)

	Amount	Cost	Length	Collateral	Type
All	3	7	3	7	2
Austria	2	6	2	10	1
Belgium	2	3	1	7	1
Bulgaria	1	7	3	12	4
Croatia	4	18	6	14	6
Cyprus	3	4	1	7	1
Czech Republic	1	5	1	3	1
Denmark	6	12	3	11	2
Estonia	5	2	1	10	1
Finland	6	12	3	12	2
France	1	4	3	6	1
Germany	2	6	1	5	3
Greece	8	23	8	18	6
Hungary	2	5	2	7	2
Ireland	2	12	2	7	1
Italy	4	7	7	9	4
Latvia	8	15	4	14	1
Lithuania	3	9	4	17	3
Luxembourg	3	1	2	3	2
Malta	0	3	0	7	0
Netherlands	8	11	2	7	1
Poland	3	8	5	8	2
Portugal	2	9	3	8	4
Romania	2	5	5	6	3
Slovakia	7	16	10	13	9
Slovenia	1	5	2	4	1
Spain	2	7	3	6	1
Sweden	4	9	3	6	2
United Kingdom	3	6	2	5	1

<sup>19</sup> Young firms are firms that have been established for less than ten years; firms investing in intangibles are those with more than 50% of their investment spend allocated to intangible assets; and innovating firms are those that introduced a new product, process or service in the last financial year.

<sup>20</sup> The dissatisfaction with collateral requirements possibly reflects collateral scarcity or the difficulty to evaluate collateral.

Source: EIBIS 2018.

Base: All firms that were offered/received external finance.

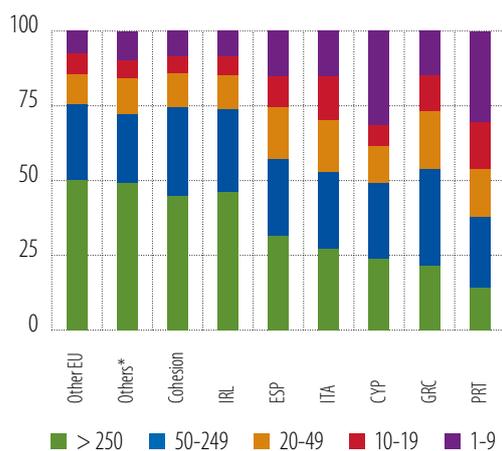
Question: How satisfied or dissatisfied are you with ...? The size of the bubbles and the numbers inside signify the share of firms that are (fairly or very) dissatisfied with a particular part of the finance that they received or were offered. Green bubbles refer to cases in the bottom quartile, red bubbles to the top quartile and orange bubbles for everything in between.

## Financial and financing conditions of SMEs<sup>21</sup>

**While SMEs are very important all across the EU corporate ecosystem, their relevance differs across regions.** In 2015, nearly 24 million SMEs in the European Union generated 56.8% of the total value added (European Commission, 2017). Figure 22 depicts the distribution of employees by size of enterprise across the three EU regions considered in comparison to an aggregate of other non-EU developed economies. Across time, the distribution is relatively stable; but across regions, it varies substantially. Enterprises tend to be smaller in the periphery: enterprises with fewer than 50 employees account for 45% of employment in this region, 30% in the cohesion and 25% in the other economies.

**Diversity within regions mimics diversity across regions.** For example, in the periphery, enterprises with fewer than 50 employees account for between 28% and 65% of employment. The minimum is recorded in Ireland and the maximum in Portugal (Figure 22). These stylised facts are important to understanding the conditions for accessing external finance across the EU, since SMEs are structurally more exposed to market incompleteness and financial frictions.

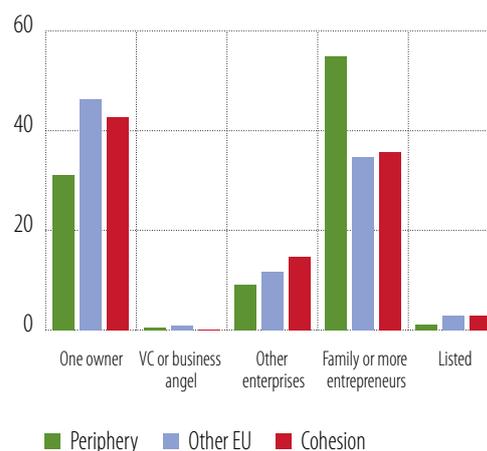
**Figure 22**  
Importance of SMEs



Source: ECON calculations based on OECD.

Note: Percentage of employees. Others\* refers to other developed economies outside the EU: US, Canada, Japan and Korea.

**Figure 23**  
Who owns the largest stake in your SME?  
(share of firms' answers)



Source: ECON calculations based on the SAFE.

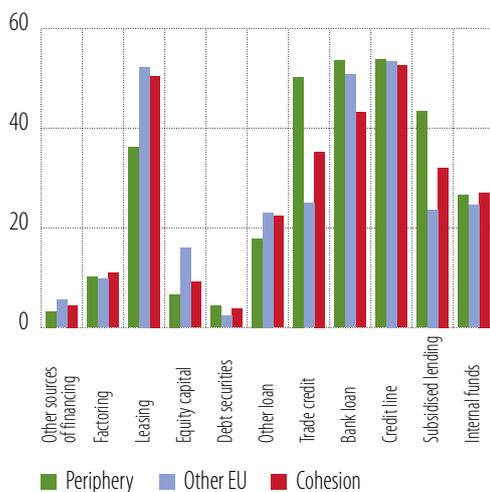
**SMEs are perceived as being riskier than larger firms for several reasons.** First, they are young, small, less transparent and, in many cases, family-run and owned by a single individual. Second, their financial structure is more rigid than that of large companies as they are more dependent on banks, and their capacity to substitute external financing sources is more limited.<sup>22</sup> The share of SMEs listed or owned by venture capital funds or business angels is small, even in other EU economies. It is negligible in the periphery and cohesion countries (Figure 23). Credit lines and bank loans are the most important sources of financing, together with leasing and trade credit (Figure 24).

<sup>21</sup> Large parts of this section are based on Kraemer-Eis et al. (2018b), i.e. the latest issue of EIF's European Small Business Finance Outlook (ESBFO). The ESBFO is published twice per year (typically in June and December) and provides an overview of the current SME financing situation in Europe.

<sup>22</sup> Besides, SMEs are perceived as riskier because they have a higher exposure to idiosyncratic shocks and tend to have less collateral. Moreover, estimating their creditworthiness is more challenging, as they are younger and subject to fewer reporting obligations.

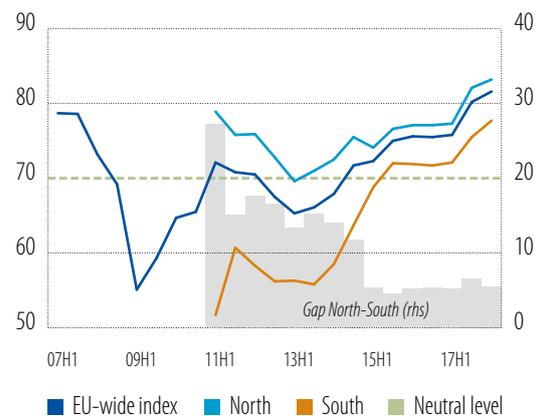
**Market access is almost non-existent for SMEs.** Debt securities have very limited relevance and equities are very scarce. Equity capital is a relevant source of funding for less than 20% of SMEs in other European countries, and less than 10% in periphery and cohesion countries. Small firms are frequently reluctant to open their capital to external investors, and are often too small for IPOs. On the supply side, information barriers are even more severe than for bank loans. Investors need to assess not only the financial viability of firms but also their growth prospects. Other sources of funding, such as private equity and angel financing, which have proved to be extremely important for innovative and fast-growing SMEs, are not very sizeable in the aggregate.

**Figure 24**  
**SME preferred source of financing**



Source: ECON calculations based on the SAFE.  
Note: Share of firms' answers.

**Figure 25**  
**SME Business Climate Index (%)**



Source: ESBFO calculations based on the semi-annual EU Craft and SME Barometer (UPEAME).  
Note: The index is calculated as the sum of positive and neutral answers with regard to the overall climate for business, averaged over the current climate and the expectations for the next period.

**Institutional investors such as investment funds, insurance companies and pension funds continue to play a limited role, especially in cohesion and periphery countries.** These investors can also be a relevant alternative source of funding to SMEs, given that they are patient investors and require highly diversified portfolios. However, their aggregate size is extremely heterogeneous across countries, with total assets worth 300% of GDP in Denmark and less than 12% of GDP in Greece. They have a strong home bias in their asset allocation, with limited scope for cross-country financial flows. Moreover, the market is highly fragmented with few operators able to carry out the minute appraisal required to invest in SMEs. Finally, while the larger pension funds and insurers do not have a home bias in their asset allocation, the smaller institutions have limited scope for cross-border investment (Darvas and Schoenmaker, 2017).

**The role of large institutional investors, such as pension funds and insurance companies, as investors in investment vehicles that provide alternative financing for SMEs is still relatively poorly developed in Europe.** This is confirmed by the results of the EIF VC Survey, a survey of European venture capital fund managers, in which respondents considered the involvement of pension funds as investors to be the most important element of the European venture capital ecosystem that is underdeveloped (Kraemer-Eis et al., 2018a).<sup>23</sup> Policymakers have started to introduce measures to improve the framework conditions for alternative SME financing, not least under the EU Capital Market Union (CMU) initiative; see Kraemer-Eis and Lang (2017).

23 The main results of the VC survey are discussed in Box C in Chapter 6.

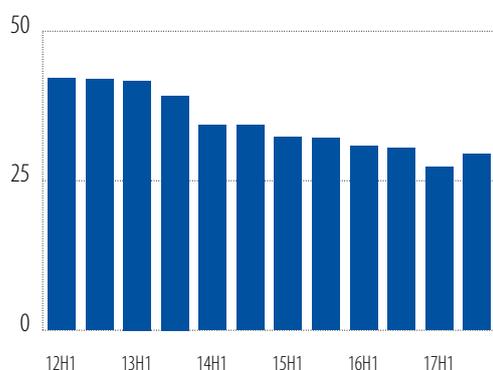
## Demand, constraints and external financing gaps<sup>24</sup>

**The outlook for European SMEs improved with the EU's economic recovery.** Figure 25 illustrates that SMEs are exceedingly optimistic about their economic situation. In the second half of 2017, the EU-wide index exceeded its pre-crisis level of early 2017. The gap between the north/centre and the south/vulnerable regions persists, but remains relatively low compared to earlier years, dropping one percentage point to 5.5%.<sup>25</sup> It is nonetheless difficult to assess this level given that the geographical breakdown does not cover the pre-crisis period.

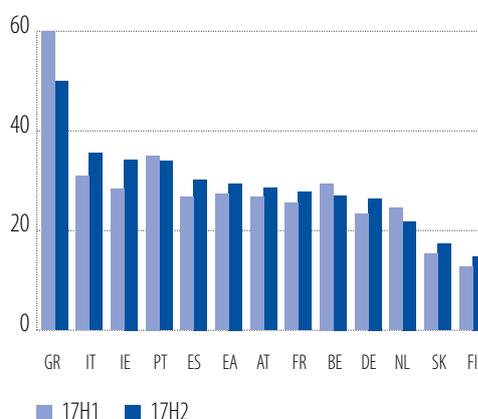
**In the euro area as a whole, around three in ten SMEs reported access to finance to be a highly important issue.** Figure 26 illustrates the extent to which euro area SMEs experience issues in accessing external finance. After successive declines over the preceding five years, this share increased slightly in the second half of 2017.

**Greek SMEs continued to struggle most when accessing external finance, and SMEs in the periphery tended to report tighter conditions than their peers in the other economies.** In the second half of 2017, 50% of Greek SMEs reported significant issues in accessing external finance (Figure 27). Their situation did improve significantly compared to the previous six months. This contrasts with Italian and Irish SMEs, whose access to finance deteriorated significantly. More generally, except for Spanish SMEs, which reported conditions similar to the euro area average, SMEs in the periphery tended to report tighter conditions than their peers in the other economies (Figure 27).

**Figure 26**  
SMEs listing access to finance to be a highly important issue (%)



**Figure 27**  
SMEs listing access to finance to be a highly important issue – country focus (%)



Source: ESBFO based on SAFE.

Note: Access to finance is assumed to be highly important if it is rated 7 or more, on a scale of 1 (not important at all) to 10 (most important). This indicator derives from survey item Q0b, urgency of problems that the firm is facing.

**Euro area banks continued to ease credit standards in 2017, for large firms as well as for SMEs.** The ECB Bank Lending Survey (BLS) provides information on the supply-side determinants of bank lending (ECB, 2018b). Based on it, Figure 28 plots the quarterly net change in credit standards applied to the approval of corporate loans and credit lines. The figure illustrates how banks' perception of credit standards for

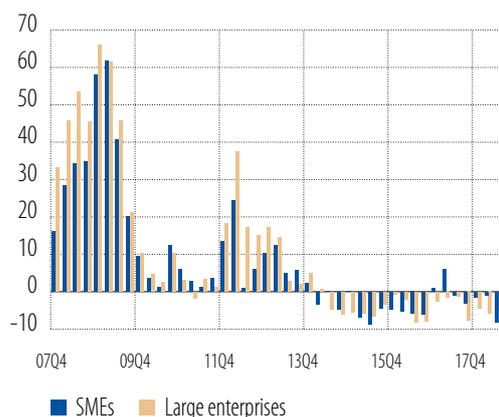
24 Most of the assessments of SMEs' access to external finance are based on survey data, as hard data disaggregated by firm size are rarely available. The sub-section presents evidence from the EU Craft and SME Barometer Survey as well as the SAFE. These two surveys provide information on financial and financing conditions of SMEs since 2009.

25 The north/centre group is comprised of Austria, Belgium, Bulgaria, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Hungary, Latvia, Lithuania, Luxembourg, the Netherlands, Poland, Romania, Slovakia, Sweden and the UK. The periphery region is comprised of Croatia, Cyprus, Greece, Ireland, Italy, Malta, Portugal, Slovenia and Spain.

firms has changed since the beginning of the financial crisis. The net change in credit standards continues to be negative, suggesting that banks are loosening credit standards. This occurs for large firms as well as for SMEs.

**SMEs and large firms continue to perceive the financing gap to be shrinking, for the seventh consecutive semester in the second half of 2017.** Figure 29 illustrates how loosening credit standards are reflected in corporates' perceptions of the external financing gap, a composite indicator constructed by the ECB, based on perceived changes in the needs and availability of external financing for firms. Since 2014, the gap has decreased more for large corporations than for SMEs. Over the last two half-years, the size gap, the perceived difference between the gap for SMEs and large enterprises, decreased substantially. This mostly reflected a deceleration of the pace at which large firms perceived the financing gap to be shrinking, as SMEs' perceived change in the financing gap remained roughly constant.

**Figure 28**  
Net changes in credit standards applied to the approval of loans or credit lines to enterprises (%)



Source: ESBFO based on BLS.  
Note: Balance of answers between banks reporting an increase and banks reporting a decrease.

**Figure 29**  
Perceived change in the external financing gap (%)



Source: ESBFO based on SAFE.  
Note: Balance of answers between corporates reporting an increase and corporates reporting a decrease.

**During the second semester of 2017, Italy and Greece remained the only two countries where SMEs perceived the financing gap to be growing.** Figure 30 illustrates the heterogeneity among countries in SMEs' perception of the (change in the) financing gap. In general, the situation of external financing markets for SMEs improved significantly compared with the 2011–12 period, particularly in Ireland, Spain, Italy and Portugal. The rate at which Greek SMEs perceived the financing gap to be growing dropped considerably compared with 2016. In all other countries for which data are available, negative values imply that SMEs believed the gap between the supply of and demand for external finance was decreasing. Consistent with the strong economic recovery in Spain, the perceived reduction of the gap was strongest in this country.

The next sub-section elaborates on access to bank finance, which seems to be of particular concern for SMEs as the previous paragraphs have shown.

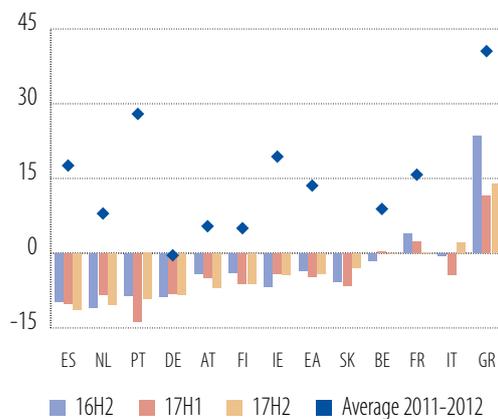
## Access to bank finance

While monetary policy continues to drive borrowing costs for non-financial corporations down to record lows, the interest rate spread between small and large loans remains significant and varies strongly across economies.<sup>26</sup> Figure 31 illustrates the evolution of interest rate levels for different loan sizes, by maturity, over the past two years. The ECB's composite borrowing cost indicator reached another record low of 1.67% at the beginning of 2018.

**The interest rate evolution might be on the verge of a turnaround.** As shown in Figure 31, for the first time in years there were no consistent declines in interest rates across all categories. Moreover, long-term interest rates increased across all categories, including for small loans. Although the cost increase for the small loan category was relatively modest, it could imply the start of trend reversal. This means that rising interest rates will increase the cost of durable investments. Short-term lending, on the other hand, continued to get cheaper, especially for small loans.

**Regardless of maturity, small loans are burdened with higher interest rates (Figure 31).** There is, however, some evidence that the situation has been normalising, since the interest rate spread has been declining to its pre-crisis historical average. It is interesting to note that the spread for loans with short-term maturities is wider than that for loans with long maturities (of above five years). This confirms that small loans are mostly obtained by SMEs, as smaller firms tend to be more short-term-debt oriented (EIB, 2017; Masiak et al., 2017).

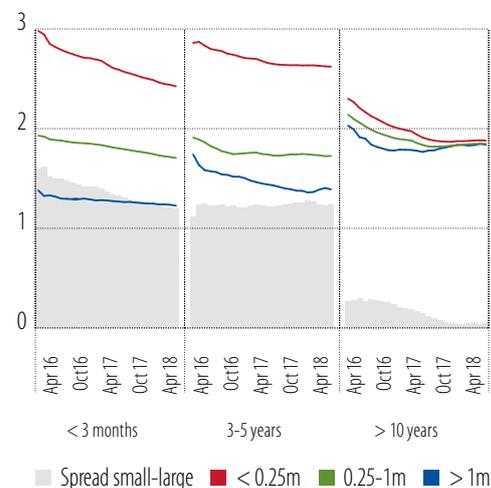
**Figure 30**  
Perceived change in the external financing gap by SMEs at the country level (%)



Source: ESBFO based on the SAFE.

Note: The horizontal blue marks denote the average level of the index in 2011–12, the period in the aftermath of the crisis when SMEs reported the highest values of the perceived change in the financing gap.

**Figure 31**  
Interest rates by loan size and maturity, and size spread (%)



Source: ESBFO based on ECB.

Note: The figure depicts the 12-month backward moving-average floating interest rates charged by banks on loans to non-financial corporations (other than revolving loans and overdrafts).

<sup>26</sup> Although this information is not made available by firm size, it is published for three distinct loan size categories: small loans (<EUR 0.25 million), medium-sized loans (EUR 0.25 million to EUR 1 million) and large loans (>EUR 1 million). Assuming smaller loans are predominantly used by smaller firms, one can employ this information to draw some conclusions on the different lending conditions faced by firms in different size classes.

**There is still a wide diversity of SMEs' financing conditions within the EU, with SMEs in the periphery and cohesion countries facing tighter access.** To synthesise the various sources of information related to SMEs' access to finance, EIF's Research & Market Analysis<sup>27</sup> has established the EIF SME Access to Finance Index (ESAF, see Box C). The indicator emphasises the wide diversity of SMEs' financing conditions within the EU, a conclusion also reached when considering the share of credit-constrained SMEs in the EIBIS.

<sup>27</sup> See [www.eif.org](http://www.eif.org) for more information about EIF. See [http://www.eif.org/news\\_centre/research/index.htm](http://www.eif.org/news_centre/research/index.htm) for more information about EIF's Research & Market Analysis and its publications.

#### Box D

##### The EIF SME Access to Finance Index (ESAF)

The ESAF is a composite indicator that summarises the state of SME external financing markets for the EU28 countries. It was first introduced and elaborated upon in the European Small Business Finance Outlook, a semi-annual European Investment Fund Working Paper (see Kraemer-Eis et al., 2016). The indicator provides a convenient tool to compare and benchmark country performance in the context of SMEs' access to finance in the EU.

The index is composed of four sub-indices, related to loans, equity, credit and leasing, and the general macroeconomic conditions in which SMEs operate. The sub-indices are in turn comprised of a series of variables. The normalisation process proceeds using the min-max method and indicators are geometrically aggregated, after being weighted equally. The min-max normalisation method implies individual countries' ESAF values require a relative interpretation, *vis-à-vis* the worst and best performing country on the respective sub-indicators. The methodology is elaborated upon in Gvetadze et al. (2018).

The relative interpretation implies that, while it is possible to compare the ESAF values of countries within a given year, or compare how the relative position of countries has changed over time, it is problematic to interpret an ESAF value isolated on a scale of 0 to 1. For example, by itself, a value of 0.5 does not imply that a country performs averagely in terms of access to finance. Instead, it implies that a country performs averagely compared with the best and the worst performing countries. It is also not possible to track the performance of an isolated country's ESAF over time. An increase in the value of its index does not necessarily imply that SMEs in that particular country gained increased access to finance. The results of the most recent update, using data for 2017, are presented in Figure D.1 (red dots).

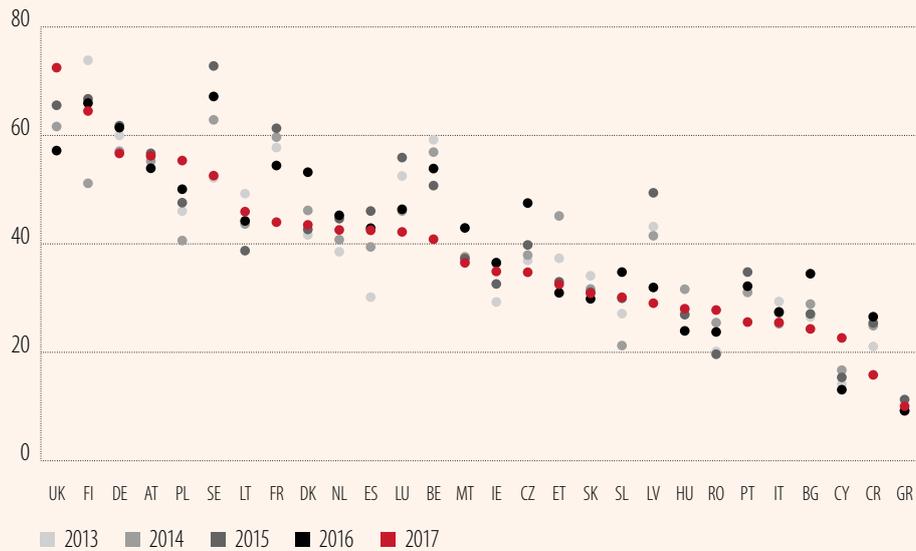
The 2017 ESAF ranking is headed by the UK, which takes the lead from Sweden. While the UK has consistently performed well over the past five years, the improvement in British SMEs' finance conditions between 2016 and 2017 might come as a surprise to some, given the political background against which it occurred. Sweden fell five spots in the ranking and, in addition to the UK, is now preceded by Finland, Germany, Austria and Poland, recording its worst relative performance since the beginning of measurements. Sweden and the UK also experienced the biggest change in the absolute value of the indicator. Sweden's ranking drop appears to be caused by a deterioration in the conditions on the credit and leasing market, but the macro conditions also turned less favourable.

Greece still closes the ESAF ranking, preceded by Croatia, which fell back two spots in the ESAF ranking due to the dismal performance of its equity markets (last place) and deteriorating conditions on both the loan market (28<sup>th</sup> place) and the credit and leasing market (26<sup>th</sup> place). Cyprus, due to positive evolutions in both the equity as well as the loan market, was therefore able to move up one place, after ranking next to last from 2013 to 2016.

Two other noteworthy positive performances are by Spain and Romania. For Spain, the 2017 improvement implies a continuation of its gradual climb in the ranking, from 21<sup>st</sup> to 11<sup>th</sup> place over the course of the last five years. The favourable evolutions on the Spanish external finance market are in line with the exceptional post-crisis recovery it has experienced, reflected in strong growth numbers and a significant decline in its unemployment rate.

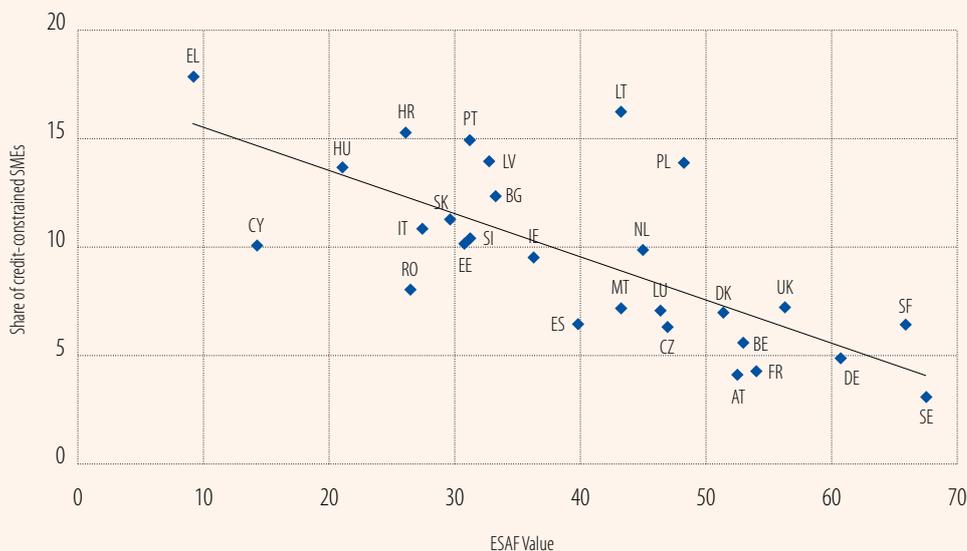
**Figure D.1**

**The EIF SME access to finance index** (rescaled to 0-100)



**Figure D.2**

**ESAF and proportion of firms reporting being financially constrained in the EIBIS**



Source: Gvetadze et al. (2018) and EIBIS 2017.

The ESAF measures relative external financing conditions in the broadest way possible, by proxying not just the gap between finance supply and demand, but all aspects of SME access to finance, including its general availability and cost. Figure D.2 illustrates that there is close (negative) correlation (-0.72) with the proportion of SMEs reported to be financially constrained, an indicator derived from the EIBIS.

## SME securitisation and policy actions targeted at SMEs

**Various actors target SME lending as a policy goal.** Among these are various national promotional banks and international financial institutions, including the EIB Group (the European Investment Bank and its sub-holding, the European Investment Fund). Incentives have been set up to support SMEs' access to finance, including favourable lending conditions, credit guarantee schemes, guarantees on issuances of mini-bonds and various forms of incentivised venture capital and private equity funding. Initiatives developed under the Capital Market Union (CMU) can also foster the exchange of information and improve market infrastructure (Box D).

**Guarantee products can support SME access to finance.** Credit guarantees are among policy instruments which are extensively used by financial institutions in western Europe (Chatzouz et al., 2017). The national/regional guarantee institutions are the main suppliers that meet the demand for credit addressed by SMEs, but multinational providers such as the EIB Group can also play an important role.

**A functioning securitisation market can transform illiquid loans to SMEs into an asset class with adequate market liquidity** (EIB 2017, Chapter 6, Box 3). SME securitisation (SMESec), which includes transactions backed by SME loans, leases and other products,<sup>28</sup> can provide indirect access to capital markets for SMEs. When analysing SMESec, it is important to look not only at bank lending, but also at leasing companies, which form part of the securitisation market. Given that bank financing has been less available for leasing companies post-crisis, it may be expected that SMESec could be more relevant for leasing.

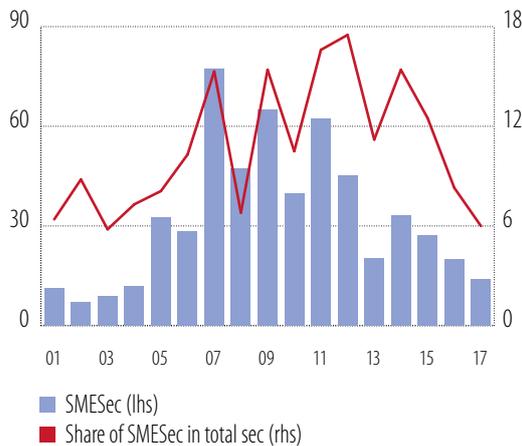
**SMESec issuance remains at low levels as it is still suffering from the crisis.**<sup>29</sup> The European securitisation market had grown steadily from the early 2000s until the outbreak of the global financial crisis. Yet, in 2017, the overall issued (and visible) volume of SME deals (EUR 14.1 billion) was significantly lower than 2016 values (EUR 19.9 billion, Figure 32) and at its lowest value since 2004. In terms of countries, the market activity is concentrated: in 2017, SMESec issuance occurred mainly in Belgium (EUR 5.7 billion, 40% of SME issuance), Spain (EUR 3.8 billion, 27%), Italy (EUR 2.8 billion, 20%), and to a lesser extent in Portugal and Germany.

**The market share of SMESec in overall securitisation remains low compared to the historical average.** It rose from 6% in 2001 to 18% (of total yearly issuance) in 2012, the highest value ever registered in Europe. Since then, it has declined. In 2017, the share of SMESec went back to 6%, and in the first quarter of 2018, it reached only 5%. The decline reflects decreased origination activity as well as the shrinking stock of SME loans in the financial intermediaries' loan books.

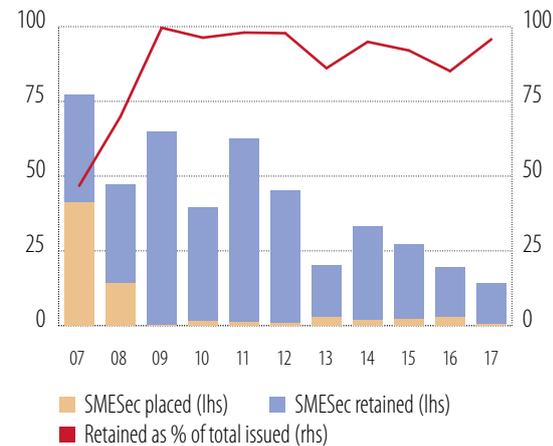
28 For more information on the importance of leasing for SME finance, see Kraemer-Eis and Lang (2012).

29 The source for market activity data in this section is AFME (2018).

**Figure 32**  
**Issuance of SME securities in Europe:**  
**volume and share of total securitisation**  
(EUR billion, left-hand side; and %, right-hand side)



**Figure 33**  
**European SME securitisation by retention**  
(EUR billion, left-hand side; and %, right-hand side)



Source: ESBFO based on the Association for Financial Markets in Europe (AFME).

Note: SMESec: securitisation of transactions for small and medium-sized enterprises.

**The nature of the SMESec market changed during the crisis.** It went from being a developing market pre-crisis (with most transactions placed in the primary market) to a purely retained/ECB repo-driven market during the crisis. Less than 5% of issuance is placed with investors.<sup>30</sup> It is therefore not surprising that typical originators are not only large banks or banking groups – some of these are active as originators in several countries – but also mid-sized banks. In the field of leasing, non-bank asset finance providers are active as originators. Current market activity is dominated by repeat originators (Moody's, 2018). The shift towards retained securitisation led to liquidity drying up during the crisis.<sup>31</sup> Consequently, origination requires higher all-in costs as, in addition to credit enhancement, repos include considerable haircuts to the face value of the notes.

**Despite the financial and sovereign crisis and a prolonged negative economic cycle, the European securitisation market in general has performed relatively well, with comparatively low default rates.** However, as indicated, the European SMESec market has still not recovered, many years after the crisis. Resolving this problem could be helped by developing short- and medium-term perspectives as well as reasonably defined criteria for simple, transparent and standardised securitisations that should receive preferential regulatory treatment.

<sup>30</sup> The ECB's asset repurchase or "repo" facility allows asset-backed securities, among other assets, to be used as collateral for funding.

<sup>31</sup> The shift towards retained securitisation enables originating banks to repo the security in central banks' operations.

**Box E****The Capital Market Union and SME financing: a pooling or separating equilibrium**

Several lines of action envisaged for the CMU target SME finance (see the Capital Market Union action plan for a review<sup>32</sup>). Compared to fragmented national markets, a fully integrated capital market, as foreseen by the CMU, can help solve the information problem typically affecting SME financing. Here we show that this can be achieved in two (non-exclusive) ways.

- Separating equilibrium: the CMU favours the emergence of efficient information technologies, discriminating between viable and non-viable SMEs. In this case, conditions for good firms improve, but worsen for smaller and more opaque SMEs.
- Pooling equilibrium: the CMU fosters better diversification and spreading of the risks and costs of financing SMEs, even if full discrimination between viable and non-viable SMEs is not achieved.

A basic common EU framework for providing a standardised system of information would be extremely useful in achieving a separating equilibrium. The scale of the CMU provides a powerful incentive to implement such initiatives. Possible measures include EU-wide business registers with standardised information, comparable rating methodologies, credit registers and a common Prospectus Regulation. These measures have the potential to simplify the comparability of information and thus improve allocative efficiency with a better matching between supply and demand of funding.

While rules and standards for transparency would help significantly, financial instruments may in themselves develop efficient mechanisms for information processing. We first look at banks and then at non-banking capital markets.

**Global banking**

Banks are likely to remain dominant in funding SMEs. Owing to the opaqueness of SMEs, it is unlikely that new technologies will be able to supplant the collection and processing of soft information through long-term banking relationships. As soft information is intrinsically difficult to standardise, relational banking will still play a crucial role in discriminating between viable and non-viable SMEs. However, the CMU can have an important effect on the way soft information is used and processed by banks. Consider three possible developments.

- (1) CMU favours a further internationalisation of the European banking sector. Transnational banks may have different lending behaviour from national ones, especially those operating in local markets. On the one hand, they may use more selective lending technologies. On the other, they can exert competitive pressure on local banks. According to Petersen and Rajan (1994), incomplete contracts between a lender and a borrower are sustained through repeated interactions and expected future rents. When competition kicks in, these rents are reduced and the relationship can break down.

The integration of banking activities within the CMU may therefore force local credit systems to become more selective in their credit allocation towards viable SMEs. Consequently, there would be a shift towards a logic of cherry picking, with limited attention paid to local interests. As argued for example by Detragiache et al. (2008), this can have important implications for peripheral local markets. As the best firms are drawn towards funding from global banks, lending conditions for the other firms will likely worsen. As default rates in the pool of the worse firms is higher, credit for them will become dearer and scarcer.

<sup>32</sup> See [https://ec.europa.eu/info/business-economy-euro/growth-and-investment/capital-markets-union/capital-markets-union-action-plan\\_en](https://ec.europa.eu/info/business-economy-euro/growth-and-investment/capital-markets-union/capital-markets-union-action-plan_en).

- (2) Banks (local and foreign) may securitise loans more easily in a larger market. An integrated European capital market may help banks dispose of securities backed by bank loans to SMEs, reducing the capital absorption and hence the cost of SME lending (Panetta and Pozzolo, 2018).
- (3) Banks may act as advisors to SMEs willing to enter capital markets. Banks could help their clients to reach standards of governance and transparency enabling them to enter the international capital markets, and could support them in undertaking the necessary steps towards such markets. In these cases, banks would develop fee-based lines of business. Banks are probably the only institutions able to become information brokers, transforming soft into hard information and helping local firms access global markets, indirectly (securitisation) and directly (advisory), thus softening the core–periphery effect of the CMU. This development could take place even if foreign banks do not enter local markets.

### Capital markets

Developing a package for SME listing on public capital markets is one key objective of the CMU. Here, information requirements might be more stringent than for banks, especially in the case of equity, where the growth potential of the companies matters beyond their business viability. Moreover, hard information is crucial because capital markets match investments to investors through decentralised mechanisms and distant geographies. Information is processed and provided by agents, who act as intermediaries. These agents likely have a stake in the information processing either because (1) they can be interested in preserving the functioning of a specific market and its network externalities, or (2) they have an interest in providing accurate information, as they are also investors with skin in the game.

The first case applies, for example, to pan-regional equity platforms, where SMEs can list in multiple jurisdictions. These forms of financing are still in their infancy but it would be essential to achieve a critical mass of listings and liquidity unavailable to national platforms. National differences still hinder the cross-country integration of such platforms (taxation, listing and disclosure requirements, anti-fraud regulations, post-trade costs, constraints on foreign ownership). Platforms themselves have a strong interest in assessing participants in the market. These being typically two-sided markets, the selection process is crucial in attracting as many investors and as many good firms as possible on the two sides of the market. Hence, the CMU will crucially favour this process of integration and thus improve the matching of demand and supply with deeper and more efficient markets.

The second case applies when the initial investment assessment is carried out by an agent that also participates in the investment and keeps some skin in the game. This is the case for asset-backed securities, if they are retained by the originator (as discussed for banks above), and by venture capital, private equity and all sorts of other funds. Again, all these are measures envisaged within the CMU. Information is therefore directly processed and generated by the initial investor. A similar principle could also direct long-term investors such as pension funds and insurance companies towards SMEs. Even if these institutions lack the scale and the skills to select viable investments, as discussed above, their operations could be intermediated by specialised investors able to process information. Also, as cross-border activities of such institutions are frequently constrained by regulatory and institutional impediments, the CMU will likely lift many such barriers.

Summing up, the information-processing mechanisms linked to specific financial instruments, which will likely grow under a CMU, may help to achieve a separating equilibrium. The allocation of capital will therefore improve across the Union.

A generalised transition towards transparency and standardised information is already affecting firms' behaviour and will certainly continue to do so. However, many firms will not be able to achieve standards of transparency and governance and growth potential compatible with these financial developments. If the financial resources marshalled by global markets concentrate only on the most

transparent firms and if the lower layer of more opaque firms is deep enough, then a core–periphery pattern in which some viable projects are not financed will likely emerge. Within this framework, markets will be unable to support risky start-ups and less transparent firms that nevertheless provide a large share of employment. There is consequently a potential scenario where public intervention might be necessary anyway, with a growing role for instruments such as public guarantees. Common European rules for managing guarantee funds will be useful instruments within the CMU.

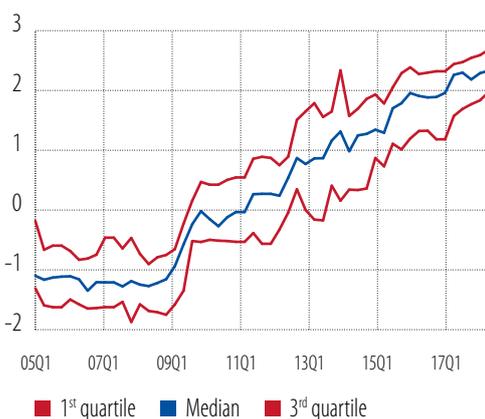
Given the importance of banks in the EU financial system, we now turn to a more detailed analysis of the links between bank credit and the corporate ecosystem.

## Bank credit and the corporate ecosystem

### EU banks and the macroeconomic environment

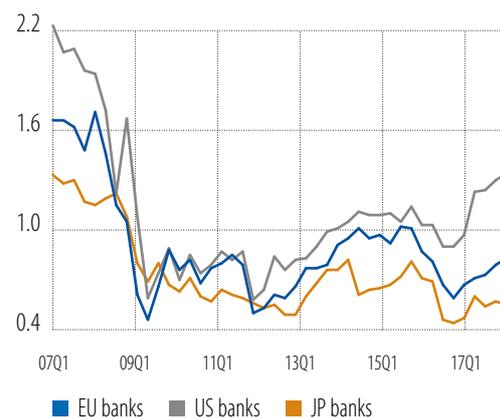
Since the beginning of 2010, on the back of more stringent regulatory requirements and more adverse market conditions, EU banks have increased their capital positions in an unprecedented manner. In the middle of 2017, the total average Common Equity Tier 1 (CET1) ratio of the EU banking sector stood at 13.8%,<sup>33</sup> 13.5% for larger banks and 15.0% for smaller banks (EBA, 2018). From the middle of 2011 to the middle of 2018, larger European banks increased their CET1 ratio by 702 basis points. Overall, even after including the surcharges for systemically important institutions, there is no remaining capital shortfall (EBA, 2018a).

**Figure 34**  
Factor-based measure of the capital and leverage ratios of EU banks



Source: Authors' computations based on Thomson Reuters Datastream. See Galiay and Maurin (2015)

**Figure 35**  
Banks' relative valuation (price-to-book ratios)



Source: Authors' computations based on Thomson Reuters Datastream.

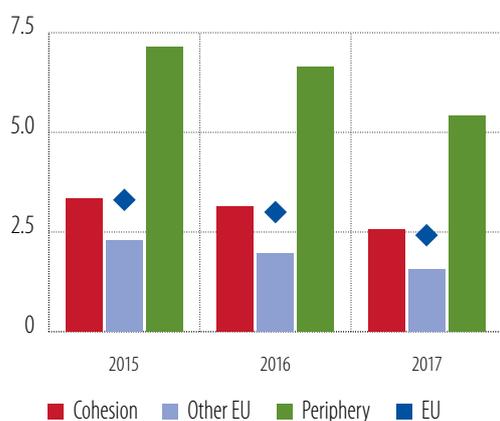
33 The estimate assumes full implementation of the Capital Requirements Directive/Capital Requirements Regulation (CRD IV–CRR) in the Basel III framework.

**Fears of the negative impact of the very low interest rate environment have not materialised (Rose et al., 2018<sup>34</sup>) and overall, EU banks have become more resilient.** Figure 34 reports a composite indicator that provides a more comprehensive view of the strength of banks' balance sheets. This is obtained by computing the principal component of a broad set of measures, such as the total capital ratio, risk-weighted capital ratio, leverage ratio and loan-to-deposit ratio (Galiay and Maurin, 2015).<sup>35</sup> The indicator of banks' strength has been on an upward trend since the beginning of 2009, suggesting that the evolution in banks' balance sheet structure has made them more resilient to adverse shocks.

**EU banks remain confronted with challenges and uncertainties that hamper their valuation (Figure 35).** With the worldwide improvement in economic conditions, banks' income should rise and support their valuation. Indeed, since the middle of 2016, the relative valuation of bank stocks has rebounded in advanced economies, mostly in the US but also in the EU (up to end-2017) and to some extent in Japan. However, the gap between banks' relative valuation in the EU and the US has increased. Several factors can explain this: the relative position in the business cycle (with stronger economic activity in the US); evolution of the business model; further regulatory adjustments, more stringent in the EU than in the US; or uncertainty regarding impaired assets. The ongoing EBA stress test, by further improving transparency and confidence, should support banks' valuation (EBA, 2018b).

**The intensity of impaired assets has reduced and the gap in non-performing loan ratios across regions has narrowed.** When considering non-performing loans (NPLs), it is important to look at non-covered NPLs. Indeed, NPLs not backed by provisions or collateral are those that provide a better proxy of the risk faced by a bank. Figure 36 shows the ratio of uncovered NPLs to total assets. This has been declining across the three regions since data became available. The decline was strongest in the periphery countries, albeit from a higher level, pointing to convergence. However, in this region, the ratio remains twice as high as the EU average.

**Figure 36**  
Uncovered NPL ratio (% assets)



Source: Authors' computations based on EBA Risk Analysis Report.

**Table 4**  
Dissatisfaction with external finance

	Country groups		
	Cohesion	Other EU	Periphery
<b>Amount</b>			
Share of dissatisfied firms	5	4	6
<b>Cost</b>			
Share of dissatisfied firms	11	8	15
<b>Maturity</b>			
Share of dissatisfied firms	4	3	7
<b>Collateral</b>			
Share of dissatisfied firms	17	12	13

Source: Authors' computations based on ORBIS and EIBIS. See Kolev et al. (2018).

34 Rose et al. indicate benign implications of negative rates for commercial banks thus far. They examine the effect of negative nominal interest rates on bank profitability and behaviour using a cross-country panel of over 5 100 banks in 27 countries. Their dataset includes annual observations for Japanese and European banks between 2010 and 2016, covering all advanced economies that experienced negative nominal rates, including currency union members as well as both fixed and floating exchange rate countries. Comparing negative nominal interest rates with low positive rates, banks experience losses in interest income that are almost exactly offset by savings on deposit expenses and gains in non-interest income, including capital gains on securities and fees.

35 Based on 33 listed EU banks located in Austria, Denmark, Estonia, France, Germany, Italy, Portugal, Spain, Sweden and the UK. The blue line depicts the median of the distribution, and the red lines the first and third quartile. For each bank, the principal component of a set of indicators is computed and demeaned over 2003:Q1–2018:Q2. For each bank, an increase in the indicator suggests that the bank's capacity to withstand adverse shocks has improved.

**The reduction in the degree of impaired assets bodes well for banks and the economy as a whole.** In general, banks with a high NPLs ratio are likely to react by tightening credit standards (EIB, 2017; Aiyar et al., 2015). When affecting a large part of the domestic banking sector, as during a financial crisis, NPLs are likely to distort the efficient allocation of savings, resulting in credit misallocation.<sup>36</sup> In this case, NPLs lock bank capital into backing unproductive assets at the expense of firms that may have more profitable investment projects. In addition, SMEs are likely to be more affected, as they are more dependent on banks.

**Sovereign exposure and bank funding could become potential issues when monetary policy is normalised.** To some extent, the end of the Asset Purchase Programme has contributed to supporting sovereign debt valuation in banks' balance sheets. A depreciation associated with the termination of the programme would impair bank asset valuation significantly given the still high level of exposure, especially in some jurisdictions. Once policy normalises, other sources of liquidity will have to substitute for the extensive liquidity provided by central banks. The cross-border interbank market will have to re-activate and long-term funding will need to play a larger role.

### Banks' strength and satisfaction with banks' credit

**The level of dissatisfaction with bank loans continues to vary widely across the regions (Table 4).** Corporates in the periphery tend to be more dissatisfied with the cost and collateral requirements associated with the financing provided. Firms in the cohesion group tend to be more concerned with the collateral required. Hence, the conditions for accessing bank finance continue to be different. To some extent, however, this can reflect the weaker outlook of weaker corporates.

**When analysing bank credit, it is important but difficult to disentangle what refers to credit supply, the determinants on the side of the bank, and what refers to credit demand, the borrower characteristics.** This step is required before monitoring the relative importance of each and designing adequate policies. At the macroeconomic level, auxiliary information has been used to ensure identification.<sup>37</sup> At the microeconomic level, empirical evidence is rarely required to match bank-firm data and information on access to credit conditions at the loan level.

**Based on the matching entailed in the EIBIS, it is possible to study the determinants of corporations' satisfaction with bank lending in several ways, and to disentangle the effects of borrowers' and lenders' financial health.** Kolev et al. (2018) match banks with corporates: unique information at the EU level provided by the EIBIS. They find significantly different effects of demand- and supply-side factors on credit conditions across regions in Europe. While heterogeneity of banks' financial health has a significant impact on bank lending conditions in other economies, the effect is essentially insignificant for the period covered (2015-16).

**In periphery countries, corporates associated with banks with weaker financial conditions are significantly more likely to be dissatisfied with their financing conditions than in other economies.** This suggests that more fragile banks in these countries are likely to face significantly tighter financial constraints, reducing credit supply. This is in line with the idea of a continuing effect of the financial fragmentation observed in Europe after the sovereign debt crisis. The analysis provides suggestive evidence that banks in periphery countries are still experiencing some ramifications of the financial and sovereign debt crises.

**In other economies, firms' financial health is the main determinant of satisfaction with external finance.** Banks' financial positions have virtually no statistically significant effect on borrowers' satisfaction in this region. Hence, in other economies, weaker firms are more likely to be dissatisfied with their financing

<sup>36</sup> The first effect is a volume effect (EIB, 2017). Higher NPLs result in provisioning, high administrative costs and an overall reduction in the returns on equity, given that impaired assets do not generate any return. The weaker bank accumulation is accompanied by an upward shift in the credit supply curve of the banking sector: for the same economic conditions (in terms of demand and risk), credit standards tighten, loan origination is lower and/or the lending rate is higher.

<sup>37</sup> One example is the proxies obtained from the ECB BLS (Altavilla, Darracq-Parries and Nicoletti, 2015).

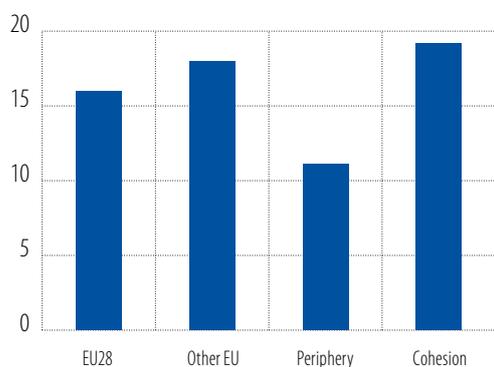
conditions, whereas banks' financial health has virtually no impact on satisfaction. This suggests that firms' financing conditions are more impacted by banks' risk management practices than banks' financial constraints, i.e. depending on borrower risk, banks offer different credit conditions.

## Financing patterns of foreign-owned versus home-owned firms

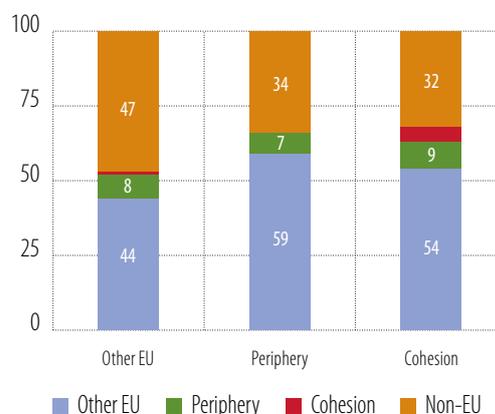
**Home-owned and foreign-owned firms differ in several dimensions.** During the financial crisis, in the periphery, foreign-owned firms were able to withstand more adverse financial conditions than local firms. However, the macro benefits were limited given the relatively smaller share of foreign-owned firms in these economies.

**About 16% of firms in the EU are foreign-owned.**<sup>38</sup> The lowest percentage share of foreign-owned firms is recorded in the periphery, where one in ten firms is foreign-owned (Figure 37). By contrast, almost one in five firms is foreign-owned in the other economies and cohesion countries. The highest percentage shares of foreign-owned firms are in Luxembourg and the Czech Republic, followed by Belgium. Most foreign owners of firms in the EU come from other economies and non-EU countries (Figure 38). The largest foreign owners from EU core countries are firms in Germany, followed by France and Luxembourg. The non-EU country that owns most of the firms in the EU is the US.

**Figure 37**  
Share of foreign-owned firms in the EU and regions (% , 2016 and 2017)



**Figure 38**  
Distribution of the ownership origin of foreign-owned firms



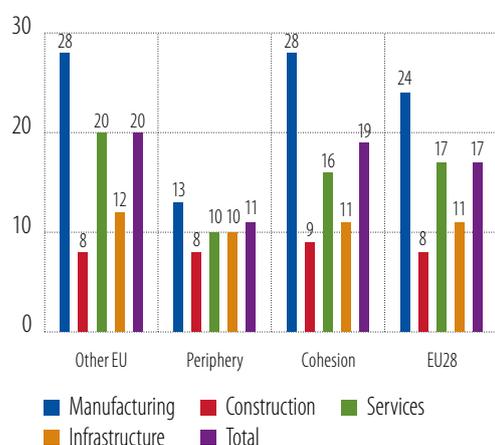
Source: ECON calculations based on EIBIS and ORBIS pooled data.

Note: Results are weighted using value added.

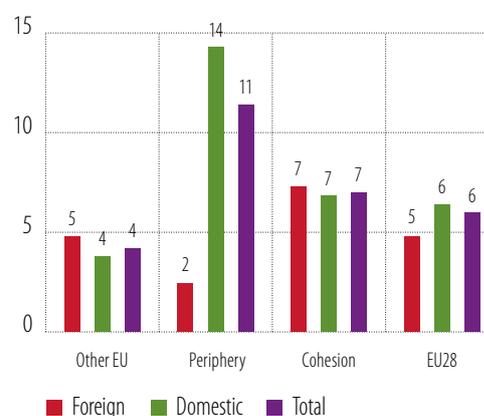
**Foreign-owned firms are concentrated in the manufacturing sector (Figure 39).** The sector where foreign-owned firms are the least present is construction. Half of all foreign-owned firms are in the manufacturing sector. The share of foreign-owned firms increases with firm size, with 26% of large firms being foreign-owned, well above the average of 17%. For these reasons, the rest of the analysis focuses only on large manufacturing firms.

<sup>38</sup> We used matched EIBIS–ORBIS data on the ownership of all firms for 2016 and 2017. We obtained a pooled sample of data for a unique set of 19 832 firms. Information on the ownership of firms was available for about 90% of the sample. Foreign-owned firms are defined as firms that have a majority owner located in another country. Majority owners are defined as having a percentage of ownership above 50. Conversely, domestically owned firms are those that are independent (i.e. do not have a majority owner), or that have a majority owner located in the same country. Across EU countries, the correlation with the employment share reported in the OECD survey amounts to 66%.

**Figure 39**  
Share of firms that are foreign-owned by sector and regions (%)



**Figure 40**  
Share of financially constrained large manufacturing firms by ownership type



Source: ECON estimations based on the EIBIS and ORBIS pooled data.

Note: EIBIS and ORBIS pooled data for large manufacturing firms. Results are weighted using value added.

**Home-owned firms in periphery countries are considerably more financially constrained than comparable foreign-owned firms in the same countries (Figure 40).** We compare access to finance of foreign-owned firms and home-owned firms in the three regions (Figure 40). Domestically owned firms are substantially more likely to be financially constrained than foreign-owned firms in the periphery. This gap is much smaller in other EU economies and cohesion group economies.

**Competitiveness cannot explain the gap between foreign-owned and home-owned firms that are financially constrained, and financial health can explain only a very small part of it.** On the one hand, competitiveness does not differ substantially between foreign-owned and home-owned firms (Table 5).<sup>39</sup> Home-owned firms in periphery countries are only slightly less innovative but more likely to be exporting than foreign-owned ones. On the other hand, domestic-owned firms in the periphery are “weaker” than their foreign-owned peers (Table 5): they are more leveraged and have a lower return on assets. But the difference is too small to explain the marked differences in access to finance.

**However, differences in financing mix may play a larger role in explaining the gap.** Foreign-owned firms tend to rely to a larger extent on intra-group funding and make substantially more use of revolving credit facilities than traditional bank loans.<sup>40</sup> Conversely, home-owned firms in the periphery are more reliant on external finance and less reliant on intra-group funding for investment (Figure 41).

**Domestically owned firms in periphery countries rely considerably more on bank loans, whereas foreign-owned firms prefer other types of bank finance, including revolving credit facilities (Figure 42).** These credit lines used by foreign-owned firms are likely to be guaranteed by the parent company. The analysis therefore suggests that the differences in access to finance are driven by differences in the financial liability structure. Foreign-owned firms manage to compensate for tighter financial conditions at home by means of either intra-group funding or some type of foreign-secured credit facility (e.g. a “letter of credit”).

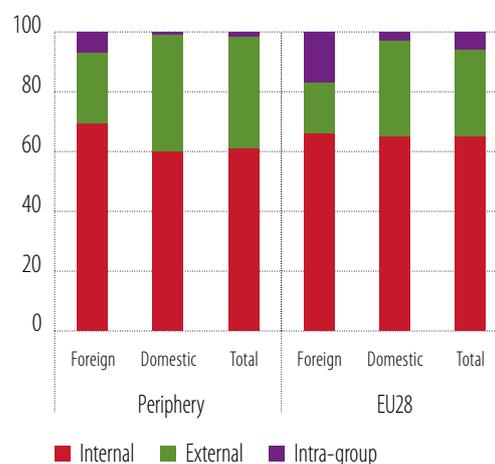
<sup>39</sup> Indicators are defined as follows. Exporters: the share of firms performing exporting activities (excluding those that answered don't know or refuse to say); FDI: the share of firms performing foreign direct investment (excluding those that answered don't know or refuse to say); Innovation: the share of firms reporting having introduced product or process innovations given R&D expenditures; SOA machines: the average of firms' share of state-of-the-art machinery; Labour productivity: natural logarithm of the added value deflated by GDP deflator over the number of employees (excluding negative values of value added); Full capacity: the share of firms declaring operation at or above full capacity.

<sup>40</sup> Both findings hold even if we limit the sample to firms that are comparable in terms of size and sector.

**Table 5**  
Share of firms that are foreign-owned by sector and regions (%)

	Periphery		EU28	
	Foreign	Domestic	Foreign	Domestic
Exporters	88	95	94	88
Innovation	82	79	59	64
SOA machines	46	54	44	52
Productivity	11.14	11.20	10.98	10.91
ROA	15.1	9.6	12.6	13.2
Leverage	15.2	26.7	15.6	19.8

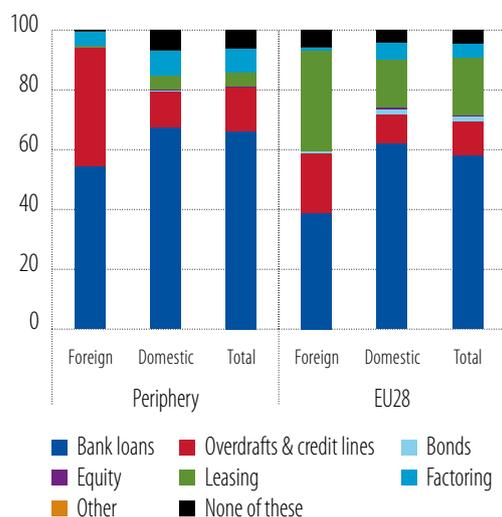
**Figure 41**  
Financing mix of domestically and foreign-owned firms (%)



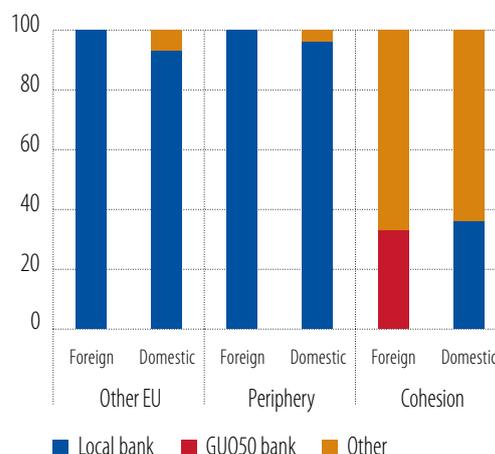
Source: ECON estimations based on the EIBIS and ORBIS pooled data.

Note: EIBIS and ORBIS pooled data for large manufacturing firms. Results are weighted using value added. SOA machines refer to the proportion of corporates reporting state-of-the-art machinery and equipment.

**Figure 42**  
Source of external finance for domestically and foreign-owned firms (%)



**Figure 43**  
Bank loans' origins for domestically and foreign-owned firms (%)



Source: EIBIS and ORBIS pooled data for medium-sized and large-sized manufacturing and infrastructure firms.

Note: Results are weighted using value added. GUO is Global Ultimate Owner.

**Bank loan origin does not seem to explain the differences between comparable domestically owned and foreign-owned firms in periphery countries (Figure 43).** In the periphery and the other economies, both foreign-owned and domestically owned firms receive bank loans from banks located in their country. In cohesion economies, this is much less frequent, especially for foreign-owned firms, which receive

one-third of their loans from banks located in the country of their majority stakeholder and two-thirds from banks that are neither local nor located in the country of their majority stakeholder.

**Our analysis suggests that foreign-owned firms in periphery countries have been more cushioned from tightened access to external finance.** This did not result from the ability to originate most loans in the jurisdiction of the parent corporations and it seems more likely to be related to the greater access to other types of bank finance, including revolving credit facilities. These credit lines used by foreign-owned firms are likely to be guaranteed by the parent through a foreign-secured credit facility (e.g. a “letter of credit”). Hence, policy measures aimed at providing guarantees are likely to cushion corporates from heightened financial tensions.

## Conclusion and policy implications

**Underpinned by monetary policies that are still exceptionally supportive, the EU economy is continuing to grow, with its sixth year of recovery.** Liquidity is abundant, and bank credits are available, as the banking sector has recovered and the adaptation to more stringent regulatory adjustment is well advanced. The output gap has closed and the process of monetary policy normalisation is emerging.

**After years of loose financial conditions, the removal of the monetary support will take time.** Some parts of the EU will become more exposed, but, after years of deleveraging, the stronger balance sheets of both financial and non-financial corporates should dampen the reaction of corporate investment during this phase of monetary policy tightening. Brexit and increased trade tensions are major risks to the cyclical upturn.

**Another pressing concern on which European policymakers and European institutions can act is the low level of potential output.** After years of depressed investment, a subdued rebound in productivity and with the prospect of an ageing European population, policies to shift long-term potential growth upwards are required.

**Targeted intervention aimed at supporting investment in promising key areas is part of these policies.** SMEs continue to be more exposed to tighter financial conditions, now mostly for structural reasons. Financial conditions are tighter in parts of the EU – mostly economies in the periphery and cohesion areas. However, the small share of credit-constrained firms suggests that access to finance is no longer the major problem faced by corporations.

**When developing targeted financial support, it is important to address corporations facing adverse access to finance for reasons outside the scope of their business,** because the financial system is not suited to their needs or parts of it are dysfunctional. Owing to their activity, age or size, some corporations face problems in posting the collaterals required by the financiers. Others are not satisfied with the outline of the financial offer – in terms of maturity, for example.

**There is evidence of misallocation of resources,** as measured by the dispersion of firm-level productivity, particularly in some periphery and cohesion countries. Financially constrained firms with high productivity and growth prospects co-exist with underperforming firms. Policies to alleviate financial constraints should discriminate between these two populations.

**Parts of the most promising economic sectors lack the support to take risks and engage in innovative activities or increase spending on intangible investment.** There is a greater need for risk-sharing type instruments, such as guarantees, and young and innovative firms facing financial constraints could benefit from an increased supply of equity products.

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## Chapter 6

### The development of equity financing in Europe

**The European equity base is relatively weak.** It is less developed than the US in all sections (private equity, venture capital, listed) and has shown no sign of catching up. The European capital market struggles to provide funding for the real economy. European companies are considerably more dependent on bank lending than those in the US and Asia. Lower turnover indicators suggest that European secondary markets are not as liquid as US markets.

**There are many reasons for the gap with the EU's major competitors.** On the supply side, there are institutional and cultural factors, corporate culture with a reluctance to dilute power and tax bias in favour of debt. On the demand side, factors include structure and regulation of the financial sector, transaction costs and financial literacy. Ageing is likely to further dampen the demand for equity. Overall, the cost of equity remains high, and issuance activity does not fill the gap. Brexit is likely to worsen the situation.

**The underdeveloped equity base comes at a cost, with Europe running the risk of not participating in the technological revolution.** A stronger equity basis would be welfare enhancing, giving greater resilience to financial shocks, more scope for private investor-based risk sharing and improved allocation of capital, more risk-taking capacity and innovation, and avoiding the growth-stage trap.

**The reintegration of the EU financial system is accompanied by a shift towards more equity-based cross-border financial flows, providing an opportunity to foster the equity base at the EU level.** Improvements in the institutional and regulatory environment, stronger enforcement of investor protection rules and a better business code of conduct should reinforce the equity base of EU corporates. This would enable EU corporates to raise capital at more competitive costs.

**The design of the capital markets union is key to incentivising cross-border equity investment.** The capital markets union (CMU) can play a pivotal role in incentivising and fostering the geographical diversification of financial holdings within the EU. Importantly, it should not only deepen the single national financial market but also contribute to developing a cross-border European financial market.

## Introduction

**The financial crisis ended several years ago but the EU lost ground in several promising sectors after years of subdued investment.** To reverse the decline in potential output growth, the financial system must be tuned to provide more capital to the corporations operating in strategic and innovative sectors.

**This chapter presents an overview of the European equity base.** It is shown to be relatively underdeveloped in several ways, being relatively fragmented, and weaker than major developed trading partners. The insufficient depth of the equity market in Europe brings several costs, which we review. The current situation is underpinned by many factors. Some can be tackled in the context of the capital markets union. This provides a unique opportunity to overhaul the EU parts of the legal and institutional infrastructure to favour stronger developments of cross-border equity flows and therefore markets.

The chapter consists of four sections. The first section reviews several aspects of the European equity base from a historical perspective. Some of the factors explaining the current under-development of the EU equity base are then presented in the second section. The third section presents some of the benefits the EU could reap from a stronger equity base. The fourth section concludes and provides several policy recommendations.

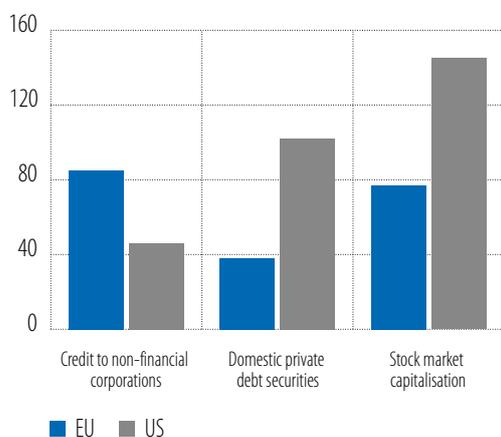
## The European equity base from an international perspective

**Corporations show a typical evolution in their financial structure.** They are initially financed mostly by families and friends, and possibly grants. Their activity sometimes enables them to access more loans from suppliers or from pre-payments from customers. In parallel, private equity (PE) starts to play a role, with venture capital (VC), a specific type of PE, focusing on innovative high-growth companies. Later, other debt funds might join. Finally, mature corporations get market access, for debt or equity. When a corporation first enters the financial system, PE finance plays a key role. We give an overview of the listed equity markets in Europe and then elaborate on PE and VC before analysing financial integration in the EU.

## Financial markets: the EU gaps

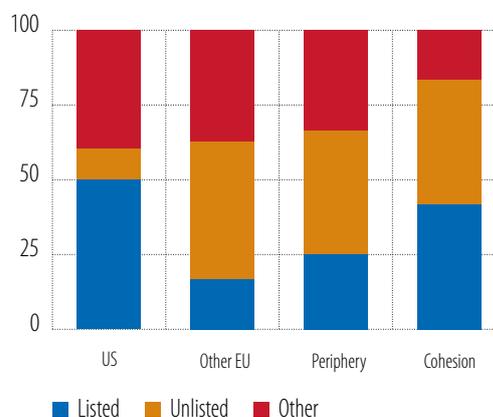
**Financial markets are much less developed in the EU than in the US.** The stock market capitalisation of non-financial corporates in Europe is below that in the US by around 80 percentage points (p.p.) of GDP (Figure 1). The difference between Europe and the US in equity finance is less pronounced, however, as in Europe a large share of equities is unlisted (Figure 2). Overall, equity finance is less developed in the EU than in the US, and equity markets are even less developed. Markets for corporate debt securities are also substantially less developed, with its share in GDP being less than half that in the US.

**Figure 1**  
**Financing of non-financial corporates**



Source: *ECON calculations based on various sources.*  
Note: *See footnote.<sup>1</sup>*

**Figure 2**  
**Equity breakdown**



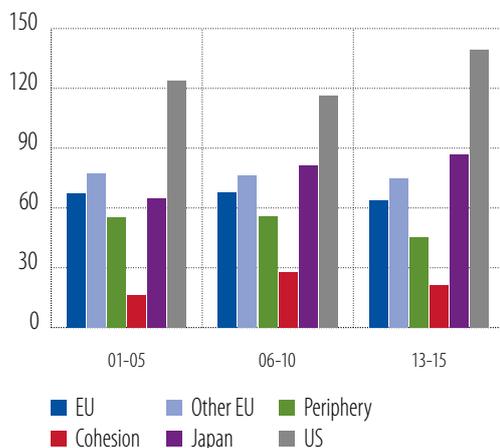
Source: *ECON calculations based on OECD.*  
Note: *Non-consolidated data.*

**The EU financial system is more bank-based.** In fact, in contrast to the US, where debt is almost equally split between securities traded on a market and loans, most corporate debt in Europe consists of bank loans. The banking sector plays a major role, and financial markets, both for debt and equities, are less developed in the EU. The predominance of bank loans across country groups remains a structural characteristic of the EU financial system (ESRB, 2014).

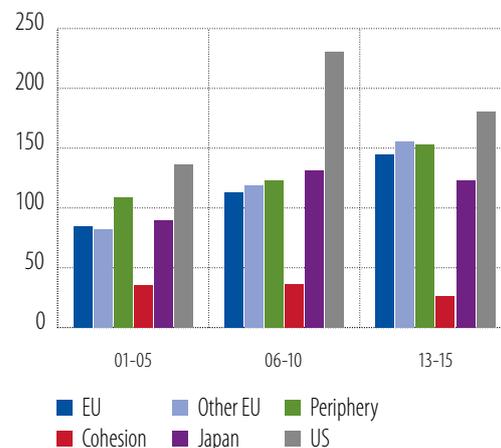
**While the gap is larger in the cohesion and periphery economies, it remains important for the other EU economies.** In fact, there is a wide diversity across the EU, both by region and within each region. Other economies tend to have the most developed listed equity markets, with the stronger capitalisation in terms of GDP, with a capitalisation amounting to around 75% of GDP (Figure 3). While this is comparable to the share in Japan, it is far below that in the US. Moreover, the situation varies widely inside the region, with capitalisation being very much higher in the UK, and lower in Austria, at 117% and 25% of GDP, respectively, over the 2013–15 period.

<sup>1</sup> World Bank: Global Financial Development Database and BIS: Long series on total credit to the non-financial sectors. Stock market capitalisation: total value of all listed shares in a stock market as a percentage of GDP. Debt securities: total amount of domestic private debt securities (amount outstanding) issued in domestic markets as a share of GDP. Credit to private NFCs: credit to private non-financial sector from banks (total) at market value.

**Figure 3**  
**Equity market capitalisation**  
(outstanding amounts, % GDP)



**Figure 4**  
**Equity turnover**  
(annual activity, % capitalisation)



Source: ECON calculations based on World Bank, Financial Structure Database and Eurostat. See Beck et al. (2000).

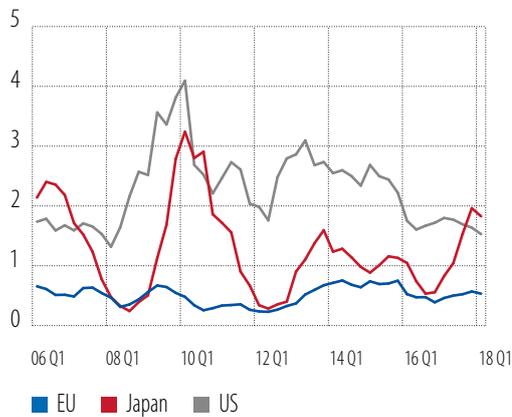
**Capitalisation in the periphery is three-quarters of that in the other EU economies region, with a wide dispersion.** Compared with the average in the periphery region, listed equity markets are more developed in Spain, and less so in Italy (respectively 74% and 24% of GDP on average over the 2013–15 period). Cohesion countries are well below the other two groups, with capitalisation being around one-third of that of the other economies. Since the beginning of the 2000s, there has been no clear narrowing of the gap across EU regions.

**In terms of turnover, activity in the US market is again above that in the EU (Figure 4).** Across EU regions, the situation differs slightly from overall capitalisation, with equity markets in the periphery being as active as the other economies, but more moderate in the cohesion economies. Higher levels of market activity are accompanied by stronger equity issuance. Changes in the latter are positively related to lagged changes in aggregate local stock market liquidity (Hanselaar et al., 2018). This relation is as economically significant as the well-known relation between equity issuance and lagged stock returns. It survives the inclusion of proxies for market timing, capital market conditions, growth prospects, asymmetric information and investor sentiment. By reducing liquidity premiums and transaction costs, greater activity leads to lower costs and stronger issuance.

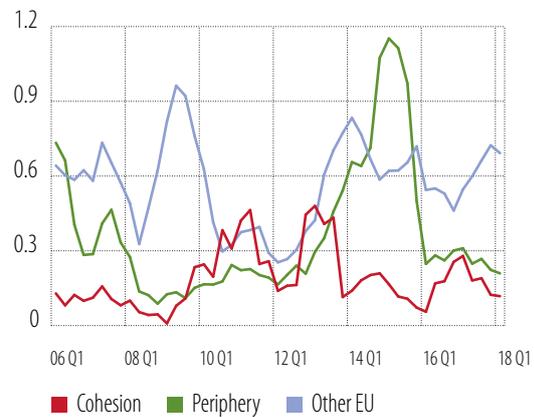
**As liquidity is low, primary and secondary issuance activity in the EU remain well below that in the US and Japan (Figure 5).** Issuance activity is partly cyclical: it declines in downturns and increases in upturns. This pattern is similar in the US, EU and Japan. In the EU, cyclicity is much less pronounced, but comes with an issuance rate on average around three times less than that in the US and half that in Japan over the 2006–18 period.

**Inside the EU, there is a wide issuance diversity by region (Figure 6).** Equity issuance is stronger where markets are more developed, in the other regions. This does not bode well for EU convergence towards a shared model.

**Figure 5**  
**Primary and secondary share offering**  
(% GDP, 4-QMA)



**Figure 6**  
**Primary and secondary share offering in EU regions**  
(% GDP, 4-QMA)



Source: ECON calculations based on Bloomberg.  
Note: 4-QMA denotes four-quarter moving average.

**Brexit could worsen the gap if activity is not transferred to continental Europe.** Equity underwriting amounted to EUR 80 billion in the EU in the first half of 2018 (AFME, 2018). EUR 24 billion were underwritten in the London Stock Exchange.<sup>2</sup> Together, the London Stock Exchange (LSE), Deutsche Börse and Euronext account for almost 70% of equity underwriting in European exchanges.

### Private equity and venture capital<sup>3</sup>

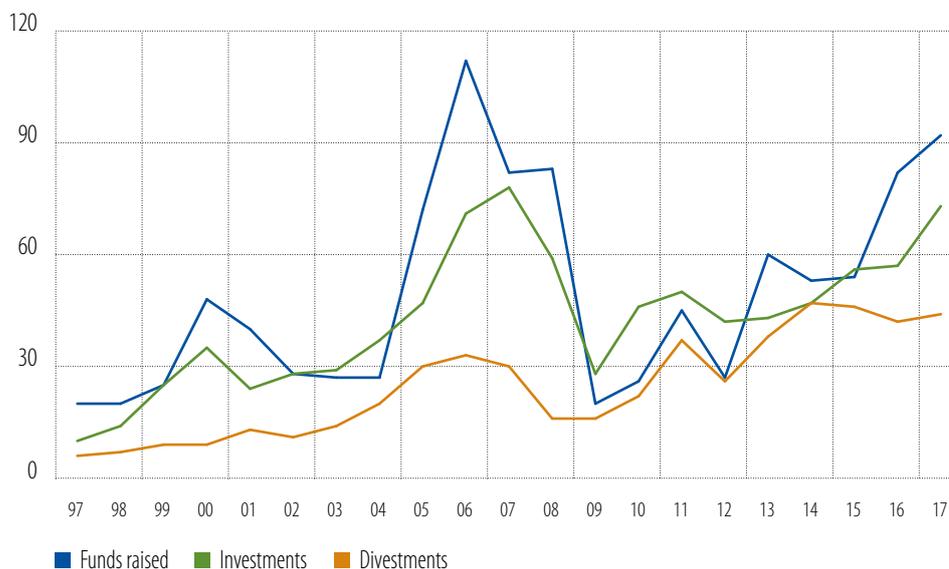
**Private equity is a form of equity investment in private companies not listed on the stock exchange.**<sup>4</sup> It is a medium to long-term investment, characterised by active ownership, for example, by strengthening management expertise, delivering operational improvements and helping companies access new markets. Venture capital is a type of private equity that is focused on start-up companies with high growth potential. VC refunds entrepreneurs with innovative ideas for a product or service who need investment and expert help in growing their companies.

<sup>2</sup> Equity underwriting includes initial public offerings (IPOs), follow-ons and convertibles.

<sup>3</sup> Large parts of this section are based on Kraemer-Eis et al. (2018b), i.e. the latest issue of EIF's European Small Business Finance Outlook (ESBFO). The ESBFO is published twice per year (typically in June and December) and provides an overview of the current SME financing situation in Europe.

<sup>4</sup> See Invest Europe at <https://www.investeurope.eu/about-private-equity/private-equity-explained/>.

**Figure 7**  
**Fundraising, investment and divestment amounts by private equity firms located in Europe (EUR billion)**



Source: ESBFO, based on data from Invest Europe.

**Over the past 20 years, European private equity activity has exhibited booms and busts, and fundraising and investment now seem to be returning to pre-crisis levels.** At the most famous peaks, in 2000 and 2006, private equity funds located in Europe raised EUR 48 billion and EUR 112 billion, and invested EUR 35 billion and EUR 71 billion, respectively (Figure 7).<sup>5</sup> The peaks were followed by significant downturns: the “dotcom crisis” in the early 2000s and the financial and economic crisis from 2007. In 2017, the total funds raised by PE firms located in Europe rose to EUR 92 billion, an increase of 12% from the previous year. This constitutes the highest value since 2006. During 2017, private equity funds located in Europe invested EUR 73 billion (up 29% compared with the year before), and divested companies for a total value of EUR 44 billion (up 6%).<sup>6</sup>

**The European venture capital market remains fragmented and is geographically far less homogeneous than its US counterpart.** Figure 8 provides an overview of VC investments as a share of GDP for European and selected Organisation for Economic Cooperation and Development (OECD) countries, as well as the European average. In all EU economies, VC investments are well below those in the US. While the traditional core markets in Europe (e.g. the UK and Scandinavia) have maintained relatively well developed market activity since the crisis, few markets, such as Spain, have caught up. However, in total, the EU VC market is one-seventh the size of the US market. Markets suffer not only from their small size but also from an institutional investor base that is not sufficiently ready to invest in this asset class (Kraemer-Eis et al., 2018b).

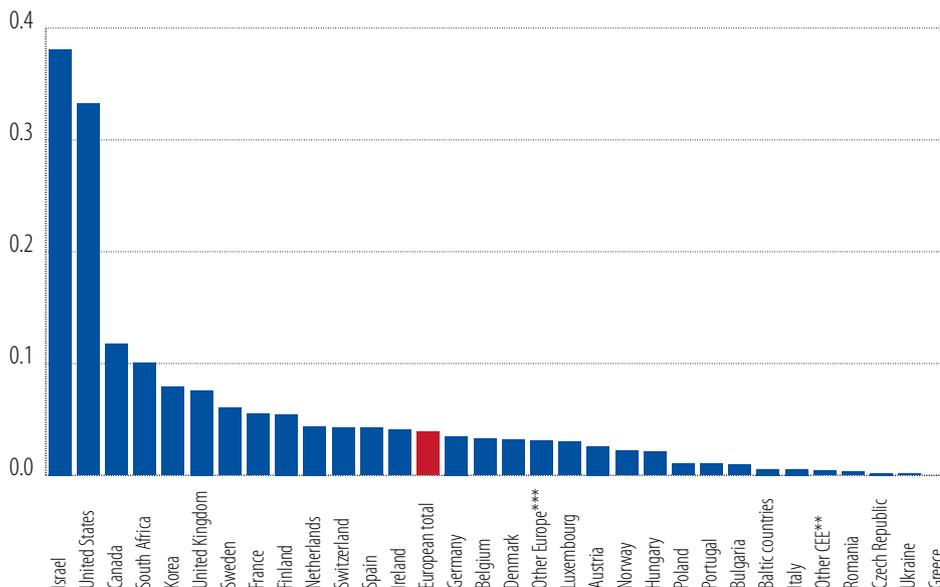
**In the EU, venture capital investors tend to target tech “hubs” rather than regions and it is difficult to interpret within-country diversity.** Looking at the geographic dispersion of European venture capital activity in more detail, the picture becomes more complex. Recent European Investment Fund (EIF) research has shown that European hubs, particularly those backed by EIF investments, are at the core of a

<sup>5</sup> These figures and those that follow are based on statistics from Invest Europe, the association representing Europe’s private equity, venture capital and infrastructure sectors, as well as their investors. See Invest Europe (2018), the Invest Europe website [www.investeurope.eu](http://www.investeurope.eu) and Kraemer-Eis et al. (2018b) for more information on Invest Europe private equity activity statistics.

<sup>6</sup> Invest Europe statistics show divestment amounts at cost, that is, the total amount divested is shown as the total amount that had been previously invested, and hence does not include any profit on the investment.

complex network of national and international investments. This claim is supported by data on investment amounts originated by hubs: 23% of these investments remain in the hub, 40% reach out to other in-country locations and the remaining 37% travel beyond the national frontier (Kraemer-Eis et al., 2016).<sup>7</sup>

**Figure 8**  
**Venture capital investments by country of the portfolio company**  
(% of GDP, 2017 or latest available year)



Source: *ESBFO, based on Invest Europe and OECD (2018).*

Note: *European total corresponds to Europe as covered by Invest Europe (that is, EU minus Cyprus and Malta, but plus Norway, Switzerland, Ukraine, and those former Yugoslavian countries that are not part of the EU).*

**\*\* Other Central and Eastern Europe (CEE):** *Bosnia-Herzegovina, Croatia, Former Yugoslavian Republic of Macedonia, Moldova, Montenegro, Serbia, Slovakia, Slovenia.*

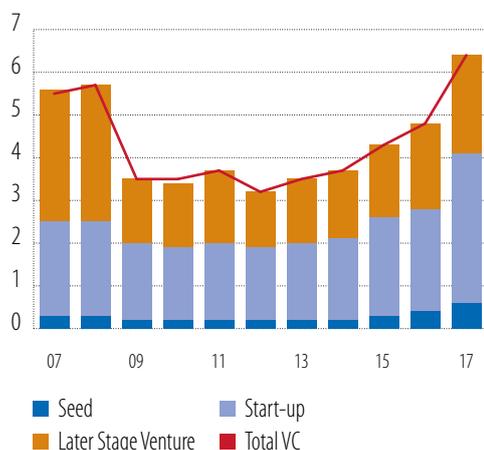
**\*\*\*Other Europe:** *Cyprus, Iceland, Liechtenstein, Malta, San Marino, Vatican City.*

**Over the 2007–15 period, the average venture capital-backed US company received five times more than its EU counterpart, i.e. EUR 6.3 million compared with EUR 1.3 million (AFME, 2017).** Larger investment rounds can be achieved by having more investors (syndicate size) and/or larger investment amounts per investor (ticket size). Both syndicate sizes and ticket sizes are bigger in the US than in Europe. For example, looking across all fund vintages from the 2005-15 period, 28% of the US funds were greater than USD 250 million, in contrast to only 10% in Europe (Duruflé et al., 2017). VC has been increasing over time in the EU. However, VC activity has increased at a much faster pace in Asia (including China).

**The gap between VC financing in the US and Europe is visible at all development stages, but is especially wide at the scale-up stage (Figure 10).** At the start-up stage, there is relatively little difference in fund size between the US and Europe. However, US companies are financed by significantly larger funds at the scale-up stage, when they need to consolidate their position in the competitive international market (AFME, 2017). In the growth capital segment, the amounts invested in the US still exceed those in Europe by more than three times. These differences are also reflected by substantial distinctions in fund and deal sizes. The average fund size in the US is noticeably larger. This seems to be driven by a group of funds in the US that are considerably bigger than those of the set of “large funds” in Europe (Kraemer-Eis et al., 2018b).

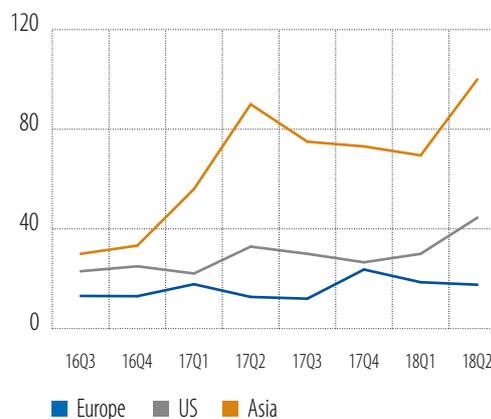
<sup>7</sup> Since higher cross-border investments can be interpreted as a signal of deeper integration of the European VC market, the EIF investments may have fostered the consolidation of a Europe-wide VC ecosystem.

**Figure 9**  
Venture capital investment amounts by stage (EUR billion)



Source: ESBFO, based on data from Invest Europe.

**Figure 10**  
Global scale-up-stage median deal size (USD million)



Source: Stresing et al. (2018).

In 2017, total venture capital investments exceeded their pre-crisis highs for the first time.<sup>8</sup> During that year, investments increased for almost all PE stage focuses (in particular for buyout, growth and replacement capital). Venture capital investments jumped by 34% to EUR 6 billion (Figure 9).<sup>9</sup> Within the VC market segment, investments rose for all enterprise development stages, i.e. seed (up 49% to EUR 600 million), start-up (up 46% to EUR 3 billion) and later-stage venture (up 17% to EUR 2 billion). Before the crisis, later-stage ventures had been the driver of VC investment. Conversely, since 2009, investments at the start-up stage have become the largest component of VC investments.

Following the crisis, investors showed a cautious approach to VC, and the share of government agencies increased. This share increased from 14% in 2007 to 35% in 2011. According to Invest Europe, government agencies accounted for 29% of total investments in venture capital funds in 2017. It is noteworthy that government agencies have played their role and supported the market in a countercyclical way, particularly during a time of economic and financial crisis when total venture capital fundraising levels declined by far more than 50%.

## Financial integration in the EU

The European equity base can be developed by a combination of deeper single national financial markets within the EU and the development of a cross-border European financial market. For several reasons, the latter is more efficient. Some evidence suggests that financial reintegration in the EU inclines towards more equity-based activity (Lane and Milesi-Ferretti, 2017). The capital markets union (CMU) provides an opportunity to strengthen this trend and ensure it remains structural.

EU financial integration has resumed slowly (Figure 11). EU financial integration increased following the adoption of the euro in the early 2000s until the start of tensions in financial markets in 2007. Then, until the end of the sovereign debt crisis, it collapsed to levels below those prior to the euro adoption. Since then, it has resumed slowly, but by the middle of 2018 it was still well below its pre-crisis peak.

<sup>8</sup> The breakdown by investment and funding stage focus has been available since 2007.

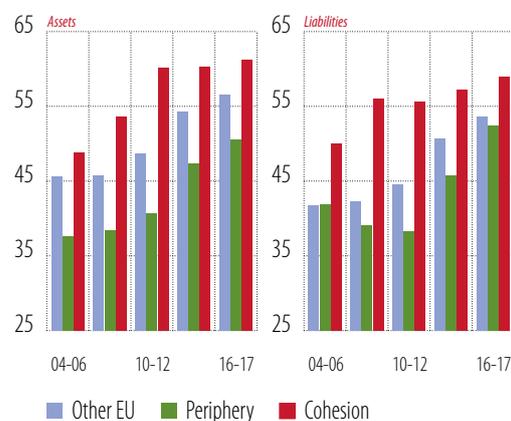
<sup>9</sup> Note that the equity investment activities of "business angels" are not included in the Invest Europe statistics. Business angels are, however, important for the financing of small- and medium-sized enterprises (SMEs) and for innovation. See Kraemer-Eis et al. (2018) for a general overview of this market segment and recent developments.

**Figure 11**  
Financial integration indicator



Source: *ECON estimation based on ECB, IMF and Eurostat.*  
Note: *See EIB Investment Report 2017. By construction, the indicators range from 0 to 1.*

**Figure 12**  
Share of equity in cross-border investment position (%)



Source: *ECON computations based on IMF.*  
Note: *Sum of direct investment and portfolio investment in equity.*

**Price convergence is strong, while cross-border asset holdings are recovering more slowly.** The reduction in price dispersion is stronger and quicker than fragmentation, whose indicator, based on quantities, lags behind. To some extent, this reflects the construction of the indicator. This construction is based on stocks, which are more sluggish to adjust. Conversely, financial prices tend to reflect the balance of financial flows and therefore react more quickly.

**Financial integration prior to the crisis was not efficient or sustainable, and cannot be seen as a benchmark.** Cross-border flows relied on banks' flows and on government debt. Cross-border banking flows have not yet resumed. Across euro area economies, this may, to some extent, reflect a side effect of the full allotment liquidity monetary policy of the European Central Bank (ECB), which reduces the incentives for banks to trade between themselves at short maturities.

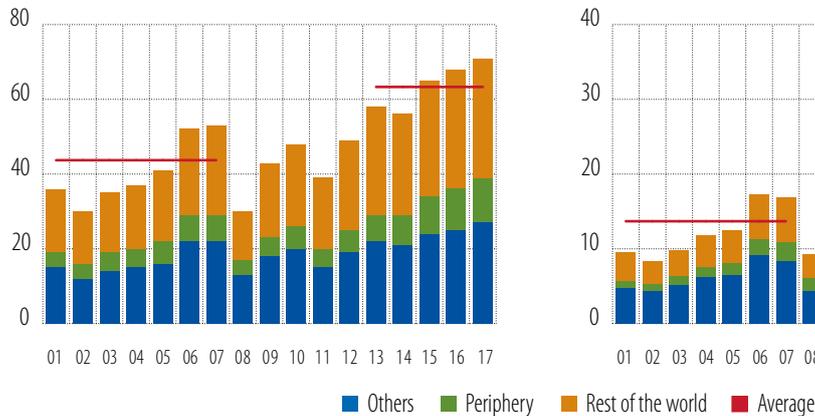
**Several indications suggest a shift in the nature of cross-border financial flows towards more equity (Figure 12).**<sup>10</sup> In the other EU and periphery groups, the other investment category used to account for slightly less than 50% and 40%, respectively, before the crisis.<sup>11</sup> In 2017, the respective shares were smaller by eight and ten percentage points, respectively. Conversely, the share of foreign direct investment (FDI) substantially increased. The trend in cohesion economies is different, however, as the decline in the share of other investment was not matched by an increase in the share of FDI flows, but rather mostly reflected a shift towards portfolio investment. To some extent, the breakdown between FDI and equity is arbitrary, and one should look at the sum.<sup>12</sup> Summing the two components, the increase in the share of equity in cross-border liability is noticeable in the three regions (Figure 12).

<sup>10</sup> See Lane and Milesi-Ferretti (2017) for global trends.

<sup>11</sup> Considering the average of assets and liabilities.

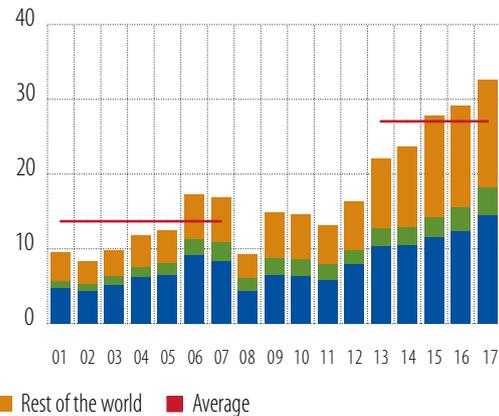
<sup>12</sup> If the investor assumes control (usually a share in the capital of more than 10%), the investment is classified as FDI. If the investor acquires less than 10% of the capital, the investment is classified as a portfolio investment.

**Figure 13**  
Provenance of equity portfolio liabilities  
in other economies (% GDP)



Source: ECON computations based on IMF Portfolio Investment Survey. Liability position with respect to cohesion is very small and thus omitted.

**Figure 14**  
Provenance of equity portfolio liabilities  
in periphery economies (% GDP)



Source: ECON computations based on IMF Portfolio Investment Survey. Liability position with respect to cohesion is very small and thus omitted.

**Within the portfolio category, investments were reallocated across asset classes, debt and equity.** Before the crisis, portfolio debt used to be about twice the size of equity flows in the other economies and periphery groups, while in 2018 they are approaching roughly equal magnitudes in other economies and equity flows are now twice the size of portfolio debt in the periphery group. In contrast, in cohesion economies, portfolio debt surpassed equity flows after the crisis.

**The increase in equity portfolio liability positions since the end of the crisis is impressive, especially in the periphery.** International Monetary Fund (IMF) data were used to construct a geographical breakdown of the equity liability position in the other economies (Figure 13) and in the periphery (Figure 14). Pre-crisis (i.e. from 2001 to 2007), liability positions in equity averaged 41% and 12% of GDP in the other economies and the periphery, respectively. Post-crisis (i.e. from 2013 to 2017), they averaged 63% and 27%, respectively. To some extent, however, the rise in the periphery was more the result of purchases by non-EU investors than purchases by investors from other economies. Furthermore, the trade inside the periphery did not expand much.<sup>13</sup>

**Under the umbrella of the CMU, the right infrastructure and level of protection can be provided to help shore up equity.** Indeed, the equity gap can be more easily closed at the EU level, as the aim is not to replicate a small equity base everywhere but to form a large one at the European level. In doing so, the CMU can also improve access to finance by small and medium-sized enterprises (SMEs) (see Kraemer-Eis and Lang, 2017). Some have called for the building of a Financing Union for Investment and Innovation (FUII), which would merge together existing initiatives, i.e. the capital markets union (CMU), the banking union and the Juncker Plan (Villeroy de Galhau, 2017). This union would help to foster private risk sharing significantly, firstly by providing incentives for cross-border investments – preferably in equity – through the harmonisation of accounting, tax and insolvency laws, and secondly by developing pan-European savings products more oriented towards long-term investment.

<sup>13</sup> The case of cohesion economies is not reported owing to data limitations.

## Some factors contributing to the gap

We analyse some of the main factors limiting the development of a stronger equity base in the EU overall. We recall the link between equity issuance and the cost of equity. Within a simple framework, we show the relevance of the tax bias in favour of debt. We then consider the role of the legal and social environment. We show that, while corporate culture plays a role in explaining the reluctance to issue, an improved business environment would be conducive to stronger FDI inflows. We also consider the structure of the EU financial sector, which is bank-based. Finally, we explain why demographic factors will add further weight to the development of equity markets in the EU.

### Elevated cost of equity

**Figure 15**  
Issuance activity and cost of issuance



Source: ECON calculations based on Worldscope.

Note:  $q$  is computed as the sum of the market value of equity, preferred stock and debt divided by total assets (Chung and Pruitt, 1994).

**Listed firms can tap the stock market to raise capital when the banking system is impaired.** Figure 15 plots the share of firms issuing equity against Tobin's  $q$ .<sup>14</sup> Firms are more likely to issue when valuations are favourable, when Tobin's  $q$  is high, or when the cost of equity is low. However, it is well-known that the cost of equity is difficult to estimate (Box A). However, estimates suggest that the equity risk premium (ERP), the difference between the cost of equity and the risk-free rate, is elevated.

**Reacting to the cycle, issuance activity is structurally reduced by an elevated ERP.** Though the years 2005–7 are known for a rapid expansion in credit, many firms sought to benefit from the high valuations prevailing at the time by issuing equity as well. During the financial crisis, on the other hand, firms were reluctant to tap the market. At first glance, this appears surprising, given the evidence for a credit crunch,

<sup>14</sup> Tobin's  $q$  ratio is a function of the share price, which in turn depends not only on the cost of equity but also on expectation of future dividends. It equals the market value of a company divided by its assets' replacement cost. The issuance indicator equals one if the difference between funds raised through share sales and funds used for buybacks exceeds 2.5% of beginning-of-period assets.

but listed firms were also affected by the decline in aggregate demand. At the same time, managers may have been reluctant to sell shares when valuations were depressed. Despite the tight correlation between  $q$  and issuance activity, the 2015–16 increase in valuations was not matched by an increase in issuance.

**Box A****Estimating the cost of equity for euro area non-financial corporations**

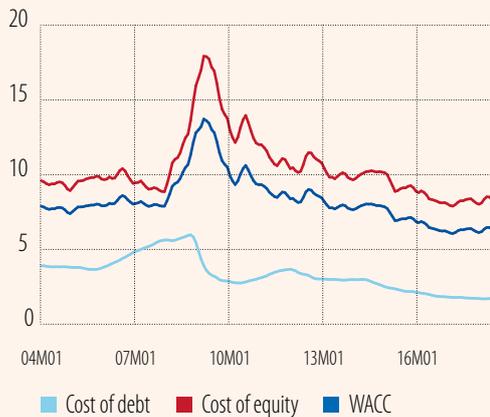
The cost of equity represents the return investors require as compensation for the risk of holding equity. Despite equity financing representing a smaller share of the overall financing than debt financing, various forms of equity financing have consistently been a significant part of the funding structure of euro area and US companies. However, whereas the cost of debt can usually be readily observed, the cost of equity cannot. This is because the cost of equity has two components: the risk-free rate and an ERP. Whereas the former component is observable, the latter, defined as the additional return an investor requires on top of the return on a risk-free asset, is not, and has to be estimated. As a result, both the level of equity and changes in the cost of equity are by definition model-dependent and subject to uncertainty.

Dividend discount models (DDMs) are one class of models frequently used to estimate the ERP component inherent in the cost of equity. DDMs exploit the idea that the share price equals the present value of expected cash flows to shareholders. The simplest version of a DDM is the Gordon growth model, which assumes that these cash flows grow at a constant rate, while more sophisticated models make assumptions for a time-varying growth rate of future dividends, discount these cash flows with appropriate maturity discount rates and take share buybacks into account.<sup>15</sup> A major advantage of DDMs is that they, like investors, are forward looking. A major challenge associated with estimating DDMs is that their components, in particular future dividends, are themselves estimated.

The cost of equity for euro area non-financial corporations is around 8%, down from close to 18% during the height of the financial crisis (Figure A.1). This estimate is based on the DDM proposed by Geis et al. (2018), with the estimation allowing for a company-specific dividend growth path, and takes into account shareholder pay-outs in the form of buybacks. Share buybacks have become a more popular form of shareholder compensation in the euro area in recent years, and are a significant part of shareholder compensation in the US. The level of share buybacks shows greater variation across the economic cycle than dividend payments, which is why estimates of the cost of equity resulting from models taking share buybacks into account usually result in estimates that display greater cyclical variation and by definition exhibit a higher level of cost of equity than models including only dividend payments.

<sup>15</sup> For a more detailed derivation of the DDM, see Geis et al. (2018).

**Figure A.1**  
The cost of financing of non-financial corporations (% p.a.)



Source: EIB calculations based on Geis et al. (2018), ECB and Worldscope.  
Note: Three-month moving average.

**Figure A.2**  
Equity risk premium in the euro area and the US (% p.a.)



Source: Geis et al. (2018).  
Note: Three-month moving average.

The cost of equity remains high compared with the cost of debt. Despite being at its lowest level for the last 15 years, it reflects a higher level of ERP than during the years prior to the financial crisis (Figure A.1 and Figure A.2). As can be seen in Figure A.1, the decline in the euro area's cost of equity in the last two years has been limited. The reason for this is that the price increase in euro area stock markets has been supported mainly by expectations of higher earnings, reflecting the ongoing economic expansion, which in turn has resulted in a relatively persistent high level of the ERP. Figure A.1 also sheds light on the high levels of overall weighted average cost of capital (WACC) during the financial crisis, which peaked at above 13%, and now stand around 6%.

While the current levels of the ERP in the euro area and the US are roughly comparable according to this model estimate, a larger share of the increase in equity prices over the last two years can be attributed to a fall in the ERP in the US than in the euro area. As Figure A.2 shows, investors in US and European equities demand broadly similar levels of compensation for bearing equity market risk, with part of the decline in the US ERP being attributed to increases in the discount rate, and part to improving earnings expectations.<sup>16</sup>

Lower demand and elevated risk aversion explain the elevated cost of equity. Despite some decline engineered by the very accommodative monetary policy across Europe, the cost of equity is still pushed up by a substantial equity risk premium, estimated to be in the range of 5–6% per year.

<sup>16</sup> These results are also supported by findings reported, for example, in Dison and Rattan (2017).

## Tax bias in favour of debt

**Firms' liability structure is influenced by taxation.** In most developed economies, corporate income tax systems have a bias towards debt since they allow a deduction of interest payments. Interest paid is the cost of doing business/generating income, while taxing income is based on net gains as opposed to gross gains. Moreover, the cost of equity is unknown, and this makes it difficult to reduce tax on dividends paid. Overall, the so-called tax-shield value of debt has a direct impact on non-financial corporates' financing behaviour. Some countries, e.g. Belgium, have introduced an allowance for corporate equity to reduce this bias.<sup>17</sup>

**The effective marginal tax rate (EMTR) has a positive impact on the relative use of debt (Box B).** This may be the consequence of the fiscal bias towards debt. Since interest payments on debt are tax deductible, a rise in the EMTR makes the use of debt cheaper than other kinds of external finance. The effect is even greater when we control for country-specific variations in the fixed effect model. The effect is significant and sizeable: a 1 p.p. increase in the EMTR is associated with a 0.5–0.7 p.p. increase in the debt-to-asset ratio.

**Tax policies designed to encourage the use of equity financing are likely to lead to more capitalised firms.** The simple partial equilibrium model appears to give a similar conclusion to that in the literature: the capital structure responds significantly to changing tax incentives (de Mooij, 2011; Adalet McGowan et al., 2017; Panier et al., 2015).

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<sup>17</sup> The novel tax provision (the notional interest deduction, or NID), introduced in Belgium in 2006, reduced the tax driven distortions that favour the use of debt financing by allowing firms to deduct a notional interest charge that is a function of equity from their taxable income. Panier et al. (2015) show that: (1) the NID led to a significant increase in the share of equity in the capital structure; (2) both incumbent and new firms increase their equity ratios after the introduction of the NID; (3) the largest responses to these changing tax incentives are found among large and new firms; (4) the increase in equity ratios is explained by higher equity levels and not by a reduction in other liabilities.

**Box B****Estimating the effect of the tax bias towards debt**

We use a simple partial equilibrium model to assess the impact of corporate tax rate on the debt to financial asset ratio of NFCs. We estimate panel regression models on a set of OECD economies in which the liability structure depends on the effective marginal tax rate (EMTR), profitability, the cost of equity and other factors. Each variable is specific to the economy, and the estimation is carried out over a window of several years, using alternately a fixed effect model and a random effects model.

EMTR is proxied using data from the Oxford University Centre for Business Taxation. It corresponds to the change in the cost of capital arising from introducing the tax, expressed as a proportion of the cost of capital in the absence of tax. Profitability is measured by the ratio of the gross operating surplus to gross value added. It captures the internal finance channel; the substitution towards internal finance. Demand indicator or business cycle activity is proxied by the deflated sovereign yield. Stock prices are used as an inverse measure of the cost of equity; they are taken in logarithm. The results are shown in Table B.1.

The coefficients are all significant and the results are relatively intuitive (Table B.1). First, profitability seems to be a source of internal finance substitution for debt. This corresponds with the pecking order theory that suggests that, whenever possible, firms should reduce their use of external finance and thus debt. Second, the use of debt is positively correlated with overall demand pressure. Indeed, a more favourable state of affairs, captured by an increase in the real ten-year sovereign yield, should result in increased external finance needs. Third, an increase in stock prices, i.e. a decline in the cost of equity, favours equity and has a negative impact on the debt-to-asset ratio.<sup>18</sup>

**Table B.1**  
**Regressions of the debt-to-asset ratio**

	With fixed effects	With random effects
EMTR	0.735*** (0.202)	0.541*** (0.198)
Profitability	-1.696*** (0.296)	-1.030*** (0.260)
Demand indicator	0.016*** (0.004)	0.019*** (0.004)
Stock prices	-0.027** (0.011)	-0.028*** (0.011)
Observations	352	352
R-squared	21%	
Number of countries	23	23

Note: Standard errors in parentheses, \*\*\*p < 0.01, \*\*p < 0.05, \*p < 0.1. Constant not reported.

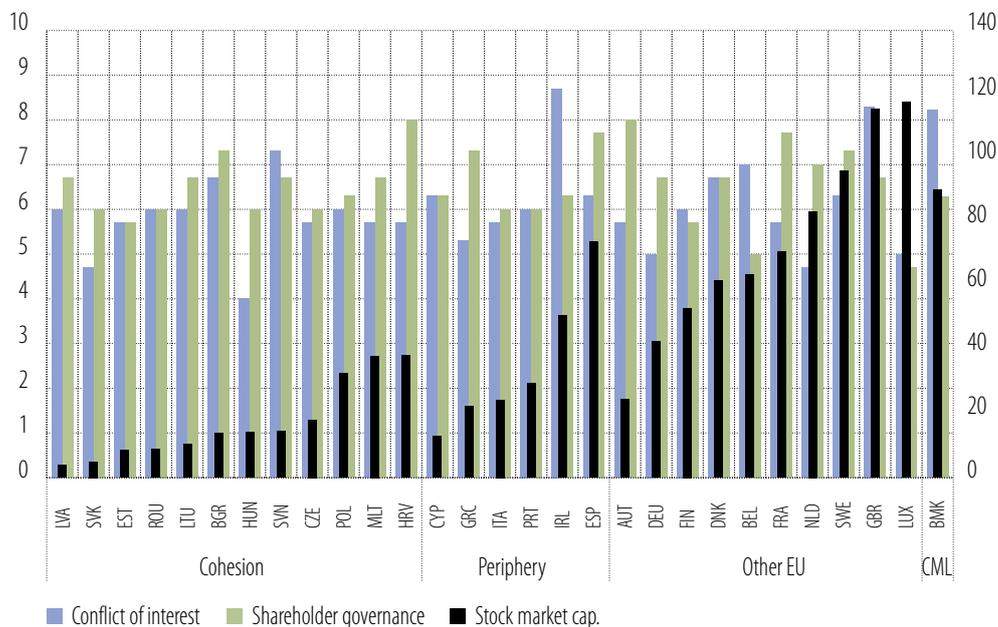
<sup>18</sup> See Box A for a discussion on the cost of equity and the link with stock prices.

## Institutional and social factors

**Lack of trust can account for smaller stock markets in parts of the EU.** In turn, changes in the business environment or improved enforcement of existing investor protection laws can lead to stronger local stock markets. This is especially needed in particular parts of the EU, mostly in the cohesion region.

**In public corporations, agency conflicts arise from the separation of ownership and control.** Those in control of the corporation have incentives to enrich themselves at the expense of others. The early literature focused on agency conflicts between managers and shareholders. Acting in their own interest, managers seek higher-than-market salaries, perquisites and job security (Jensen and Meckling, 1976). As residual claimants, stockholders are particularly vulnerable to such agency conflicts.

**Figure 16**  
Protecting minority investors



Source: *Doing Business 2018 and Global Financial Development Database.*

Note: *Common Law countries (CML), used as a benchmark (BMK), refers to the average, consisting of the UK, Ireland, the US, Canada and New Zealand.*

**Appropriate regulation of self-dealing transactions supports stock market development (Djankov et al., 2008).**<sup>19</sup> The protecting minority investors dimension of the World Bank's "Doing Business" project tracks the corresponding regulations for a broad cross-section of countries (Figure 16).<sup>20</sup> It appears that there is scope for improvement in all EU countries.

**Compared with the common law benchmark, most EU countries afford weaker protection to minority investors.** Historically, common law has placed a greater emphasis on investor protection than civil law

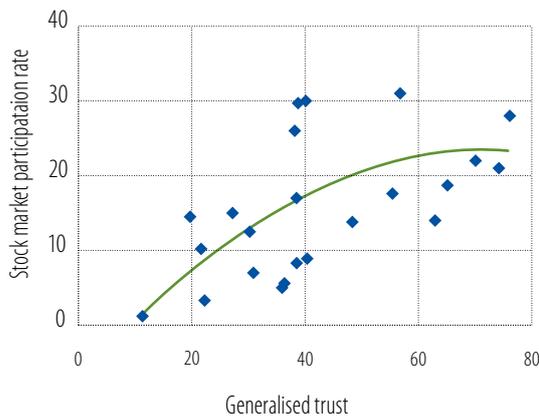
<sup>19</sup> Self-dealing or tunnelling refers to the opportunity for those in control of the firm to divert resources on the occasion of transactions with related parties (Djankov et al., 2008). Tunnelling includes outright theft and fraud, as well as loan guarantees or asset sales at prices advantageous to the controlling shareholder.

<sup>20</sup> Protecting minority investors is composed of two sub-indices: the conflict of interest regulation index and the shareholder governance index. The conflict of interest index represents the regulation of self-dealing transactions outlined in the text, while the shareholder governance index measures the rights of shareholders in corporate governance. Both indices range from 0 to 10, with an increase associated with an improvement in the business environment.

(La Porta et al., 2006).<sup>21</sup> Figure 16 shows the average stock market capitalisation of OECD members with a legal origin in common law (last bucket on the right-hand side). Indeed, common law countries such as the UK and Ireland have on average larger stock markets than most EU countries. The institutional environment can be conducive to equity markets.

**Trust is particularly important for financial transactions and has been invoked to explain financial market development (Guiso et al., 2008).** In a low trust environment, investors expect to be cheated, resulting in low valuations. Low valuations in turn discourage entrepreneurs from issuing and selling shares. Trust matters because third-party enforcement is imperfect and costly. In Figure 17 and Figure 18, we use generalised trust, an indicator based on the European Values Study.<sup>22</sup> The amplitude of the x-axis shows that trust varies widely across the EU; it tends to be higher in Scandinavia and lower in the cohesion and some of the peripheral economies. Figure 17 displays a positive association between stock market participation rates and generalised trust. Moreover, ownership concentration is also higher in societies with less generalised trust (Figure 18).

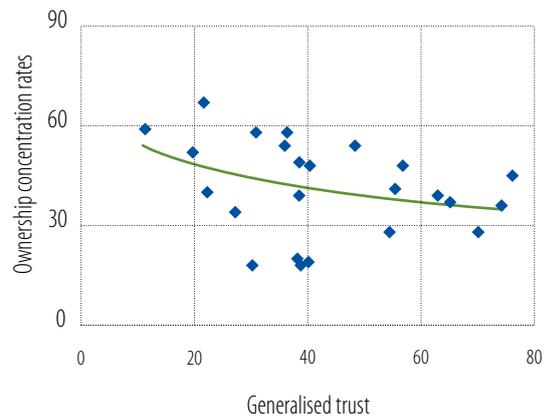
**Figure 17**  
**Stock market participation and trust**



Source: *European Values Study; Giannetti and Koskinen (2010).*

Note: *Stock market participation rates refer to domestic investors' participation in the domestic stock market.*

**Figure 18**  
**Ownership concentration and trust**



Source: *European Values Study; La Porta et al. (2006).*

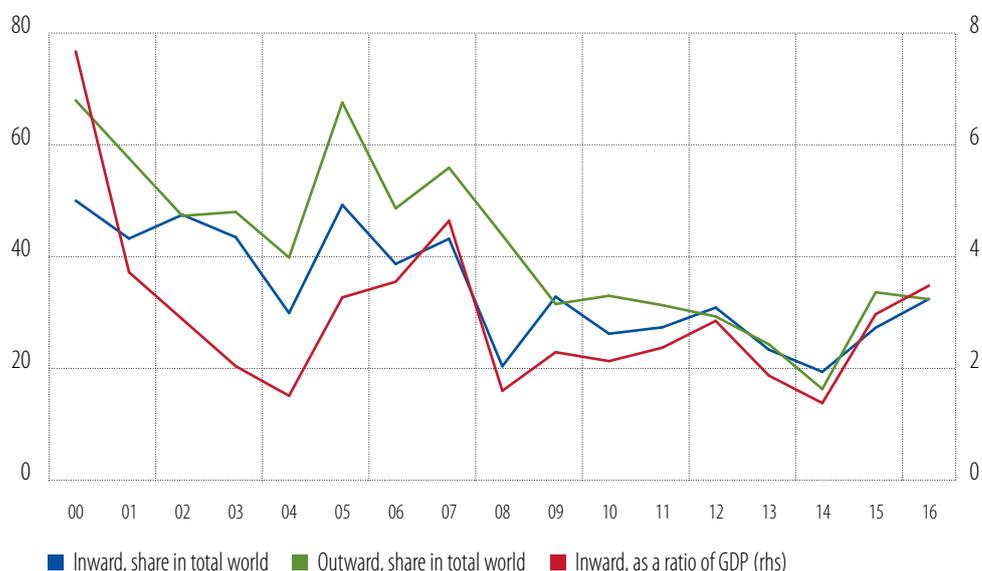
Note: *Ownership concentration is given by the average percentage of common shares owned by the top three shareholders in the ten largest non-financial, privately owned domestic firms in a given country.*

## Improved business environment would support stronger FDI flows

**Foreign direct investments (inflows) support growth and employment and improve productivity and competition by transferring new technologies and know-how to the recipient economy.** Studies focusing specifically on the EU economies document that FDI flows are contributing to growth, labour productivity and – through indirect spillover effects – increase the innovation activity of domestic firms (Falk et al., 2012).

21 Common law is formed by judges who set precedents by solving specific legal disputes. Civil law originates in Roman law and draws heavily on statutes and codes to organise legal material.

22 Generalised trust is given by the share of respondents answering that most people can be trusted to the following question: “Generally speaking, would you say that most people can be trusted or that you need to be very careful in dealing with people?”

**Figure 19****EU FDI flows (%)**

Source: ECON calculations based on Eurostat, UNCTAD.

**EU economies have both provided and received a substantial portion of the total FDI flows across the globe.** However, since the beginning of the millennium the share of the EU in both total inward flows and outward flows is trending downwards (Figure 19). In the 2001–7 period, with 2.9%, average FDI inflows to GDP were well above the world average of 2.2%. However, during 2009–16, despite the steep jump in 2015, inward flows to the EU averaged slightly below 2% of EU GDP, whereas the world average in the same period was 2.2% (Figure 19).

**EU countries can attract more capital transfers by improving the institutional and regulatory environment.** This relates especially to the less-developed countries that could benefit more from those flows. Theoretically, countries with lower per capita income (PCI), lower capital stock and less productivity should benefit more from FDI inflows. During 2001–7, low-PCI countries in the EU received more FDI relative to their GDPs than high-PCI countries (Figure 20).<sup>23</sup> This, in part, reflects the increase in FDI inflows to new EU members (all of which were low-PCI countries) following the accession to the Union of ten countries in 2004 and two countries in 2007. However, after the global financial crisis the gap between the two groups narrowed steadily and disappeared completely by 2014.

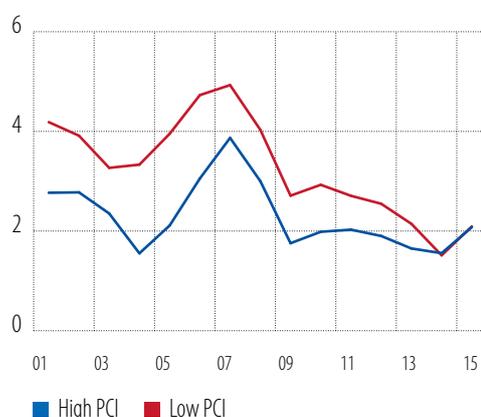
**Policy measures can raise a country's attractiveness and FDI inflows.** This is particularly relevant for lower per capita income countries, which presumably would benefit more from FDI inflows. In order to understand the potential contribution of policy measures to attracting FDI flows, we investigate the role of the economic structures of the host country in attracting the FDI flows. To this end, using all 28 EU Member States' data in the 2005–16 period, we regress the dependent variable, FDI-to-GDP, on structural indicators represented by the sub-indices of the world governance index (WGI), doing business index and global competitiveness index (GCI), one-by-one, together with the other control variables that are documented to be significant in the literature (EQ. 1). Hence, each equation contains only one structural indicator and several equations are estimated to test the relevance of each structural indicator.

$$\frac{FDI_{i,t}}{GDP_{i,t}} = \alpha_i + \beta \cdot \text{Structural Indicator}_{i,t} + \text{other controls}_{i,t} + \varepsilon_{i,t} \quad (\text{EQ. 1})$$

23 We stratified EU countries into low and high per capita income groups by setting 90% of EU average PCI as the threshold for separating the groups.

Among the structural indicators used, government effectiveness and rule of law sub-indices of WGI and goods market efficiency, labour market efficiency, innovation, institutions and business sophistication sub-indices of GCI appear significant in the estimations (Table 1). The results are similar to those of two recent studies investigating the role of structural variables in FDI flows. By using OECD countries data, with a similar technical setup, Dellis et al. (2017) found that the heritage and Fraser economic index, product market efficiency (GCI), overall quality of governance, regulatory efficiency and corruption sub-indices of WGI positively correlated with FDI inflows. Similarly, Popovici and Călin (2015) use GCI to assess the effect of structural factors on FDI inflows for ten CEE countries. Using Pearson correlation, they find that goods market efficiency, innovation, labour market efficiency, technological readiness, infrastructure and institutions components of the GCI are significantly associated with FDI inflows.

**Figure 20**  
Inward FDI flows as a share of GDP: high versus Low-PCI groups (%)



Source: ECON calculations based on UNCTAD and World Bank.

**Table 1**  
FDI Inflows and Institutional Variables

	Pooled OLS	Random effect	Fixed effect
Goods market efficiency	10.02 (3.28)**	8.31 (3.07)**	7.32 (3.31)**
Labour market efficiency	12.79 (4.87)**	12.69 (4.87)**	10.80 (5.46)**
Institutions	8.04 (3.56)**	7.07 (3.46)**	6.17 (3.73)*
Business sophistication	11.40 (5.79)**	11.16 (5.78)*	9.44 (6.44)

Note: \*\* denotes significance at 5% and \* at 10%. t-values are shown in parentheses. The variables enter different equations.

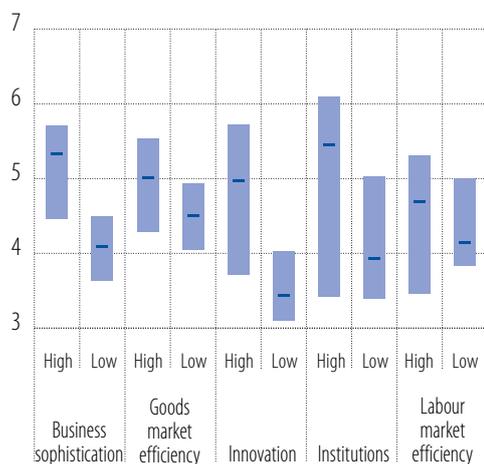
As a next step, in order to understand whether low-PCI countries have room for improvement, we investigate where, on average, the countries in each group stand according to these indicators. Figure 21 presents the relative positions of the two groups in the relevant sub-indices of the GCI.<sup>24</sup> For all sub-indices, high-PCI countries are significantly closer to the top score. The gap between the two groups is particularly striking for innovation, institutions and labour market efficiency indices.<sup>25</sup>

The two sub-indices of WGI also display a considerable difference across the two groups (Figure 22). For both indices, the median of high-PCI countries is in the top tenth percentile of the assessed countries, while that of low-PCI groups is around the 25<sup>th</sup> percentile of the distribution. Overall, rankings and the scores of the countries according to those indices show that, in terms of the quality of economic structures, low-PCI countries lag significantly behind the high-PCI countries. Given the positive role of structural variables on the FDI flows and the significant gap between the low and high-PCI countries in terms of quality of economic structures, our analysis suggests that low-PCI countries might benefit more from global FDI inflows by implementing relevant policy measures.

<sup>24</sup> See WEF (2014) for the details of the methodology.

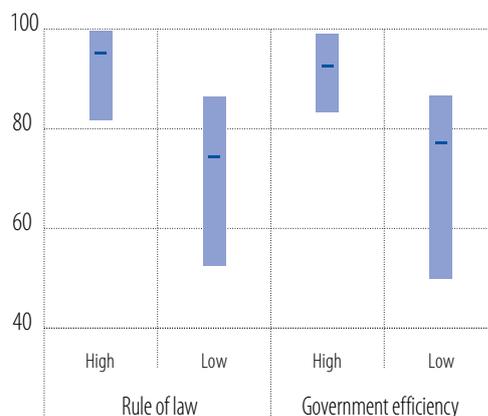
<sup>25</sup> As the position of the median suggests, the variance of the High PCI group for these indices is magnified due to the outlier(s). Here outlier(s) are the countries with the lowest level of PCI in the group.

**Figure 21**  
Scores of high- and low-PCI group countries with respect to selected GCI sub-indices



Source: ECON calculations based on UNCTAD.  
Note: The light blue vertical bar indicates the min and max interval, while the dark blue horizontal line indicates the median.

**Figure 22**  
Rankings of high- and low-PCI group countries with respect to selected WGI sub-indices



Source: ECON calculations based on Eurostat, UNCTAD.

## Corporate culture and reluctance to dilute power

**According to the pecking order theory, firms prefer internal finance to external finance.** If external funds are required, the firms will seek to issue debt rather than equities. Financial theory shows that the value of a firm is independent from its liability structure in perfect, frictionless, financial markets (Modigliani and Miller, 1958). Rather than being a realistic way to explain how firms finance their activity, this theory provides a benchmark to refer to in order to show why financing matters.

**Firms try to minimise the additional costs of asymmetric information associated with external financing.** As debt has a prior claim on the firm's assets, it is less exposed to errors in valuing the firm. An experiment suggests that corporates rarely see equity as an option, and that the premium they are willing to pay to issue debt rather than equity is very high.<sup>26</sup>

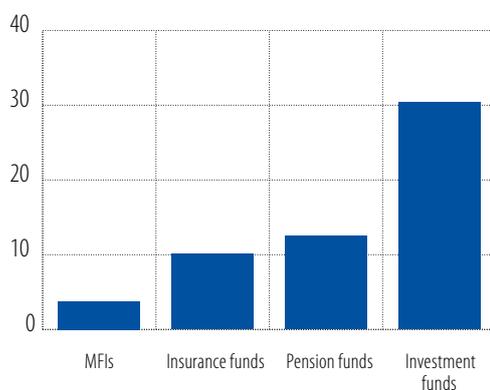
**Firms value financing that gives them flexibility without diluting ownership, such as hybrid debt instruments.** They are willing to pay a significant premium on the cost of debt to refrain from issuing equities. This behaviour is explained by aversion to equity dilution, as well as possibly weak financial literacy.

<sup>26</sup> An experiment was carried out to present firms with different hypothetical financing offers; some of these were loans and others were equity participations. Using the results of this experiment, Brutscher and Hols (2018) show that firms generally prefer debt financing over equity financing. When a firm is presented with an equity offer and a loan offer, it takes the loan offer in eight out of ten instances. Less than 1% of firms prefer more equity finance than they currently have.

## Structure and regulation of the financial sector

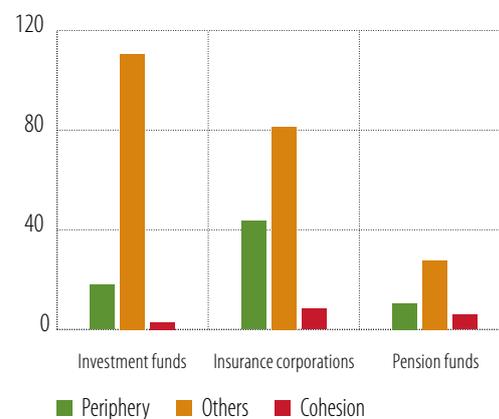
The EU financial system is bank-based, but banks only invest a small share of their assets in equity (Figure 23). This is not surprising given the business model of banks. Moreover, the most recent changes in EU regulations, such as Basel III, are likely to further limit the demand for equity addressed by banks. The same is also likely for insurers, with the new capital adequacy standards for insurers. All else being equal, the demand for equity arising from these two pillars of the financial system is likely to fall.

**Figure 23**  
Equity as a share of assets: main financial institutions (%)



Source: ECON calculations based on ECB.  
Note: Average over 2017:Q1-2018:Q1, euro area.

**Figure 24**  
Aggregate size of institutional investors (% GDP)



Source: Authors' calculations based on SAFE.

Institutional investors such as investment funds, insurance companies and pension funds continue to play a limited role, especially in the cohesion and periphery regions (Figure 24). They can also be sizeable equity investors, given that they are patient and require highly diversified portfolios. However, their aggregate size is extremely heterogeneous across countries, with total assets worth 300% of GDP in Denmark and less than 12% in Greece. They have a strong home bias in their asset allocation, with limited scope for cross-country financial flows.

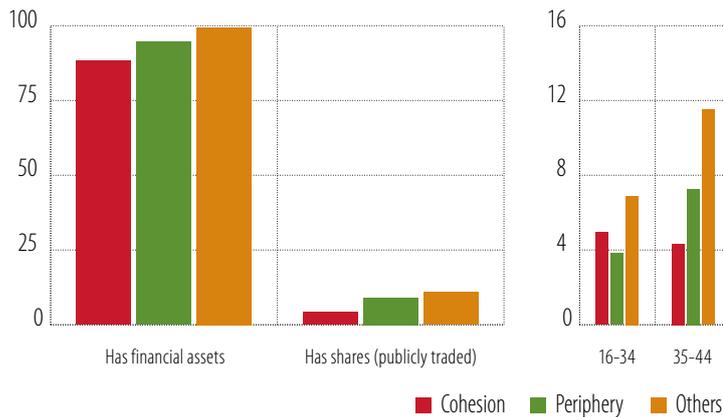
## Ageing is likely to dampen the relative demand for equity

A very small share of European households hold equities (Figure 25). A relatively large share of European households have financial assets: from 82% in cohesion countries to 99% in the other economies. However, less than 9% of European households have equities. The ratio even declines to less than 5% in the cohesion region. This possibly reflects a lack of financial literacy as well as the elevated cost of trading and monitoring an equity portfolio.

Demographic changes are likely to further reduce the relative demand for equity. Most advanced economies, including Europe, are ageing. Consequently, both individuals and the pension funds that pay their benefits will start to reduce their exposures to equities and shift to fixed-income instruments and other low-risk assets to preserve capital and provide a guaranteed income stream. Indeed, older

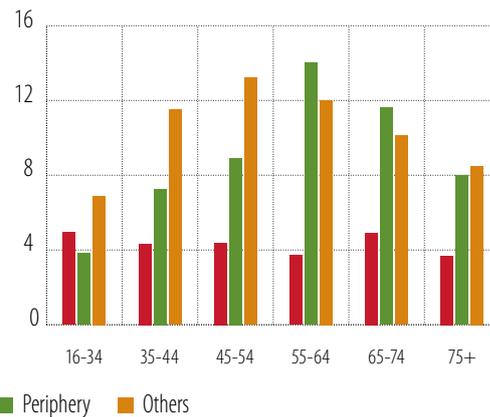
people tend to hold a smaller share of their financial wealth in equity (Figure 26).<sup>27</sup> However, according to the life-cycle hypothesis, an increase in saving is also likely to accompany the ageing process, thereby increasing the overall volume of funds to be invested.

**Figure 25**  
**Financial assets: participation rate**



Source: *ECON calculations based on ECB.*  
Note: *Share of households having financial assets and traded shares.*

**Figure 26**  
**Household asset allocation by age**  
(share of equity, %)



Source: *ECON calculations based on ECB.*  
Note: *Share of households having financial assets and equities.*

## Some benefits of a stronger equity base

Having elaborated on the reasons for the weak equity base of European corporates, we now turn to the benefits to the EU economy if policies aimed at fostering the equity base were to be implemented. We do not aim to give a full picture, as we do not net the benefits with the associated costs, in terms of transition towards a new financial system, for example. We elaborate on five benefits. First, the EU would benefit from increased resilience to financial shock. Second, the impact of credit constraints on capital expenditure would be reduced. Third, more equities would give more scope for private-investor-based risk sharing. Fourth, the innovation capacity of the EU economy would be fostered. Fifth, the growth-stage trap would be reduced.

### Increased resilience to financial shocks

**The financial crisis clearly revealed the relative merits of strong capital markets in times of economic stress.** Companies with direct access to capital markets performed substantially better during the crisis than those without, as the latter found themselves vulnerable to credit droughts once banks got into trouble (Figure 27). The most crisis-hit countries are notably those with smaller equity bases. In Greece, Ireland, Italy, Spain and Portugal, credit to firms forms a larger percentage of GDP than the continental EU average. Bond markets are smaller than average except in Italy and Portugal, and stock market capitalisation is above average only in Spain.

<sup>27</sup> A projection by McKinsey shows that if Europeans of all age groups maintain the asset allocations they have today, the rising share of the population of 65 and over will drive down the overall share of household financial assets in equities from 29% today to 25% in 2020 in the United Kingdom; from 25% to 22% in France, and from 19% to 16% in Germany (the fall is somewhat less pronounced in the US, where the proportion of equity is expected to fall from 42% to 40%). This effect will be reinforced by the move of several countries from defined benefits to defined contribution pension schemes – as the latter have a well documented bias against equity investment.

Figure 27

Investment recovery after financial crisis (100 in crisis year)



Source: ECON computations based on 67 countries over 50 years, a total of 121 financial crises.

Note: The green line shows countries that are more bank-based and the blue line shows countries that are more market-based.  $t = 0$  corresponds to the crisis year. Time  $t$  refers to the years before (-) and after (+) a financial crisis hits.

**During the economic downturn, companies financed with higher levels of equity faced less risk of financial distress than those financed mainly with debt.** The procyclical dynamic of corporate leverage exacerbated the recession in many more bank-based countries than market-based ones, forcing companies to cut back employment to meet debt payments and leaving them in danger of bankruptcy. Langfield and Pagano (2016) report a negative association between growth and the ratio of bank to market-based intermediation. Reducing the cyclical sensitivity of external finance access to debt fosters the resilience of the financial structure.

**When it comes to moderating business cycle fluctuations, banks and markets differ considerably in their effects.** In normal downturns healthy banks help to cushion the shock, but when recessions coincide with financial crises the impact on GDP is three times as severe for bank-oriented economies as it is for market-oriented ones (Gambacorta et al., 2014).

## Dampened impact of credit constraints on capital expenditure

**Mispricing can result in credit-constrained firms' investments having a greater sensitivity to stock prices.** The exercise in Table 2 adopts the framework of Baker et al. (2003) to more formally examine the role of mispricing. Baker et al. (2003) show that overvalued but credit-constrained firms invest and issue equity while undervalued credit-constrained firms reduce investment and issuance volumes depending on the degree of undervaluation. Firms with financial slack invest regardless of whether the firm is over or undervalued. Credit-constrained and therefore equity-dependent firms will show a greater sensitivity of investment to stock market valuations than firms with financial slack. This mechanism is known as the equity financing channel. The mispricing hypothesis implies a negative sensitivity between investment and future stock prices, and this sensitivity is more negative for credit-constrained firms. Over time, mispricing is corrected and periods of high investment are followed by low returns and vice versa.

**The investment and financial policies of credit-constrained firms are more sensitive to stock prices.** Table 2 presents the baseline results. The dependent variable in Column 1 is capital expenditure.

As expected, investment is decreasing in equity dependence and increasing in  $q$ . Importantly, the interaction term is positive and statistically significant. Thus, the investment of credit-constrained firms is more sensitive to stock market valuations. It is important to note that a pecking order can also account for credit-constrained firms' greater sensitivity of investment with regard to  $q$ .

**Table 2**  
**Baseline results**

	Investment	Equity	Debt
CC	-0.155*** (0.00)	0.622*** (0.00)	-0.557*** (0.00)
$q$	0.009*** (0.00)	0.029*** (0.00)	0.018*** (0.00)
CC $\times$ $q$	0.054*** (0.00)	0.374*** (0.00)	0.056 (0.21)
Cash flow	0.030*** (0.00)	0.022 (0.54)	0.000 (0.98)
Constant	0.052*** (0.00)	0.001 (0.91)	0.030*** (0.00)
$n$	21 083	15 805	21 337

*Note:* Results from fixed effects regression. Standard errors are cluster robust.  $p$ -values are given in parentheses. \*\*\* denotes significance at the 1% level. All specifications include period fixed effects. Explanatory variables are lagged by one period. Investment is defined as capital expenditure( $t$ )/assets( $t - 1$ ). Equity given by indicator equal to one if the difference between funds raised through share sales and funds used for buybacks exceeds 2.5% of beginning-of-period assets. Debt is defined as (debt( $t$ ) - debt( $t - 1$ ))/assets( $t - 1$ ). Adapted from Baker et al. (2003).

**Financial policies are consistent with those on investment.** Column 2 presents results on equity issuance. Equity-dependent firms are more likely to issue equity, and so are firms with high  $q$ . Again the interaction between equity dependence and  $q$  is positive and significant. The issuance activity of equity-dependent firms is thus more sensitive to stock market valuations. Column 3 shows results on debt. The dependent variable is given by the first difference in total debt scaled by beginning-of-period assets. On average, credit-constrained firms reduce their indebtedness. Debt is increasing in Tobin's  $q$ , indicating that high-growth firms use both equity and debt to finance their expansion. The interaction term is not significant.

**Evidence partially supports the existence of an equity financing channel.** To distinguish the mispricing channel from standard adverse selection arguments, Table 3 examines the association between future returns and investment. Future returns are measured as the total average return over periods  $t + 1$ ,  $t + 2$  and  $t + 3$ . The evidence is consistent with mispricing to the extent that firms which invest a lot earn poor future returns, and the same applies to equity issuers. In addition, the framework of Baker et al. (2003) makes the specific prediction that the coefficient on the interaction term between equity dependence and future return is negative. But, contrary to the hypothesis, the interaction turns out to be insignificant. Thus, the investments of equity-dependent firms are no more likely to turn bad than those not dependent on equity.

**Table 3**  
**Baseline results**

	Investment	Equity	Debt
CC	-0.113*** (0.00)	1.196*** (0.00)	-0.619*** (0.00)
Future returns	-0.014*** (0.00)	-0.073*** (0.00)	-0.026*** (0.00)
CC × future returns	0.018 (0.61)	0.392 (0.23)	0.066 (0.51)
Cash flow	0.046*** (0.00)	0.162*** (0.00)	0.031** (0.05)
Constant	0.045*** (0.00)	0.002 (0.88)	0.036*** (0.00)
<i>n</i>	12 836	11 679	12 953

*Note:* Results from fixed effects regression. Standard errors are cluster robust. *p*-values are given in parentheses. \*\*\* and \*\* denote significance at the 1% and 5% level respectively. All specifications include period fixed effects. Explanatory variables are lagged by one period. Investment is defined as capital expenditure(*t*)/assets(*t* - 1). Equity given by indicator equal to one if the difference between funds raised through share sales and funds used for buybacks exceeds 2.5% of beginning-of-period assets. Debt is defined as (debt(*t*) - debt(*t* - 1))/assets(*t* - 1).

**Banks reject or limit the financing of high-growth enterprises despite their good economic returns.** Box C analyses how HGEs can be constrained in their access to finance. On the one hand, the risk profile of the company is the major focus of the credit analysis and banks do not go above a conservative threshold. On the other hand, the equity investors of HGEs are the final beneficiaries of the growth, as good projects are appraised by their increasing stock prices and generate higher dividends. Equity investors have every incentive to invest in HGEs. Therefore, HGEs would benefit the most from the development of equity markets.

**Box C****Can market finance alleviate financing conditions for HGEs?**

We define HGEs as enterprises with average annualised turnover growth of more than 10% per year over a minimum three-year period and having at least ten employees at the beginning of the growth period. Besides the high growth, we also define two other growth enterprises.

1. Stable enterprises: those that register turnover growth below 10% or increase turnover fast for a period of less than three consecutive years. In this category, enterprises might also register drops in the turnover, but for less than three consecutive years;
2. Declining enterprises: those that register a decline in turnover for at least three consecutive years.

Based on this definition, the resulting share of HGEs from our sample is 8%, while those enterprises that are in their declining phase account for 22% of our sample, and 70% of our sample are those enterprises that are in a stable phase.

Given their nature, HGEs may be more inclined to report access to finance as one of the main obstacles when doing business. Their rapid expansion involves major risks and liquidity shortages that may end in insolvency (Delmar et al., 2013). Such risks are closely followed by the banks and may be the reason of rejection in providing additional loans. We test the hypothesis that HGEs face more difficulties in

their access to finance by checking the significance of financing constraints for enterprises under each growth phase: high growth, stable and declining. We explore this link without inferring any causality. If the presence of financing constraints is more positively linked to the high-growth status than in the stable and declining phases, it indicates unrealised growth due to the presence of financing boundaries, despite the growth that has already been recorded. Consequently, the highest positive impact on economic growth can be achieved by alleviating the financing conditions of HGEs and unlocking their growth potential.

We assume that, depending on their nature as well as demand conditions, firms are not affected symmetrically by finance constraints. To test this proposition, we use a linear probability model. We regress  $y$ , a dummy indicating that the firm is alternatively HGE, stable or declining on an indicator of financing constraints,  $FC$ , and a set of control variables (we treat the crisis period separately):

$$y_{it}^* = \alpha + \beta_0 FC_{i,t-1} + \beta_1 \text{Crisis} * FC_{i,t-1} + \gamma \text{ControlVariables} + \varepsilon_{it} \quad (\text{EQ C.1})$$

The financing constraints index,  $FC$ , is constructed from firms' survey answers to specific key questions about access to external finance.<sup>28</sup> The indicator, available only over the two years of the European Investment Bank Investment Survey (EIBIS), is backcast using the relationship estimated with leverage, liquidity ratio and cash position, as well as sector and country dummies (Ferrando et al., 2015). With this methodology we obtain a proxy for financial distress even for the period when no survey data is available. In this way we can analyse the dynamics during the financial crisis. The estimation results of EQ.1 are reported in Table C.1.

**Table C.1**  
**Estimation results of EQ C.1**

	HGE	Stable	Declining
FC	0.66*** (0.041)	0.20*** (0.072)	-0.90*** (0.065)
FC*Crisis dummy (09-10)	-0.22*** (0.021)	-0.48*** (0.042)	0.69*** (0.04)
Observations	95 260	95 260	95 260

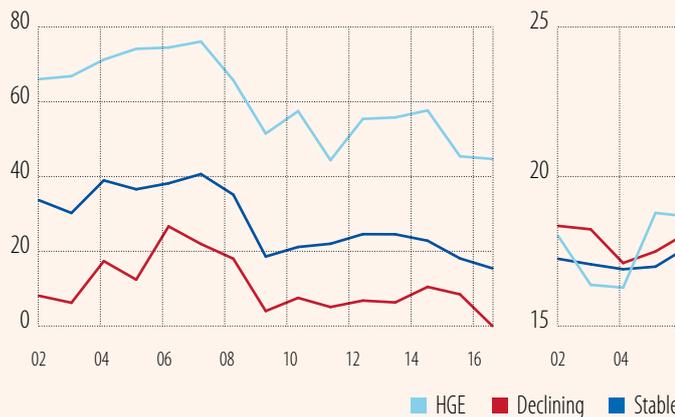
Table C.1 shows that HGEs are financially constrained more often than enterprises in stable or declining growth phases. However, they were less affected during the financial crisis. This might be explained by the procyclicality of their investments. On the one hand, the financing demand of HGEs during economic downturns is low. Investment projects are cancelled under worsening market conditions, and internal sources are sufficient for their working capital. On the other hand, HGEs increase investments whenever market conditions are improving and demand is high. For this reason, they also need external financing, but by applying more often for loans, they are more often rejected or limited in some aspects (lower volume, higher interest rates).

Increased difficulty in getting additional loans might be explained by the high leverage (or low equity base) of HGEs. Despite their profitable current and future investment projects (high investment rates) and good performance in terms of servicing their existing loans (low debt burden), they are not able to contract additional loans. This might be due to their relatively high indebtedness (high financial leverage) or lack of tangible assets. Additionally, fast growing innovative companies that have more

<sup>28</sup> The index takes the value 1 if any of the following four cases is met: quantity constraint (unhappy with the received amount), rejected, price constraint (too expensive) and discouraged (not seeking because would be rejected).

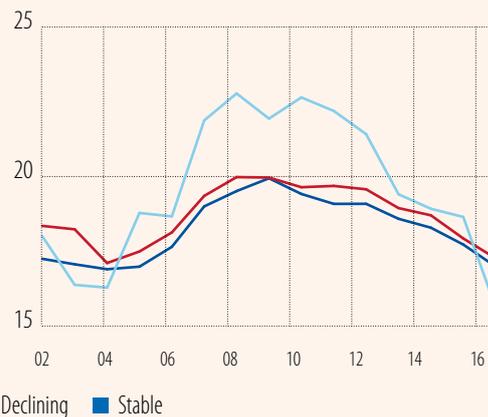
intangibles than tangible assets and service companies that function in general with a low level of tangible assets might face rejection due to the lack of assets used as collateral.

**Figure C.1**  
Investment rate



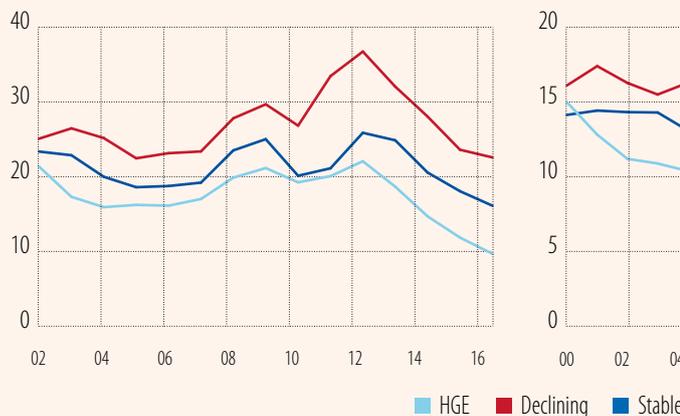
Source: Author's calculations based on ORBIS.  
Note: Investment rate is defined as the variation in fixed assets between two subsequent years over previous fixed assets.

**Figure C.2**  
Indebtdness



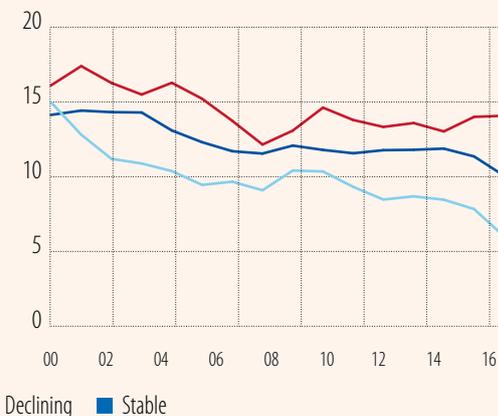
Source: Author's calculations based on ORBIS.  
Note: Financial leverage is defined as the sum of short-term loans and long-term debt over total assets.

**Figure C.3**  
Debt burden



Source: Author's calculations based on ORBIS.  
Note: Debt burden is defined as interest paid over EBIT plus depreciation and amortisation.

**Figure C.4**  
Equity ratio



Source: Author's calculations based on ORBIS.  
Note: Equity ratio is defined as shareholders' fund over total assets.

We next investigate more formally the link between the type of firm and its type of financing. We estimate EQ C.2, where, as before, = 1 if the company is, respectively HGE, stable or declining (results are shown in Table C.2):

$$y^*_{it} = \alpha + \beta_1 \text{Bank}_{i,t} + \beta_2 \text{Bonds}_{i,t} + \beta_3 \text{Equity}_{i,t} + \beta_4 \text{Grants}_{i,t} + \beta_5 \text{Family/Friends}_{i,t} + \text{ycontr. var} + \epsilon_{it} \quad (\text{EQ C.2})$$

Equity financing, whenever possible, plays a greater role in financing of HGEs than in stable or declining enterprises. We check the importance of different financing sources using the EIBIS 16 and EIBIS 17 (Table C.2). Any additional equity financing of HGEs would lift the financing barrier, resulting in the double impact of additional investments. Besides receiving the financing in the form of equity, the improved balance sheet (lower leverage), qualifies the enterprise for additional bank loans.

**Table C.2**  
**Estimation results of EQ C.2**

	HGE	Stable	Declining
Bank financing	0.07* (0.066)	0.12* (0.075)	-0.11** (0.019)
Newly issued bonds	0.05 (0.372)	0.26** (0.033)	-0.15* (0.063)
Newly issued equity	0.12** (0.03)	0.11 -0.324	-0.13 (0.133)
Grants	0.06 (0.176)	0.15** (0.045)	-0.10** (0.047)
Family/friends	0.08* (0.056)	0.11 (0.173)	-0.12** (0.038)
Observations	5 935	6 422	6 366

Source: Authors' estimations.

Note: Probabilities are given in parentheses. \*\*  $p < 0.05$ , \*  $p < 0.1$ . The explanatory variables consist of each type as a share over total external finance. As control variables, we use the size, country and sector fixed effects.

Unlike other enterprises, HGEs rely significantly on equity. The estimation of (EQ C.2) shows that bank financing is not sufficient for them. Equity financing (private equity or listed shares on capital markets) plays an important role in matching their high demand for financing. For stable enterprises, grants and bond issuance are more important, while for declining ones the probability of using any type of external financing is significantly lower.

## Avoiding the growth-stage trap for innovative companies<sup>29</sup>

**A larger EU domestic market could better support the emergence of leading innovators, as in China.** However, several barriers to investment in the EU are still hindering rapid firm growth, in particular in the service sectors. Failure to develop a larger and less fragmented VC market in Europe risks hampering innovation and growth, placing Europe even further behind in terms of leading global innovative companies. Indeed, VC is not a financing instrument for all types of companies, but rather one that targets young and innovative enterprises with very high growth potential (Kraemer-Eis and Lang, 2017).

**A shortage of risk capital for small, growing, early-stage European businesses is holding back the development of high-growth sectors essential for economic competitiveness (AFME, 2017).** Moreover, limited financing opportunities are prevalent not only at the seed and start-up stages of a company's life cycle, but also when innovative companies seek financing to realise their growth ambitions.

**This "growth-stage trap" phenomenon means that Europe is not reaping the benefits of the most promising young companies.** Once they graduate from the seed, start-up and early-expansion stages

<sup>29</sup> This section is based on Kraemer-Eis et al. (2018b).

and embark on an ambitious global growth path, the young companies the EU has nurtured need higher investment ticket sizes. In the process, Europe loses much-needed entrepreneurship, technological know-how and jobs. During the 2003–15 period, on average, 44% of the venture capital companies backed by EIF investee funds were acquired by non-European buyers, particularly from the US, which mainly targeted start-ups in the same industry by vertical integration (Prencipe, 2017; Kraemer-Eis et al., 2017).

**Empirical evidence and EIF’s own research suggest that public venture capital support is relatively well targeted and achieving positive effects in Europe.** In a study of investment patterns of different venture capital investor types, Bertoni et al. (2015) found that governmental VC investors in Europe specialise in investments that do not attract private investors due to high information asymmetries and high failure risk. Such investments particularly benefit young and small seed-stage companies in sectors such as biotechnology and pharmaceuticals, in which time to market is long and new product development is very costly.

**Governmental venture capital fills part of the financing gap arising from the insufficient number of private venture capital investors.** However, there is a need to use public sector resources primarily to mobilise private sector capital, as in the example of the Investment Plan for Europe (Kraemer-Eis et al., 2018b). In order to better understand the market needs of the European VC ecosystem and improve the design of EIF’s products offered aimed at supporting this market, the EIF conducted the first VC Survey in 2018. The results are summarised in Box D.

#### Box D

##### Main results of the EIF VC Survey<sup>30</sup>

The EIF VC Survey was carried out among venture capital general partner (GP)/management companies headquartered in the EU28 and some additional countries (mainly Norway, Switzerland and Turkey). The surveyed population includes companies in which the EIF invested as well as those in which it has not invested. The first survey wave was conducted in November/December 2017. The questionnaire covered three areas: (i) the VC market sentiment, (ii) market weaknesses and public intervention, (iii) the value added, products and processes of the EIF. In this box, we summarise the content of the survey.<sup>31</sup>

#### Market sentiment

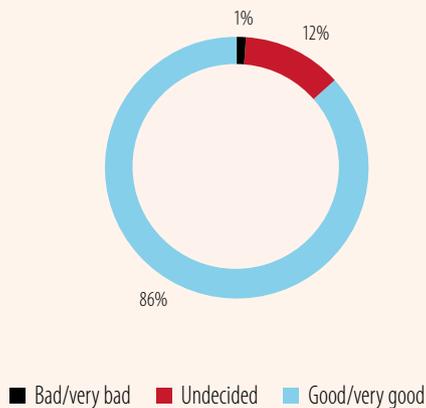
The state of business is perceived as positive, with most fund managers reporting an improvement over the last year and a positive outlook for 2018 (Figures D.1 and D.2).

Availability of funding and fundraising environment. A large majority of the fund managers consider that there is a lack of funding to finance VC-supported companies’ prospects in general; fewer managers believe that this is an issue affecting their own portfolio companies in particular. Less than half of the fund managers consider the fundraising environment over the preceding year to have been good; only one-third of the respondents expected an improvement in the subsequent year. Finding co-investors to syndicate was perceived as relatively easy by most respondents, with expectations largely the same for 2018.

<sup>30</sup> This box is based on Kraemer-Eis et al. (2018a–c).

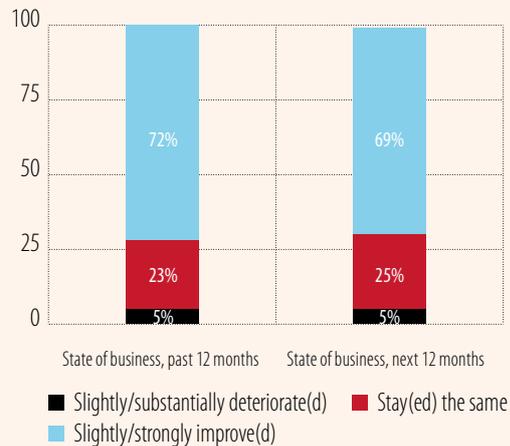
<sup>31</sup> The project forms part of the EIF’s work to assess the impact of its activities and complements the recent and ongoing quantitative analyses of the economic effects of the EIF’s VC operations. Based on this survey, a venture capital market sentiment index (barometer) is in development and will provide the possibility to track the VC market sentiment over time. Additionally, precise policy recommendations are expected to emerge from future waves. As such, this project contributes to a sustainable venture capital ecosystem in Europe – a key objective of the EIF. It is envisaged to repeat this study regularly. Two EIF Working Papers present the results of the survey: Kraemer-Eis et al. (2018a) provides a detailed overview of the respondents’ state of business and market activity as well as their general perception of the European VC market and public intervention. In doing so, this part of the study looks at the current situation, developments in the recent past, and expectations for the future. Kraemer-Eis et al. (2018c) look into fund managers’ perception of the EIF’s value added.

**Figure D.1**  
VC fund managers' state of business:  
current



Source: Kraemer-Eis et al. (2018a), based on EIF VC Survey data.

**Figure D.2**  
VC fund managers' state of business:  
past and expected (% of respondents)



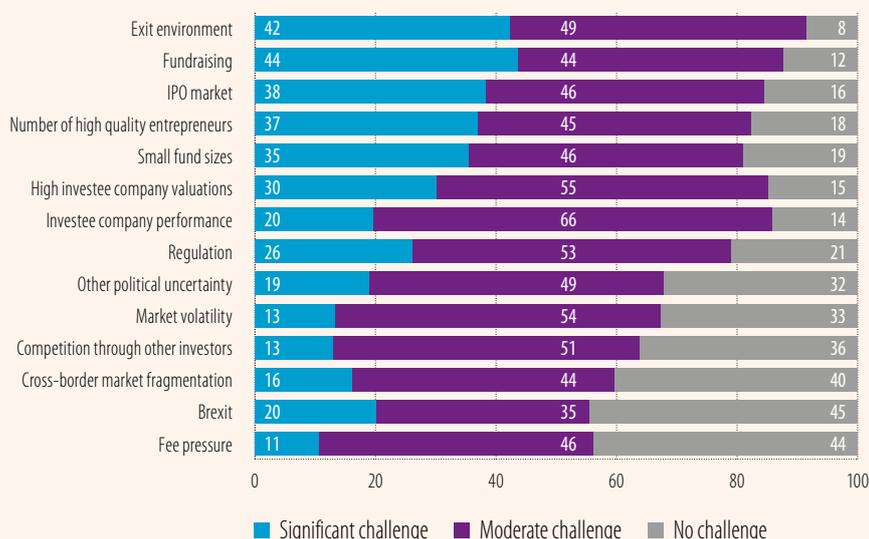
Source: Kraemer-Eis et al. (2018a), based on EIF VC Survey data.

Investments and portfolio development. The number of qualified investment proposals received and of new investments undertaken were both expected, on balance, to increase in 2018. Portfolio development during the preceding year was at least in line with expectations, with further improvement expected for 2018. Trade sales dominated the exit activity in 2017, while improved exit opportunities were expected for 2018.

Important challenges remain in the European VC business. The exit environment, fundraising and initial public offerings (IPOs) market were perceived as the three biggest challenges in the European VC business. Recruiting high-quality professionals was perceived as the biggest challenge faced by VC-supported companies; securing financing ranked second. The extent of the regulatory requirements applied in the European VC business was largely expected to remain the same, bringing no significant change to the VCs' state of business.

Overall prospects of the European VC market: promising countries and industries for future VC investments. The overall VC market in Europe and investment activities in the European VC market were both expected to improve in 2018. Fund managers were rather confident about the long-term growth prospects of the VC industry in their market and in Europe as a whole. While Germany, the UK and France were perceived as the three most promising countries for VC investments in 2018, the UK was expected to lose ground, in particular to Germany. Information and communications technology (ICT) and life sciences were perceived as the two most promising industries for VC investments in 2018. Alongside traditional industries, the importance of newer sectors such as cybersecurity, fintech and deep technology is expected to rise. There are variations across countries and industries in certain aspects of the survey. In particular, the uncertainty surrounding the implications of Brexit seems to have negatively affected the market sentiment of UK-based fund managers.

**Figure D.3**  
**Biggest challenges in VC business**



Source: Kraemer-Eis et al. (2018a), based on EIF VC Survey data.

Note: Diagram shows the aggregated results for the EIF VC Survey question “Where do you currently see the biggest challenges in venture capital business? Please indicate from significant challenge to no challenge.” In some cases, the numbers indicated in the bars do not add-up to 100 due to rounding effects.

## Role of the public sector

Public support in general is perceived as crucial for the European VC market. The VC managers called in particular for an improved public role in increasing investment volumes and targeting different stages in venture capital financing. Nearly two-thirds of the respondents (64%) indicated governmental support should be increased for early-stage businesses. The fund managers were more satisfied with the European programmes than with national or regional programmes. Involvement of pension funds as investors appeared to be the most important element that is currently underdeveloped. The respondents perceived the readiness of large private institutional investors to invest in European VC to be poor and appreciate governmental programmes that encourage other private limited partners (LPs) to invest.

## Policy implications

The lack of funding of portfolio companies’ prospects was still perceived as significant. The challenges relating to fundraising and exit opportunities prevent European venture capital from becoming a more attractive asset class. At the level of the portfolio companies, securing financing is perceived as the second most important challenge (after “recruiting high-quality professionals”).

The VC managers perceived the European VC market as underdeveloped in some parts and not dynamic enough. In particular, the large private institutional investors were not ready to invest in European venture capital; European VC funds are too small to be attractive to large private institutional investors. Moreover, cultural attitudes about risk perception play a big role. The European VC market seems to lack risk appetite and sufficient information about the track records of VC funds’ performance in order to attract LPs.<sup>32</sup>

<sup>32</sup> Independent VC fund managers act as general partners in a limited partnership in which the fund investors invest as limited partners. This is the most common legal structure for VC funds in Europe.

In general, the market needs to raise awareness about the social and economic impact of VC. It needs more success stories, which, according to the respondents, can be supported by data-driven research. The market needs to demonstrate that European VC companies are viable, that they have strong financial returns and successful exits.

To stimulate the ecosystem, public support can play a role in two ways: by tax incentives and simplified and harmonised regulatory systems, and by the provision of more public resources to increase investment volumes and encourage other private LPs to invest.

The provision of more public resources could help to crowd-in large private institutional investors. Moreover, the VC market needs to be more harmonised across Europe. The fund managers called for supporting pan-European funds, more cross-border investments and a harmonisation of legal frameworks and tax systems. It also appears that the full picture of the public VC supply is unknown to many funds. The respondents thought better coordination was needed among the governmental programmes targeting the same instrument/product/sector/country and mapping investors would also be helpful.

## More scope for private investor-based risk sharing and improved savings allocation

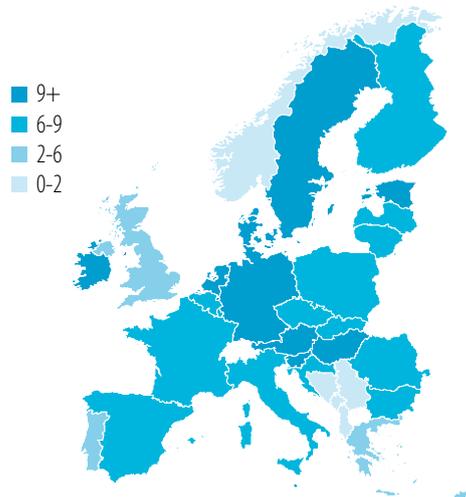
**Equity finance is a key source of risk absorption as it provides opportunities for private investor-based risk sharing.** Equities provide an opportunity to smooth idiosyncratic income shocks, as the income obtained from equity investment abroad is less dependent on domestic developments. Conversely, revenues from debt securities are fixed. Therefore, this type of financial instrument does not enable risk sharing, at least when the security is issued in the same currency. For capital markets, there are differing rules and market practices for financial products across countries, and insolvency and judicial systems vary widely. There is a broad agreement in Europe that the current level of risk sharing in Europe is insufficient to smooth shocks, particularly in the euro area, where the exchange rate is fixed (Draghi, 2018).

**Savings are very diverse and should circulate more freely across Europe to where investment needs are, especially towards productive investment (Figure 28).** In 2017, the euro area recorded a current account surplus of around 3.5% of GDP. This is an excess of savings relative to investment. More equity would provide better support for allocating cross-border capital flows and raising investment locally in Europe, not necessarily in the home economy.

**The allocation of savings across the EU is not optimal, with home bias raising local asset price inflation.**<sup>33</sup> Domestic savings tend to be invested locally, fuelling the local prices of not necessarily productive assets. As shown in Figure 29, there is a positive correlation between the adjusted savings and the change in house price: the higher the net savings, the steeper the house price increase. This correlation remains even when purged from the impact of business cycle activity, by considering the change in the ratio of house price to household income.

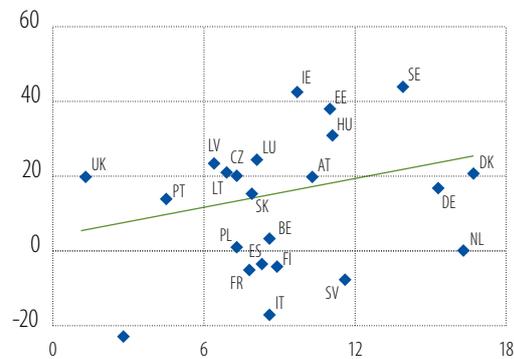
<sup>33</sup> Current account surplus is not a necessary condition for domestic asset price inflation. Indeed, prior to the crisis, several EU countries experienced large current account deficits associated with rapid house price increases.

**Figure 28**  
**Adjusted savings\* in European countries**  
(% GDP)



Source: ECON calculations based on Eurostat.  
Note: \*Adjusted savings are defined as national savings less productive investment. Average over 2013–16.

**Figure 29**  
**Adjusted savings\* versus house price change**



Source: ECON calculations based on Eurostat.  
Note: x-axis: adjusted savings\* as a percentage of GDP. y-axis: change in local house prices between 2012:H2 and 2017:H1. The coefficient of the slope is significant at 5%.

## More risk-taking capacity and fostering innovation

The (lack of) availability of different funding options can affect the type of investment firms pursue (Table 4). We look at what type of finance firms want to play a more important role in their funding mix and contrast this with their investment activities (i.e. the share of investment that firms allocate to different asset classes). On the one hand, we find that the more firms invest in research and development (R&D), the more they want external equity to feature in their financing mix. This possibly reflects the higher risk of this type of investment. The same is true for firms investing in land, business buildings and infrastructure, which may reflect the bigger deal sizes. On the other hand, for investments in machinery and equipment, what firms seem to want more is leasing and hire purchases.

**Firms with more diversified financing (e.g. trade credit, bank financing, grants and equity financing) invest more in intangibles and in innovation.** There is a strong relationship between firms' investment activities and the type of funding they would like to use. This suggests that differences in the external funding mix may have implications for the type of investment carried out by firms in Europe. Bank debt does not support the acquisition of intangibles or innovation activities of firms. It is not suited to financing intangible investment and innovation, as it requires collateral.

**Table 4**  
**What firms want more versus what type of investment they carry out**

	Bank loans	Bonds	Equity	Leasing	Factoring	Loans from family
Land	0.904*** (0.262)	1.030 (0.714)	1.562* (0.851)	-0.135 (0.331)	-0.739 (0.508)	0.398 (0.885)
Machinery	0.376 (0.242)	-0.165 (0.702)	0.551 (0.829)	0.815*** (0.299)	-0.492 (0.435)	-0.376 (0.841)
R&D	0.353 (0.352)	1.217 (0.836)	2.979*** (0.908)	-0.899** (0.458)	-0.454 (0.639)	1.526 (0.979)
IT	0.438 (0.313)	-0.403 (0.955)	1.286 (0.984)	-0.215 (0.399)	-0.397 (0.590)	0.300 (1.051)
Training	0.0628 (0.320)	-0.389 (1.074)	0.693 (1.053)	-0.242 (0.405)	-0.194 (0.570)	-0.771 (1.157)
Constant	1.839***	-3.653***	-2.763***	0.274	-2.530**	-37.37
Observations	7 195					

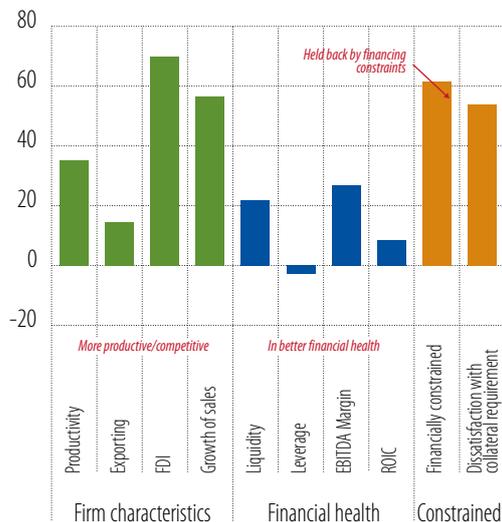
Source: EIBIS 2016 to 2018.

Note: Based on a multinomial logit regression. The dependent variable is the type of financing corporations would like to expand (the first row in the table). It is projected on the share of each type of investment carried out and a set of control variables (country, sector, size fixed effects and capacity utilisation levels).

**More developed stock markets enable stronger growth in those industries that represent the frontier of growth in modern economies, such as high-tech industries and patent-intensive industries.** Kremer and Popov (2018) show that during the decade preceding the financial crisis, and controlling for the impact of the overall size of financial markets, the sectors depending on external finance and those with better global growth opportunities grew faster in countries with bigger stock markets.

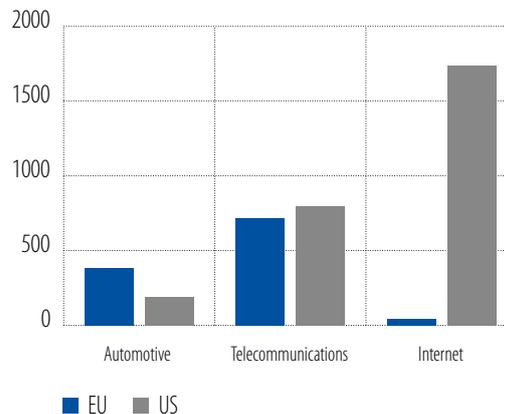
**Capital markets induce greater productivity gains, innovation and technological change than banking markets.** For example, Hsu et al. (2014) used a large dataset including 32 developed and emerging countries, and showed that industries that are more high-tech intensive exhibit a disproportionately higher level of innovation in countries with better developed equity markets. These findings are consistent with theories predicting that, as economies develop, the marginal contribution of banks to economic growth declines while that of capital markets increases, notably because market finance is better at promoting innovation and productivity and financing new sources of growth.

**Figure 30**  
**Difference between innovating and non-innovating firms**  
(% deviation from non-innovators)



Source: ECON calculation based on EIBIS16 and 17.  
Note: The figure replots the deviation from non-innovators indexed to 100. See footnote <sup>34</sup>.

**Figure 31**  
**Market capitalisation of top ten firms**  
by sector and origin (EUR billion)



Source: ECON calculations based on Thomson Reuters Datastream.  
Note: The numbers refer to April 2016.

**More diversified forms of finance, including more equity, are empirically associated with more innovation.** Innovative firms are more productive and in better financial health (Figure 30). However, they are held back by financing constraints, needing more patient and risk-taking investors. Innovators tend to report tighter access to external finance than overall corporates. The lack of collateral is a major reported reason behind the tight access to external finance reported by innovative companies. Indeed, innovative companies tend to have fewer pledgeable assets. This characteristic makes them more prone to equity finance.

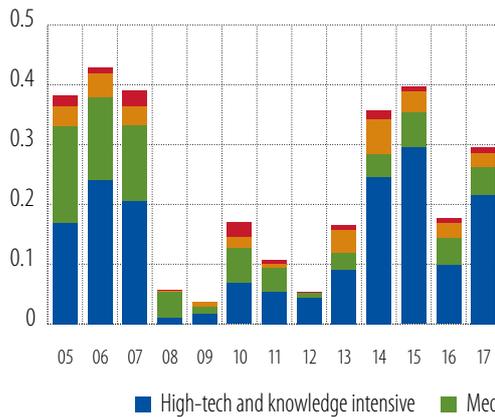
**These channels explains the part of the European gap in innovative sectors (Figure 31).** Europe is generally strong in innovation, but often loses a market leading position by acquisition, or US venture capital injection coupled with a company move to the US. New industries are dominated by US and, increasingly, Chinese companies. These industries tend to have “winner-takes-it-all” models, with associated massive investments for building such a position. In fact, for more traditional industries (such as automobile and telecommunications) capitalisation in Europe is not below that in the US; it is even higher for automobile. However, internet companies are mostly absent from EU stock markets. Their capitalisation is marginal compared to that of the corporations listed in the US (Figure 31).

**Indeed, none of the world’s eight most highly valued high technology companies are European.** The world’s most highly valued companies are technology businesses with a combined market capitalisation amounting to USD 4.7 trillion. Out of these eight companies, five (Apple, Alphabet, Microsoft, Amazon and Facebook) are from the US, two are Chinese (Alibaba and Tencent) and one is South Korean (Samsung).

<sup>34</sup> Innovating firms are defined as firms that have published a patent in the past five years. Non-innovating firms are firms that fall into the same sector/size class but did not publish a patent. (The results are robust to alternative measures of innovation.) Productivity is defined as labour productivity (VA/employee). Exporters shows the share of firms performing exporting activities; FDI is the share of firms carrying out foreign direct investments. Liquidity is measured as the current ratio (current assets over current liabilities); leverage is debt over total assets; EBITDA margin is EBITDA over operating revenue; ROIC is net income over long-term debt plus shareholder funds minus cash. Financial constraints capture whether a firm had a financing request rejected, received less than asked for, did not accept the offer because it was too expensive or did not apply out of fear of being rejected. Dissatisfaction with collateral is the share of firms dissatisfied with the collateral required. In the chart, taking the first bar as an example, 38 means that innovators are 38% more productive than non-innovators.

The most highly valued European tech company, SAP, is only the world's 60th most highly valued company. In the course of 2018, Spotify, a leading European company, left Europe to be listed in the US (Lannoo, 2018).

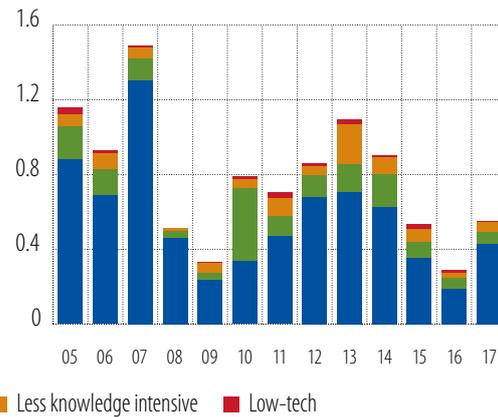
**Figure 32**  
IPOs in the EU (% GDP)



Source: ECON calculations based on Thomson Reuters Datastream.

Note: OECD classification is used to allocate the corporations to their technology intensity.

**Figure 33**  
IPOs in the US (% GDP)



Source: ECON calculations based on Thomson Reuters Datastream.

Note: OECD classification is used to allocate the corporations to their technology intensity.

**In the EU, initial public offerings (IPOs) are relatively less technology intensive.** Figure 32 and Figure 33 show the IPO share of GDP in the EU and the US, respectively. One can formalise three facts. First, the IPO activity is relatively cyclical. Activity was stronger before the crisis, collapsed during the crisis and then rebounded, to a pace below that recorded in the beginning of the 2000s. Second, following the crisis, in terms of magnitude, activity was between two and three times lower on average in the EU than the US. More recently, this gap has shrunk, however. Thirdly, the context of IPOs in the EU inclines towards less high-tech sectors.

**The IPOs of SMEs in Europe have been increasingly well supported by dedicated SME markets set up by exchanges in recent years.** These offer an alternative to main listing boards on national stock exchanges and provide SMEs with the opportunity to make IPOs once they are sufficiently well established to take a larger number of equity investors on board. These markets are characterised by more relaxed listing requirements and lower costs than the main boards. Several such markets – such as AIM (LSE), Alternext (Euronext), First North (Nasdaq), MaB (BME, Spain), New Connect (Warsaw Stock Exchange) and Scale (Deutsche Börse) – have proven successful in Europe. As of February 2017, 2 245 companies were listed on these markets in Europe, with a total market capitalisation of about EUR 200 billion. Nevertheless, compared with their US counterparts, European SMEs remain more reluctant to list.

## Conclusion and policy implications

**The European equity base is less developed than that of the US with no sign of catching up. Europe lags behind the US and Asia in many regards:** the use of equity to finance firms, the prevalence of venture capital and the relative share of IPOs. The European capital market struggles to provide funding for the real economy. European companies are considerably more dependent on bank lending than companies in the US and Asia. The cost of equity remains high and issuance activity does not fill the gap.

**There are many reasons for the gap.** On the supply side, there are institutional and cultural factors, corporate culture and a reluctance to dilute power and tax bias in favour of debt. On the demand side, factors include structure and regulation of the financial sector, transaction costs and financial literacy. Ageing is likely to further dampen the demand for equity. Overall, the cost of equity remains high, and issuance activity does not fill the gap. Brexit is likely to worsen the situation.

**A stronger equity basis would be welfare enhancing.** It would increase resilience to financial shocks, allow more scope for private investor-based risk sharing, improved allocation of capital, more risk-taking capacity and innovation, and avoiding the growth-stage trap.

**The EU financial system is reintegrating, with a corresponding shift towards more equity-based cross-border financial flows.** This provides an opportunity to foster the equity base at the EU level. Improvements in the institutional and regulatory environment, more rigorous enforcement of investor protection rules and a better business code of conduct could reinforce the equity base of EU corporates, enabling them to raise capital at more competitive costs. The design of CMU provides a rare opportunity to reach these goals: an ambitious CMU must place more emphasis on the non-bank financing of economic activity, particularly equity markets.

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# 77%

of EU firms say **lack of staff with the right skills is a barrier to investment**

# 21%

of **EU firms** say they **invested too little in training**

# 42%

of **EU firms** say they have **not invested enough in digitalisation**

**Reported boost to sales due to digital adoption:**

# 10%

**Public spending on education:**

# 1%

from **EU budget**

# 99%

from **Member States**

**Wage differential between digital vs non-digital firms**

# 12%

PART III

# Focus on skills and digitalisation



## Chapter 7

### Understanding the skill gaps facing European firms

**Against the backdrop of structural transformation and cyclical recovery in EU labour markets, nearly eight out of ten firms find that the limited availability staff with the right skills impedes investment.** Labour market recovery in Europe has progressed rapidly in the last four years, with EU average unemployment rates approaching pre-crisis levels and employment rates exceeding them. Yet, crisis repercussions and persistent fragmentation are still visible, and structural trends including demographic change and advancing digital technologies are transforming EU labour markets. This results in strong divergences at both the micro- and macroeconomic levels.

**Skill constraints reflect different combinations of factors across countries and regions.** The lack of staff with the right skills is the most frequently named impediment to investment by EU corporates, especially in cohesion and other EU countries. The fact that firms in the periphery group are less likely to report missing skills also reflects a slower economic recovery. Persistent skill shortages and mismatches can negatively affect productivity and technology adoption. In addition, skill gaps come at considerable individual and social cost. Well-functioning market mechanisms can help to avoid permanent skill mismatches and gaps.

**Cyclical factors affect firms' reported skill constraints, but the relevance for EU investment in the skills of its workforce is primarily structural.** Demographic change and ageing will affect Europe in the next few decades and increase the pressure to generate higher productivity gains. Moreover, workforce shrinkage is expected to materialise at a time when global competition will require a more skilled workforce in many industries.

**Investment in workforce skills is an essential step in the European re-tooling effort and comes with positive implications for competitiveness and social cohesion.** Education and training systems need to focus on the quality of outcomes, inclusiveness and equipping people with skills that are complementary to technology. In an integrated market, where mobility of workers means sharing the benefits of investment in skill formation, greater joint effort and coordination at the European level are valuable. About 1% of public spending on education in the EU is made at the European level. Yet EU support can make a genuine difference through funding, agenda setting and the creation of framework conditions that encourage public and private investment in skills. In addition to education, on-the-job training adds to skill formation throughout professional careers. On average, about 73% of firms in the EU invest in the training of employees. Smaller firm size and financial constraints can limit companies' investment in training. Some 20% of firms believe their investment in training has been insufficient in the last year. While training investment is associated with greater firm productivity, a firm's choice to invest in the training of its workforce also depends on structural factors and its ability to benefit from training investment.

## Introduction

**Labour market recovery in Europe has progressed rapidly in the last four years, with EU average unemployment rates approaching pre-crisis levels and employment rates exceeding them.** Yet, crisis repercussions and persistent fragmentation are still visible, and structural trends including demographic change and advancing digital technologies are transforming EU labour markets.

**Against the backdrop of structural transformation and cyclical recovery, nearly eight out of ten firms in Europe find “lack of staff with the right skills” to be a barrier to investment.** Skill gaps can negatively affect firms’ productivity and their ability to grow, innovate and adopt technological developments. For individual Europeans, not having “the right skills” limits employability prospects and access to quality jobs. For Europe, as an increasingly knowledge-based economy, not having enough of the “the right skills” means challenges to the competitiveness of its firms, and limits to boosting its longer-term growth potential and tackling inequalities.

**We analyse why firms increasingly find the limited availability of skills to be an obstacle to investment.** We start with an overview of labour markets in Europe, considering recent developments and structural trends. We then present new results from the European Investment Bank (EIB) Investment Survey (EIBIS), examining why firms in the EU increasingly report missing skills. The next section focuses on the role of training and human capital investment as channels to mitigate skill shortages and gaps. The final section concludes and discusses policy implications.

## The EU labour market at a glance

**The economic recovery strengthened in 2017 with improving conditions in EU labour markets.** The number of people employed has grown at a robust pace since 2014 and recently accelerated (2014–16: on average up 1.1% p.a.; 2017: up 1.6%) (Figure 1). In the second quarter of 2018, about 238.9 million people were in employment in the EU, i.e. the highest level ever recorded, and about 7.5 million more than before the crisis. The EU employment rate stood at 72.2% (2017), about two percentage points (p.p.) higher than before the financial crisis started (2008: 70.3%).

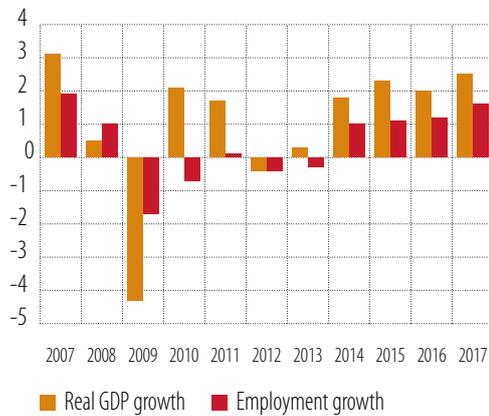
**Unemployment continued its downward trend.** By mid-2018 the EU unemployment rate stood at 6.8%, down from 7.5% in August 2017 and standing at its lowest level since mid-2008 (Figure 2). About 18.8 million people in the EU were unemployed in 2017 compared with more than 26 million in 2013 and 16.8 million in 2008.

**Strong discrepancies in labour market conditions persist across the EU Member States.** Despite being in the fifth year of recovery, crisis repercussions are still visible and labour market challenges persist. Over ten percentage points still separate unemployment rates and long-term unemployment rates for best and worst performers in the EU (Figure 3). Differences in youth unemployment rates are up to 30 p.p.<sup>1</sup> While youth unemployment has decreased significantly, it remains still slightly above pre-crisis levels. Similarly, there are large and persistent cross-country differences in the share of young people not in employment, education or training (NEET), pointing to persistent structural problems in labour market conditions in some countries (Figure 4).

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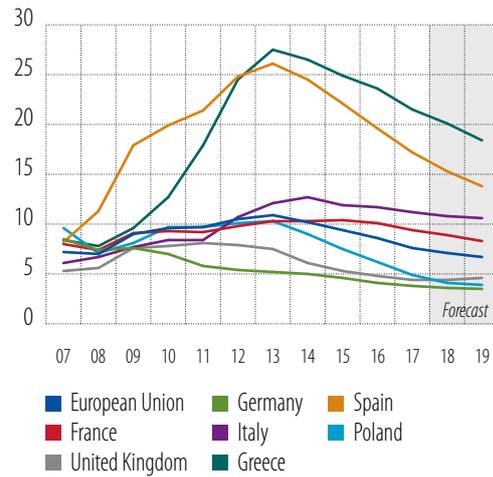
1 Youth unemployment ratios in the worst performing Member States are more than five times larger than in the best performing ones.

**Figure 1**  
EU GDP and employment changes (%)



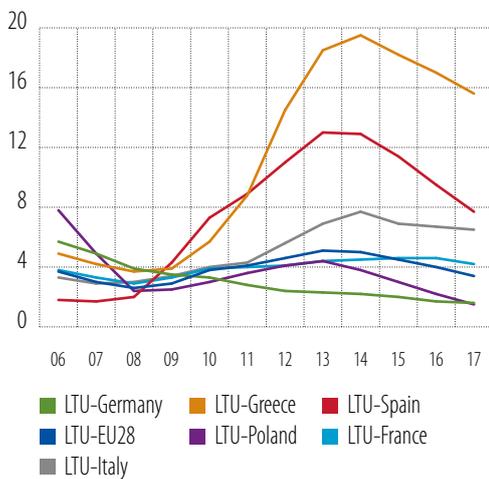
Source: European Commission (2018).

**Figure 2**  
Unemployment rates, EU and selected Member States (%)



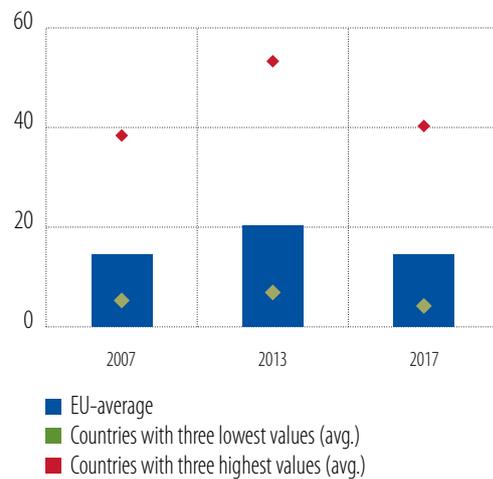
Source: Eurostat/AMECO.

**Figure 3**  
Long-term unemployment, EU and selected Member States (%)



Source: Eurostat, LFS (2018).  
Left: Long-term unemployment (more than 12 months) rates as % of active population aged 15-74. For EU and selected Member States.

**Figure 4**  
Share of young people not in employment, education and training (NEET) (%)



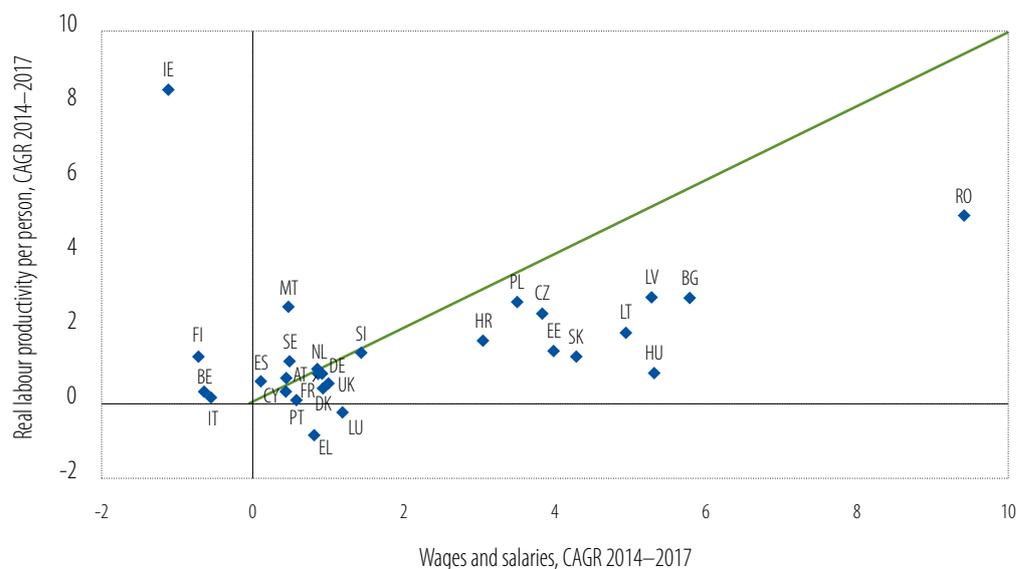
Source: Eurostat (2018).  
Right: Share of young people (aged 15-34) not in employment, education and training relative to respective age group.

**Regional disparities in labour market performance remain pronounced.** Many regions still have higher unemployment and lower employment than before the crisis. In 2017, in more than 20% of regions, most of the unemployed had been out of work for at least a year. Richer regions have recorded stronger employment and productivity increases, leading to faster growth (European Commission, 2017).

**Real labour productivity in the EU overall increased modestly.** Labour productivity has grown modestly (1% or less) since 2013, with productivity per person increasing by 0.8% in the EU in 2017. The restrained growth of productivity per person is linked to factors such as lower numbers of hours worked and a higher share of part-time jobs. Productivity per hour has grown faster since the start of the crisis, including in 2017 (up 1.2%).

**Growth in real labour productivity and wages shows heterogeneous developments across Member States.** On average, wages and salaries evolved in line with productivity over the last three years, but the aggregate picture conceals wide differences, notably due to the repercussions of the financial and sovereign debt crises and its uneven impact on Member States. Productivity growth exceeded growth in wages and salaries in about a third of Member States. Besides Ireland, where productivity increased strongly due to the revision of gross domestic product (GDP) statistics, larger productivity increases compared with growth of wages and salaries can be observed for Malta, Finland, Sweden and Belgium. In contrast, wage growth has clearly exceeded productivity growth in the Baltics and most Central and Eastern European Member States in the last three years.

**Figure 5**  
**Growth in real labour productivity and wages** (compounded annual growth rate 2014–17, %)



Source: Eurostat.

Note: Growth in real labour productivity per (employed) person and real wages and salaries, CAGR 2014–17. Real wage and salary growth is calculated with the GDP deflator. Values for Belgium refer to 2014–16 for labour productivity.

**Overall moderate wage dynamics contrast with developments in cohesion countries.** Accelerating economic growth and employment increases have so far hardly been reflected in wage developments in the EU as a whole. Wage growth has been particularly subdued in countries in the euro area. This contrasts with developments in Central and Eastern Europe, where increases have been more pronounced.

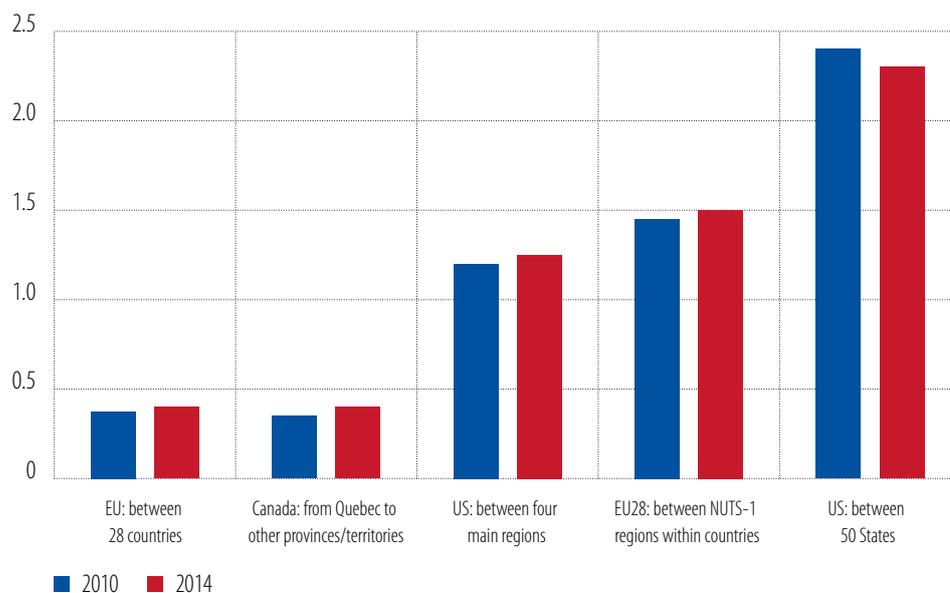
**Some indicators point to remaining slack<sup>2</sup> in the labour market moving out of the Great Recession.** Total hours worked in the economy have been growing since 2015 but were not yet back to 2007 levels as of the end of 2017. Hours worked per person continued their longer-term downward trend, also reflecting the higher incidence of part-time work. Involuntary part-time work, associated with lower

<sup>2</sup> "Slack" in labour markets refers to the discrepancy between the volume of work desired by workers and the actual volume of available work. It describes the unmet demand for paid labour in the population. See Eurofund (2017) and ECB (2017a) for discussion.

nominal wage growth (IMF, 2017), started to decrease from its peak but remains above pre-crisis levels (2017: 26.4% of part-time work was involuntary compared with 22.4% in 2007; see Figure 7). The share of people living in households with very low work intensity in the EU is higher than in 2008 (10.5% in the EU in 2016 compared with 9.2% in 2008). Broader measures of labour under-utilisation suggest some remaining slack, particularly in some periphery countries (ECB, 2017b). Moving into recovery, labour market slack has contributed to slower wage growth, together with weak productivity developments and low inflation expectations but there is some indication that its mitigating impact is becoming less pronounced, with unemployment further receding.

**In conjunction with the crisis, structural trends including globalisation, demographics and digitalisation have influenced where and how people work.** Cross-country labour mobility has increased in Europe, with eastern enlargement and the impact of the crisis adding to this trend. Also, mobility between regions in the EU has increased (Figure 6). Cross-border labour mobility is similar to other contexts where some language barriers exist. Rising geographic mobility in the EU, albeit from lower levels (Dao et al., 2014; Molloy et al., 2014), contrasts with decreasing mobility in the US.

**Figure 6**  
**Annual cross-border mobility, as a percentage of the total population**



Source: World Bank (2018), OECD Survey of the European Union, Statistics Canada, US Census Bureau.  
Note: Population mobility for Canada and the United States, labour mobility for the EU.

**More women are working, and the workforce is better educated.** Labour force participation<sup>3</sup> in the EU has been on a longer-term rise, partly due to tertiarisation effects, as attachment to the labour force tends to be stronger among the better educated (Hilgenstock and Koczan, 2018; IMF, 2018) During the last decade, employment rates<sup>4</sup> have been growing in most Member States, partly due to labour market reforms (ECB, 2018), and reflecting the greater number of women and older workers remaining in employment. Employment rates continue to vary widely among Member States and, despite the general upward trend, stand below 2008 levels in countries particularly affected by the crisis, such as Greece,

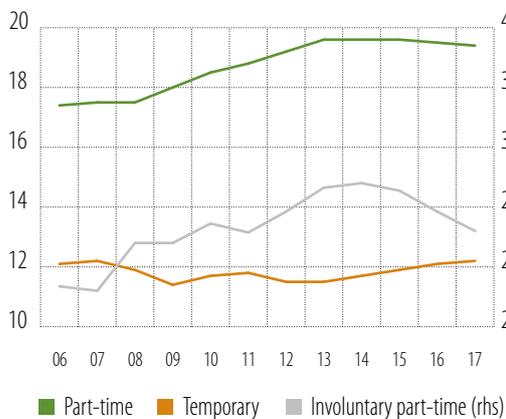
<sup>3</sup> The labour force participation rate is calculated as the labour force divided by the total working age population.

<sup>4</sup> Employment rates are calculated as the ratio of the employed to the working age population, measuring the extent to which available labour resources (i.e. people available to work) are used. In the short term, employment rates are sensitive to the economic cycle, but in the longer term they are significantly affected by governments' higher education and income support policies and by policies that facilitate employment – for instance, for women or disadvantaged groups.

Cyprus and Spain. Rising participation has so far helped to counteract adverse demographic pressure, a trend more severe for Europe than other world regions.

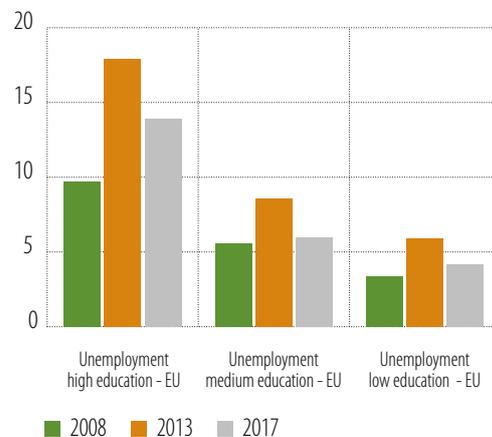
**More people work in services.** While the most recent employment increases have been broad-based across sectors, showing signs of recovery in manufacturing and construction since 2008, employment has shifted towards the service sector. Part-time work has become more frequent (share of part-time employment in 2017: 19.4%; 2007: 17.5%), reflecting changing (preferences for) work arrangements and greater female participation – often part-time to combine caring for children or adults with working – in the labour force.

**Figure 7**  
**Part-time, involuntary part-time and temporary employment, EU (%)**



Source: Eurostat, LFS.  
Left: Part-time and temporary employment as share of total employment (left axis). Involuntary part-time as share of part-time in % (right axis). Total EU.

**Figure 8**  
**Unemployment by educational attainment, EU (%)**



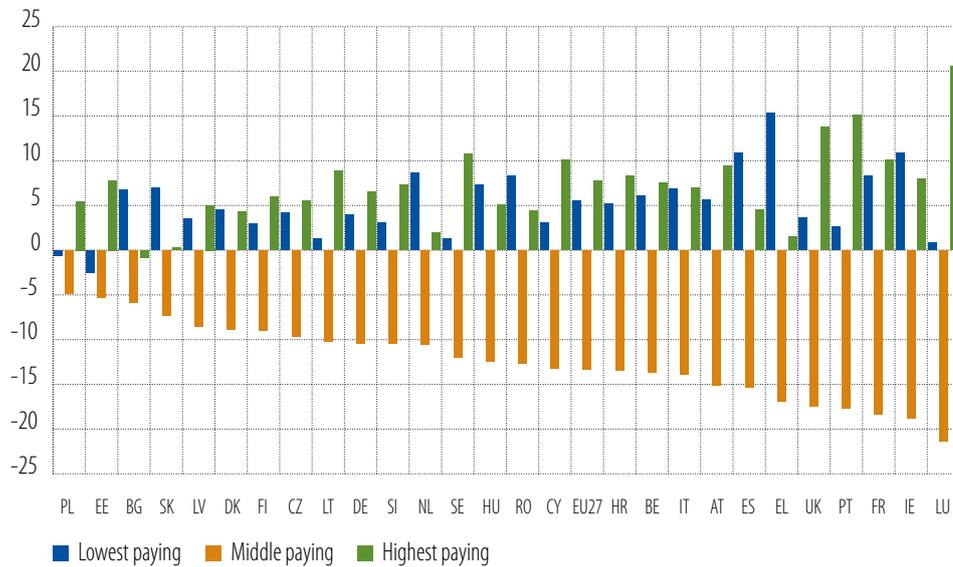
Source: Eurostat (2018).  
Right: Unemployment by educational attainment level, 20–64 years, in %. Lower education refers to ISCED 0–2, medium to ISCED 3–4 and high education to ISCED 5–8.

**Some changes in work arrangements potentially go together with weaker job security.** Employment on temporary contracts in the EU has fluctuated at around 12–14.5% in recent years (2017: 14.3% of employees). While there are strong differences across Member States, temporary contract arrangements are most prevalent among the young, and slightly more frequent than ten years ago: 43.9% of employees aged 15–24 were employed under a temporary contract in 2017 compared with 40% in 2008.<sup>5</sup> Overall, the proportion of standard employment (permanent full-time) was below 60% in 2016 (European Commission, 2018).

**There are some signs of increasing job polarisation.** Highly skilled professionals have been better positioned to take advantage of both globalisation and technological change, as their skill sets are often complementary rather than competing with technology or offshoring activity. There is a longer-term trend towards more highly educated labour getting more of the work available in higher and mid-level paying occupations, but also in low-paying jobs. This suggests that workers at lower levels of education get less of the available work, but also that some with good qualifications work below their qualification levels and for low pay. At the same time, the proportion of middle-paying jobs has been shrinking across the EU, pointing to greater polarisation of pay, albeit to different extents in different EU Member States (Figure 9).

<sup>5</sup> The share of temporary contracts is also linked to country-specific factors, including the sectoral structure of the economy, with temporary contracts more likely to be found in the non-tradeable sector.

**Figure 9**  
Changes in employment shares by wage group, 2002-16 (in percentage points)



Source: DG EMPL calculation based on Labour Force Survey (EU-LFS); European Commission (2018).

Note: The chart shows the change in employment share by wage group between 2002 and 2016 for EU Member States.

### Box A

#### Skill demand and skill gaps: what is the role of technological change?

Technological change is a structural factor that can give rise to skill shortages. The adoption of new technologies by firms can create needs for new skills that are not immediately available in the labour market, giving rise to shortages until the broader education system (including employer training) is able to meet the new skill requirements. The intensity of these shortages and the length of the adjustment process can be exacerbated if wages and working conditions fail to provide adequate signals of relative scarcity.

Recent technological changes have affected the demand for skills, job tasks and the structure of employment. Technological progress in recent decades has been characterised by the spread of information and communication technology (ICT) and has resulted in:

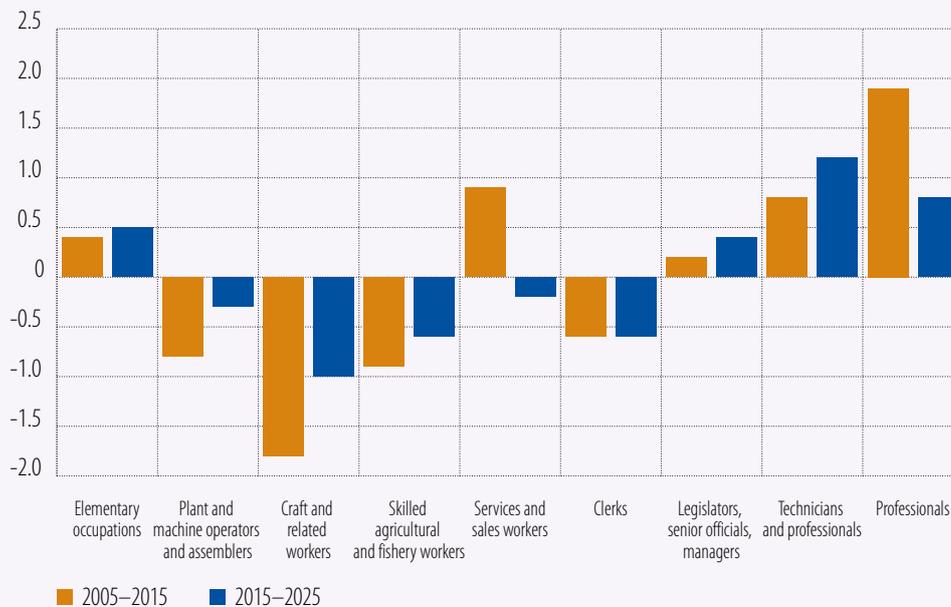
1. an accelerated demand for skilled workers that exceeds the available supply (skill-biased technical change; see Katz and Autor, 1999; Acemoglu and Autor, 2010);<sup>6</sup>
2. both a reduction in the demand for routine cognitive and manual tasks and an increased reliance of production on non-routine tasks that are not easily automated, leading to the polarisation (hollowing out) of employment (see Autor et al., 2003; Goos et al., 2009; Das and Hilgenstock, 2018).

<sup>6</sup> During the previous decade, about a million jobs were created in Europe in occupations closely linked to ICT services, such as ICT professionals, technicians and associate professionals. According to Cedefop's skill forecasts, a further half a million more jobs are anticipated to be created in the next decade in Europe (Cedefop, 2018).

The employment share of middle-skilled workers has declined in many advanced economies (see IMF, 2017). At the same time, there is evidence suggesting that some of the polarisation effects of technology on employment – so far – might be less pronounced in Europe than in the US (Graetz and Michaels, 2015; Gregory et al., 2016).

Projections point to further shifts looking ahead. Cedefop's Skills and Jobs Forecast indicates a continuing increase in both more skill-intensive jobs and elementary occupations requiring few skills, suggesting greater polarisation. According to projections, strong job creation is expected for professionals, associate professionals and technicians (Figure A.1). Some of the occupations requiring lower levels of qualification and sometimes involving a considerable amount of routine tasks, e.g. plant and machine operators and assemblers or clerks, are expected to further shrink. The top growth occupations are expected to be in health, ICT, engineering, teaching, administration and sales (Cedefop, 2016; Directorate General for Internal Policies, 2015; European Commission, 2014).

**Figure A.1**  
Past and projected changes in employment shares, (%)



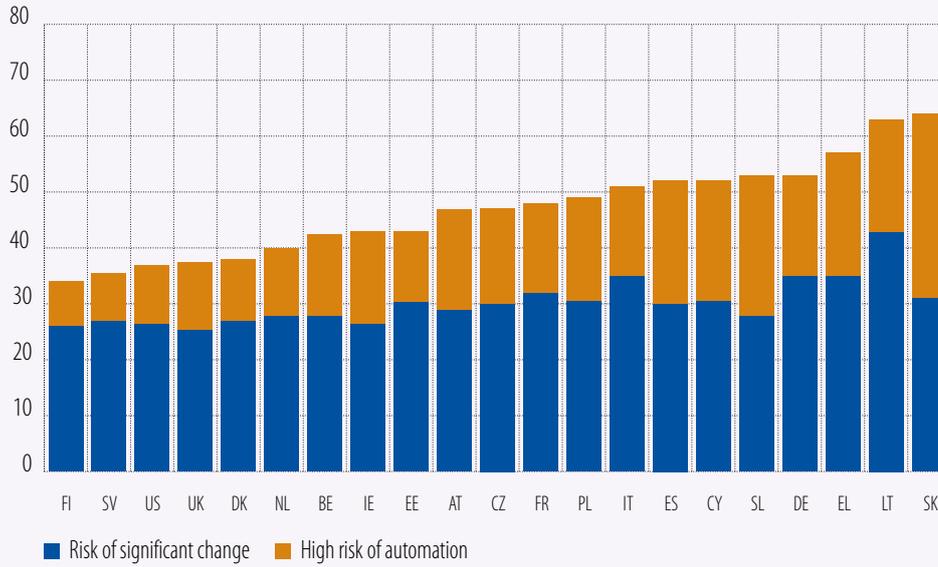
Source: Cedefop (2016).

Note: Percentage change by occupational category. EU28. Projections based on Cedefop's Skills and Job Forecast.

The projected effects of automation on jobs are subject to considerable uncertainty. While their estimates are lower than those of Frey and Osborne (2017), Nedelkoska and Quintini (2018) find that about 14% of jobs in OECD countries participating in the Survey on Adult Skills (PIAAC) are highly automatable, i.e. with an automation probability of over 70%, and another 32% have an automation risk between 50% and 70%. Richer countries appear less at risk than middle income ones, but wide gaps exist between countries of similar wealth, reflecting differences in specialisation and institutional and organisational structure. Automation risks tend to be lower in Scandinavian and Anglo-Saxon countries and higher in Germany and eastern and southern Europe, partly reflecting countries' industrial structures (see Figure A.2, panel a).

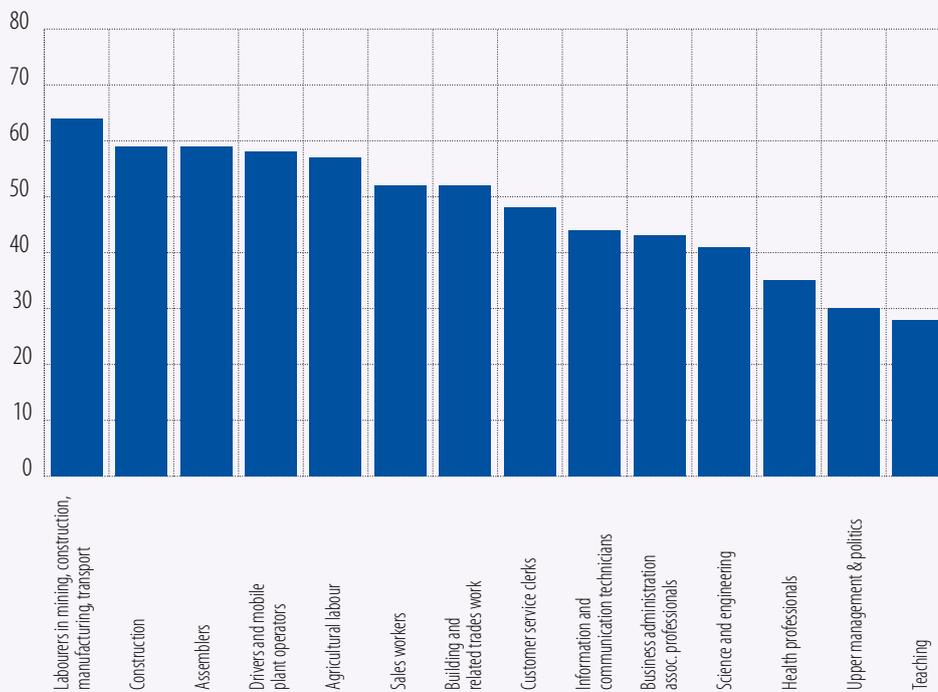
**Figure A.2**  
**Automation risks differ by type of country characteristics and job type (%)**

a. Mean automation risk by job country



Source: Nedelkoska and Quintini (2018).  
Note: Country variation in job automation risk.

b. Automation risk by job type



Source: Eurostat (2018).  
Note: Mean probability of automation by job type for selected professions.

Automation risks are not distributed equally among workers. Jobs in agriculture and manufacturing are estimated to have higher automation risks. Also, occupations subject to greater automation risk often only require basic to low levels of education, whereas the least automatable ones mostly require professional training or tertiary education (see Figure A.2, panel b).

How jobs are carried out will change. Workers in the EU see constant change in the use of technologies they apply at work and also in their job tasks, with 43% having seen the technologies they use change in the last five years or since they started their current job and 47% noting changes in working methods and practices (Cedefop, 2018). Technological change will continue to transform jobs and job tasks and automation risks, with a potentially high impact on individual careers.

Policies play an important role in successful transformation. As automation risks are not evenly distributed among workers and places, job losses in manufacturing and agriculture can give rise to spatially concentrated detrimental effects. For individual workers, the estimated risk of substantial automation is typically highest for those with low levels of education. Workers investing in adult learning are often more capable of adapting to changes in jobs.<sup>7</sup> Yet, workers most exposed to the risk of automation are also those who invest less in training (Nedelkoska and Quintini, 2018) and who often have jobs with limited access to it (Figure A.3). While evidence suggests that training can be useful for moving to jobs with a lower risk of automation, most workers requalify for closely related occupations. To the extent that automation risks will broaden, bolder moves may be required, implying the need to adapt current adult learning systems. Automation projections emphasise the value of equipping people with a good mix of cognitive (problem solving, creativity, learning to learn) and socioemotional skills (communication, collaboration) that is complementary to technological developments and facilitates adaptation to fast-changing job requirements and to mobility across different jobs.

**Figure A.3**  
Share of adults participating in life-long learning (%)



Source: Eurostat, LFS.

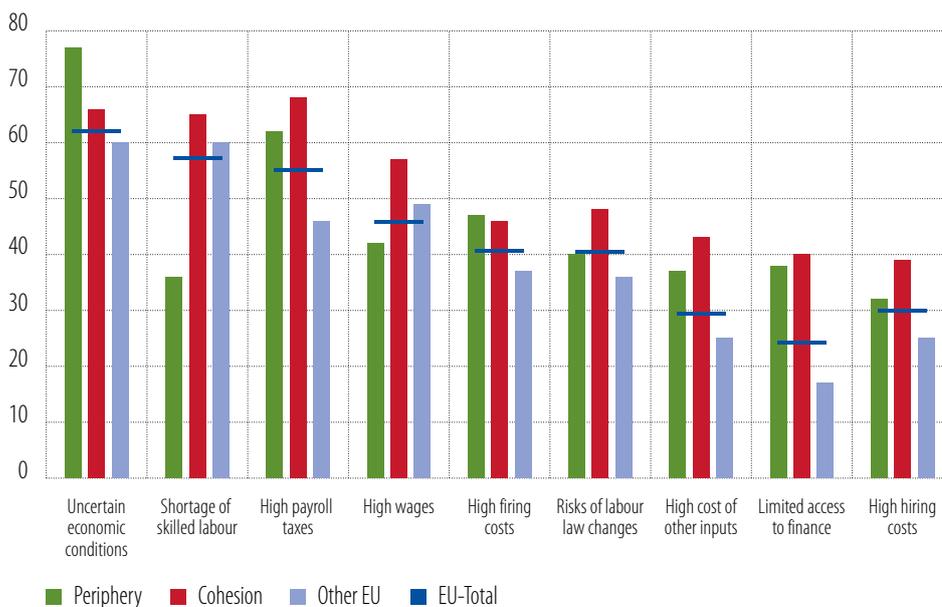
Note: Share of adults participating in education and training (last four weeks, 18–64 years). Break in series in 2013.

<sup>7</sup> It is an open question whether this is due to additional training or to the fact that those investing in training are endowed with higher cognitive and non-cognitive skills.

**Moving into recovery, signs of skill shortages have been increasing.** Skill shortages arise when employers are unable to recruit staff with the required skills in the accessible labour market and at the ongoing rate of pay (Quintini, 2011). Conceptually, there is a difference between missing skills and labour, with the former referring to what workers can do and not whether there are enough of them. However, skills are embodied in people and quantitative shortfalls of workers in the economy are also often referred to as skill shortages.<sup>8</sup> Labour and skill shortages tend to react to the business cycle. With employers becoming more optimistic, hiring demand increases. Whether and how well labour supply can respond depends on the distribution of existing skills, the extent of geographical mobility and the signals provided by wage adjustments.

**The availability of skilled labour was already one of the main obstacles to hiring across the EU at the start of the labour market recovery (Savšek, 2018).** In particular, firms reported shortages of skilled labour as an obstacle to hiring on open-ended contracts in cohesion countries and other EU countries. Part of the variation between country groups can be attributed to different stages of the business cycle, with uncertain economic conditions more prevalent in the periphery group. Firms in the other EU group also reported fewer other obstacles to hiring in comparison (Figure 10).

**Figure 10**  
**Obstacles to hiring on open-ended contracts reported by firms, year-end 2013 (%)**



Source: Wage Dynamics Network (WDN3) data.

Note: Share of firms claiming a specific obstacle relevant/very relevant by region.

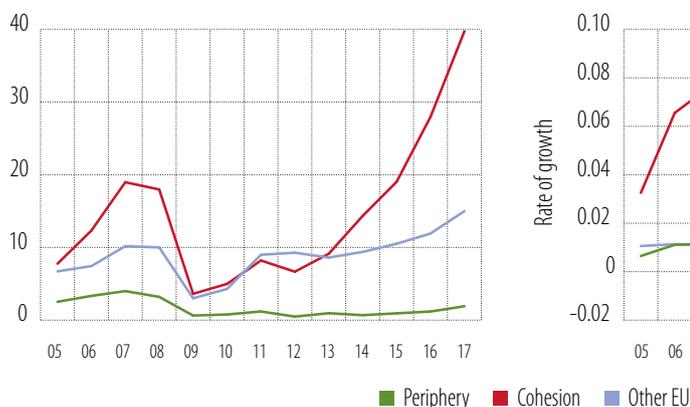
Question: How relevant is each of the following factors as an obstacle to hiring workers with a permanent, open-ended contract at the end of 2013? Employment-weighted figures, simple averages across country groups.<sup>9</sup>

<sup>8</sup> For further discussion of definition and measurement see Cedefop (2015), Eurostat (2017), McGuinness and Pouliakas (2018) and Brunello et al. (forthcoming).

<sup>9</sup> Sweden, Finland and Denmark are not included in the other EU group due to limited data availability. Additional information on the WDN can also be found in Izquierdo et al. (2017) or on the web page of the network. For further information on characterisation and analysis of the different obstacles see Savšek (2018).

**Labour shortages exceed the levels reported before the crisis.** The share of firms reporting labour shortages as a factor limiting production, including both skilled and unskilled positions, has been rising sharply since 2013, recovering from a sharp decline around 2009 and another dip at the height of the sovereign debt crisis. But there are discrepancies: the upward trend has been particularly pronounced in cohesion countries and some countries in the other EU group. Real wage growth, which should respond to increasing labour demand, also shows steep increases in cohesion countries but virtually no growth in the rest of the EU, where reported labour shortages have also increased but real earnings growth (manufacturing) remained stable or even declined, pointing to some persistence of labour market slack in recent years (ECB 2017b). The combination of employer surveys and wage data suggests a more cautious interpretation with respect to rising shortages in the EU aggregate (ECB, 2017a) but also points to increasingly genuine shortages in cohesion countries.<sup>10</sup>

**Figure 11**  
**Labour shortages by country groups, industry (%)**



**Figure 12**  
**Growth in real hourly earnings, manufacturing**



Source: European Business Survey, several years, OECD

Note: Left: Incidence of labour shortages (industry), by region. Countries are aggregated using labour force weights. Periphery: (Southern Europe): Italy, Spain and Portugal; Cohesion (Eastern Europe): Czech Republic, Hungary, Latvia, Lithuania, Poland, Slovenia and Slovakia; Other EU (Northern and Central Europe): Austria, Belgium, Denmark, France, Germany, Luxembourg, the Netherlands, Finland, Sweden and the UK.

**Some indicators might suggest a greater skill mismatch in Europe moving out of the Great Recession.** Skill mismatch broadly refers to a qualitative discrepancy between qualifications and skills that individuals have and those that are needed in the labour market. Macroeconomic skill mismatch refers to differences between the jobs on offer and the pool of unemployed along broad qualification levels.<sup>11</sup> At the aggregate level, the Beveridge curve describes the coexistence of job vacancies and unemployment and can be used to point to skill mismatches. Compared with 2008, the unemployment rate corresponding to a given job vacancy rate markedly increased, which might suggest lower matching efficiency at the aggregate EU level (Figures 13 and 14).<sup>12</sup> However, a closer look shows that the shift of the EU Beveridge curve from 2013–2017 also reflects disparities across Member States as most vacancies were created in countries with relatively low unemployment. The outward shift for the aggregate curve is by and large driven by periphery countries, where unemployment increased markedly with little change in vacancy rates. This contrasts with

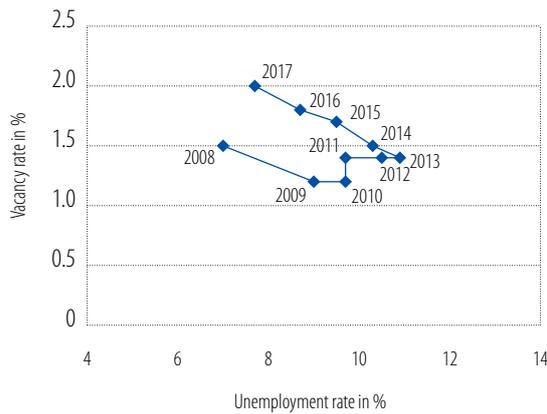
<sup>10</sup> Aggregate reported shortages and wage developments can understate the impact of occupational shortages occurring within industries. Positive wage growth in occupations registering shortages and zero or negative growth in occupations with labour surpluses or no shortages can average out. Similarly, data based on broad occupational classifications can make it difficult to discern skill-driven shortages within categories.

<sup>11</sup> Skill mismatch on the job (micro) refers to differences between employed individuals, the skills they have and those needed to perform their job.

<sup>12</sup> The outer shift in the curve could also be due to other factors. Bonthuis et al. (2016) consider for skill mismatch, geographical mismatch and sectoral mismatch and find that only the latter seems to have a more permanent effect on the position of the Beveridge curve and argue that a high share of low-skilled workers, a high home ownership rate and a high share of workers (previously) employed in the construction sector have shifted the Beveridge curve outward.

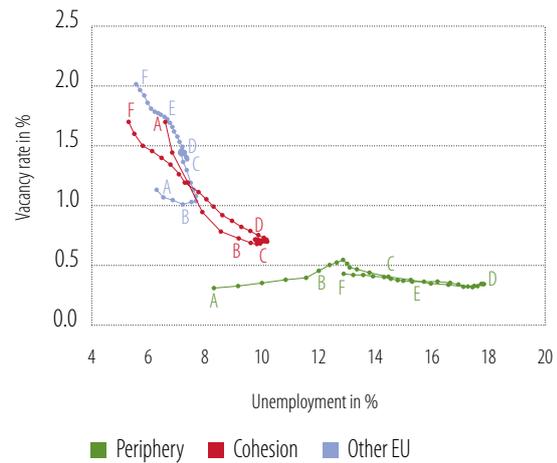
developments in the cohesion and other EU groups. Currently, the other EU group shows higher vacancy rates for similar levels of unemployment compared with 2009, reflecting improving business cycle conditions but potentially also higher skill mismatches, with changing skill demand being one factor that can make it harder to fill positions. Developments in the cohesion group, moving towards very low unemployment and high levels of vacancies, might indicate more broad-based labour shortages (see also Box C).

**Figure 13**  
EU Beveridge curve



Source: Eurostat.  
Note: Left: EU Beveridge curve for EU27, excluding Croatia due to missing data.

**Figure 14**  
Beveridge curves by country group



Source: Eurostat.  
Note: Right: Job vacancies and unemployment with four-quarter averages. A = 2009:Q1, B = 2010:Q1, C = 2012:Q1, D = 2014:Q1, E = 2016:Q1, F = 2018:Q1. Excl. DK, FR, IT and MT due to missing data.

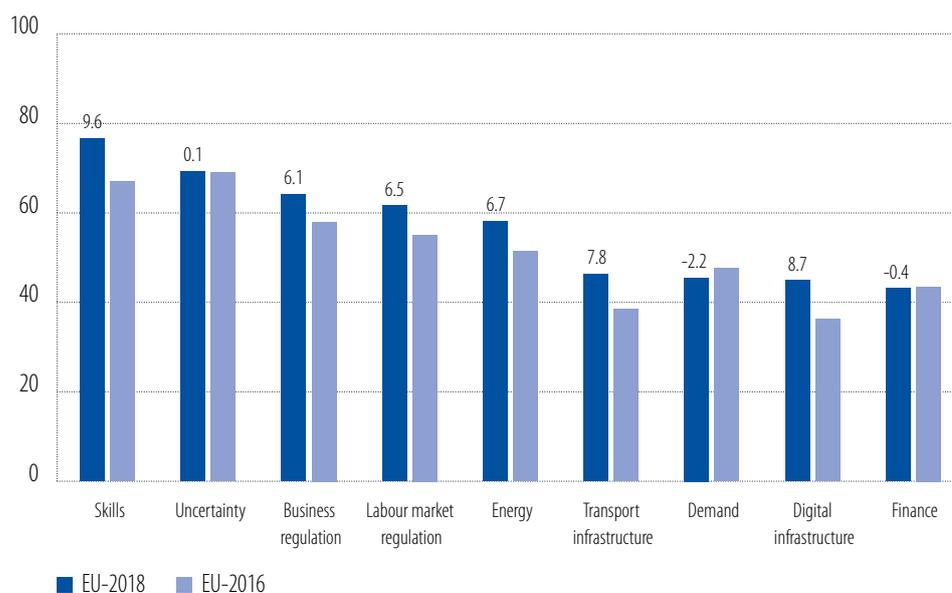
## Limited availability of skills as an investment impediment

### What factors explain firms' missing skills in the EU?

The EIB Investment Survey sheds light on where firms see the limited availability of skills as an investment impediment and why. In this section we analyse results from EIBIS (2016-2018), providing information on firms' investment activity and the impediments they see. In addition, we rely on new evidence based on a special module of EIBIS that allows us to take a closer look at challenges firms face related to skills. Here, our analysis also compares the EU with the US.<sup>13</sup>

Almost eight out of ten firms in the EU find the limited availability of staff with the right skills to be an impediment to investment. Out of the nine investment impediments considered in the EIBIS, the limited availability of staff with the right skills is the most frequently named obstacle, in line with results from 2017 (EIB, 2017). Missing skills are the investment impediment that records the largest increase (up 9.6 p.p.) among the different investment obstacles over the past three years (Figure 15).

**Figure 15**  
Share of firms reporting the respective obstacle to investment (2016–18, %)



Source: EIBIS 2016, 2017, 2018.

Note: Values above bars indicate changes compared with 2016, in percentage points.

Question: Thinking about your investment activities in your country, to what extent is each of the following an obstacle? Graph combines share of firms naming the impediment as a major or minor obstacle.

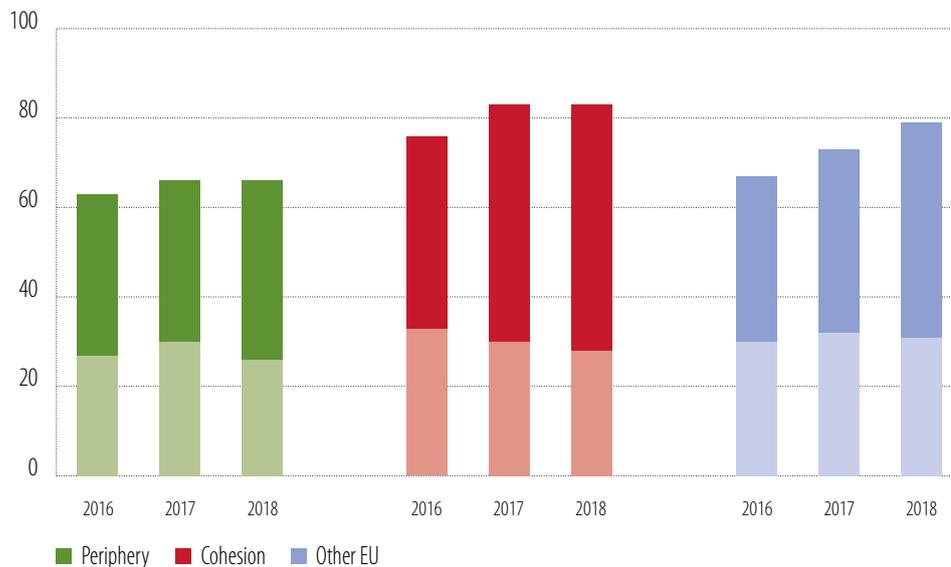
Base: All firms.

<sup>13</sup> For a further description of the Add-on Module data set (AOM) see the data annex in this report. The EIBIS General Module results are weighted by value added. Results based on the add-on module are weighted by number of employees.

**Firms’ serious concerns about finding workers with the right skills have intensified.** First, the share of firms reporting missing skills as a major obstacle increased to 47% in 2018 compared with 41% and 37% in 2017 and 2016, respectively. Second, firms’ concerns about skills have become more important relative to other obstacles, particularly those they consider to be “major”. Third, looking at impediments by country, the limited availability of skills is now the top major concern for firms in 21 Member States compared with 17 in 2016.

**Firms in cohesion and the other EU countries report missing staff with the right skills the most.** By country group, companies in the periphery group report the limited availability of skills as less of a problem and show only a slight increase over time. Firms in the other EU group show the strongest dynamic over the last three years. In 2018 79% of firms named it as an impediment, a 12 p.p. increase since 2016 (Figure 16). By country group, cohesion firms report missing skills the most (82%) and with increasing intensity. Here, firms in many regions also seem to strongly perceive the limited availability of skills as an impediment to investment (Figure 17).

**Figure 16**  
Share of firms reporting missing skills as an investment impediment, by country group (%)



Source: EIBIS 2016, 2017, 2018.

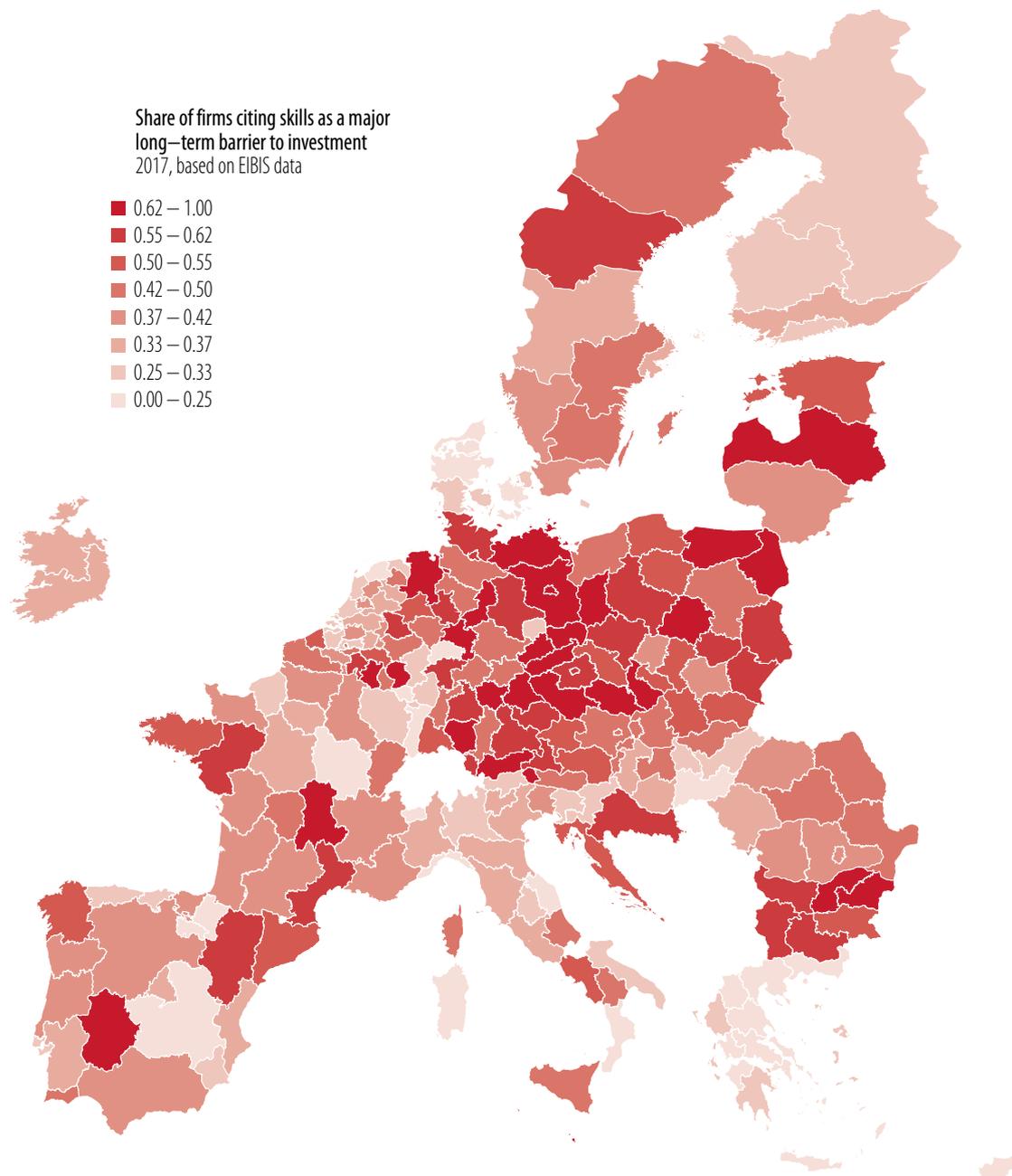
Note: Light colour = share of firms naming missing skills as a minor impediment. Dark colour = share of firms naming missing skills as a major impediment.

Base: All firms.

Questions: Thinking about your investment activities in your country, to what extent is the limited availability of staff with the right skills an obstacle? Is it a major obstacle, a minor obstacle or not an obstacle at all?

**By sector, manufacturing and construction firms miss workers with the right skills the most.** On average, 79% of manufacturing companies and 78% in construction report missing skills as an investment impediment. Services firms indicate fewer concerns (73%), and increases over the last three years are also less pronounced (up 6 p.p.) compared with manufacturing, infrastructure and construction (the first two both up 11 p.p. and construction up 9 p.p.).

**Figure 17**  
**Share of firms citing missing skills as a major long-term barrier to investment**



Source: EIBIS 2017.

Note: Values for the UK not displayed due to missing data for regional matching.

Question: Thinking about your investment activities in your country, to what extent is the limited availability of staff with the right skills a major obstacle?

Base: All firms.

**Box B****Missing skills as an investment impediment: what are we measuring?**

Asking firms about missing skills as an impediment to investment is different from other approaches used to assess skill shortages or mismatches. The regular EIBIS does not ask about hiring or hiring difficulties, which can be used to infer skill shortages,<sup>14</sup> but focuses on whether the lack of availability of staff with the right skills poses a barrier to investment to the firm. This could be driven by hiring difficulties, or firms could refer to their current staff and potential internal skill gaps, rather than pointing to some forms of skill mismatch, e.g. under-skilling, at the micro level. For hiring, firms could refer to labour shortages in general, or bottlenecks for skilled personnel in particular, that cause difficulties. Since the question relates the availability of skills to investment, it contains a more structural and future-oriented component than the European Business Survey, which asks about labour as a factor limiting production. What the firm plans to do in the future will be likely to affect its skill needs today. Whether the right skills a firm is seeking are available depends on firm-specific factors, i.e. the ability of the firm to develop and attract them and the skill supply where the company is seeking them. Hence, both firm-specific factors and operating environment can affect responses.

The availability of workers with the right skills can affect investment activities of firms in the EU. How it does so has hardly been investigated, but matters for firms and beyond. Some studies examining the effect of skill shortages find effects on specific types of investment (see, for example, Nickell and Nicolitsas (2000) for effects on R&D investment) and there are economic and societal costs to skill mismatches and gaps.<sup>15</sup> At the same time, understanding the factors that hold back firms' investment is of wider economic significance for Europe, where the recovery of investment has been slow and investment activity by corporates often remains subdued even where economic conditions are relatively favourable. The EIBIS allows the assessment of lack of skills as one of the key investment impediments for European firms over the last three years, linking it to firm-level information and comparing differences in operating environments across the EU. It thus helps to understand which firms face skills obstacles in particular, and to shed light on the factors that underpin firms' responses. In addition to a better understanding of investment impediments, it also complements the literature on skill mismatches and shortages by adding a novel aspect connected to investment.

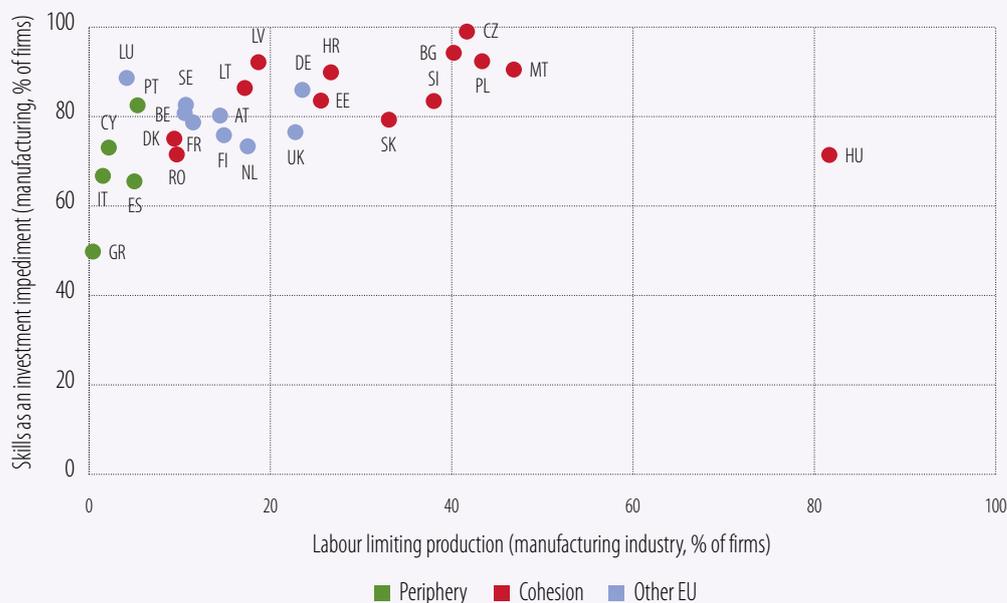
Firms' concerns about the availability of skills relate to hiring staff. Country distributions of macroeconomic skill mismatch measures, for instance, based on employment rate dispersion across skill groups (European Commission, 2017; Kiss and Vandenplas, 2015) as well as approaches to assessing mismatches at the micro level, show limited correlation with missing skills as an investment impediment when compared across EU countries.<sup>16</sup> Missing skills as an investment impediment seems more similar to measures of labour shortages in terms of country distributions (see Figure B.1), with which it shared an upward trend in recent years. While labour shortages are not the same as skill shortages, both tend to be correlated. Also, the country group distribution in the EIBIS shows similarities with other data sources, such as information from the Wage Dynamics Network, suggesting that limited availability of skills is a key obstacle to hiring particularly for companies in the other EU and cohesion countries (see Figure 10 and Figure 15).

14 In combination with macroeconomic indicators.

15 For an overview of the literature on skill mismatches and shortages, measurement and associated costs see Cappelli (2014); Eurostat (2016); and Brunello et al. (forthcoming).

16 Based on comparison between skills shortage as an investment impediment (total) and macroeconomic skill mismatch, skill shortage, overqualification and underqualification measures based on European Commission (2017) and micro-mismatch measures using field of study mismatch (OECD).

**Figure B.1**  
**Labour shortages and limited availability of skills as an investment impediment**



Source: European Business Survey, EIBIS 2018.

Note: x-axis: share of firms naming labour as factor limiting production (manufacturing, average 2017:Q3-2018:Q2), Joint harmonised EU industry survey. Q. Factors limiting production: labour; y-axis: share of firms naming missing skills as an obstacle to investment (manufacturing).

Question: Thinking about your investment activities in your country, to what extent is the limited availability of staff with the right skills an obstacle?

Base: All firms.

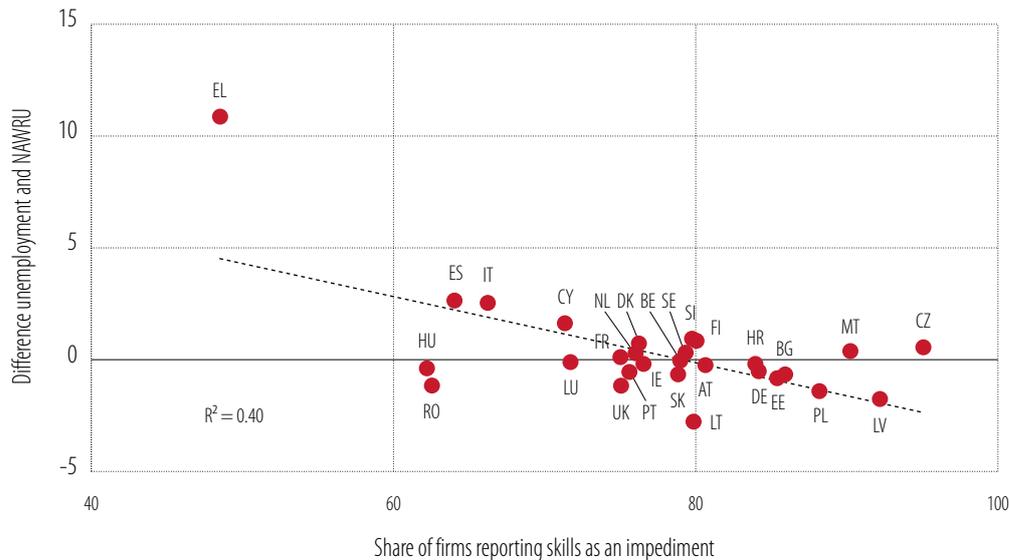
**Firms can face skill shortages for cyclical, technological and idiosyncratic reasons.** Skill shortages can partly be attributed to human resource practices and unattractive offers. Yet, it is often more dynamic and innovative firms that encounter difficulties in finding talent, because they are in greater need of skills (Cedefop, 2015). The EIBIS data similarly suggest that more growing and more dynamic firms tend to report skills shortages as an investment impediment. On average, more EU firms that invest, export, innovate and expect their investment to lead to employment growth name the unavailability of skills as an impediment. Greater reliance on external financing for investment, which can proxy for firms' ambition to grow, also tends to be more associated with missing skills.<sup>17</sup>

**The strength and length of labour market recovery is likely to affect how easily firms can find staff.** More spare capacity on labour markets should imply lower supply-side constraints and hence fewer firms experiencing the unavailability of skills as a problem. Country group patterns for the limited availability of skills as an impediment for the other EU, cohesion and periphery countries suggest an inverse relationship with unemployment levels. Breaking this down by country, we find that firms in Greece, where unemployment has been persistently high, continue to be the least likely to report missing skills as an impediment. In Ireland and Portugal, where unemployment was less elevated than in some other countries in the periphery group and dropped more quickly, firms are more likely to report the limited availability of skills as an impediment. For the EU, we find that where unemployment is above

<sup>17</sup> Results are based on a probit model assessing the intensity of reliance on external/internal finance for investment on the probability of reporting missing skills as an investment impediment, controlling for country, year and sectoral effects for the EIBIS waves 1 and 2. See Pouliakas and Wruuck (forthcoming).

the NAWRU,<sup>18</sup> i.e. there is still more spare capacity on labour markets, firms tend to be less concerned about the availability of skills (Figure 18). How quickly skills gaps become more of a constraint for firms depends on the interaction of the cycle with structural conditions and the other factors affecting quantity and composition of existing skills supply.

**Figure 18**  
**Limited availability of skills as an investment impediment and unemployment–NAWRU gap**



Source: EIBIS 2018, AMECO.

Note: x-axis shows share of firms that report missing skills as impediment to investment in %; y-axis: unemployment–NAWRU gap. The dotted line shows linear fit. NAWRU and unemployment for 2017.

Base: All firms.

**Demographic change and population shifts impact labour supply at the regional, country and European levels.** First, in the EU the working age population relative to the total has decreased in recent years.<sup>19</sup> Before 2008, it was constant or growing in most Member States, but since then it has shrunk in all but one (Luxembourg). There are about 2.2 million fewer people of working age than a decade ago and the workforce is ageing, due to low fertility rates. This can add to labour and skill shortages, particularly during economic upturns. Second, net migration has become more important for overall changes in population numbers, and many (capital) cities have exerted a pull due to (perceived) employment and education opportunities. It is not clear whether, on balance, intra-country regional mobility adds to or alleviates current problems with the availability of skills for firms. Companies seeking specific skill profiles tend to cluster. To the extent that people with the right skills have been moving to these places, greater mobility can mitigate shortages there by adding to labour supply. At the same time, population growth in a region adds to local demand for labour. In less dynamic regions, firms may seek fewer personnel and may be slower to recover and benefit less from a cyclical recovery. However, if they do, it may be harder to attract staff, partly because of past population losses that can reduce the attractiveness of a region.<sup>20</sup>

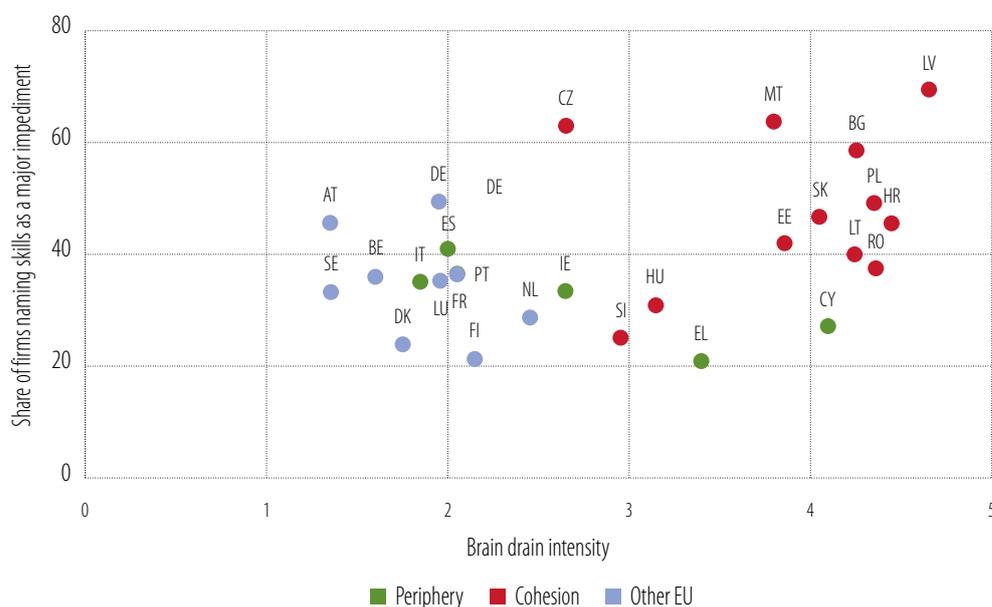
<sup>18</sup> NAWRU refers to the Non-Accelerating Wage Rate of Unemployment. A similar correlation holds for NAIRU estimates, i.e. the Non-Accelerating Inflation Rate of Unemployment.

<sup>19</sup> About 0.4% p.a. (2009–16/2009–16). See European Commission (2017).

<sup>20</sup> See Chapter 2 for further discussion of the impediments that firms face at a regional level.

**Skill shortages as a major investment impediment are most pronounced in cohesion countries.** Greater pressure from the “brain drain” coincides with a larger share of firms reporting the unavailability of skills as a major impediment (Figure 19). Cohesion countries have experienced large-scale emigration over the past decades. Over the last 25 years, almost 20 million people, i.e. about 5.5% of the Central, Eastern and South-eastern Europe (CESEE) population, have left the region,<sup>21</sup> many of them young and highly skilled (Batsaikhan et al., 2018, Atoyan et al., 2016). Emigration has also been found to reduce the supply of skilled labour in countries with a relatively small share of the population with tertiary education, such as Croatia or Romania. Most countries in the region are subject to brain drain problems to a greater extent than the rest of the EU.

**Figure 19**  
**Brain drain intensity and share of firms naming skills as major impediment<sup>22</sup>**



Source: EIBIS 2016-17; Fund for Peace/Quality of Governance data sets.

Note: x-axis: brain drain index (2016); y-axis: share of firms reporting unavailability of staff with the right skills as a major impediment to investment.

Base: All firms.

Question: Thinking about investment activities in your country, to what extent is the limited availability of staff with the right skills a major obstacle?

**Moving into recovery, cyclical conditions can amplify structural trends, such as demographics and technological change, and exacerbate firms’ reporting of shortages.** Further analysis examines how cyclical, structural and firm-specific factors affect the reporting of lack of skills as an investment impediment across the EU and for the three different country groups (cohesion, periphery and other EU).<sup>23</sup> The binary dependent variable captures whether a firm reports the limited availability of staff with the right skills as an investment obstacle. It considers the influence of cyclical conditions on labour markets using a measure of labour market slack based on detrended unemployment with a smoothing filter. As one structural factor limiting the availability of skills, the model includes a measure to capture the intensity of the brain drain as a problem at the country level. We control for firms’ perception of labour market regulation

<sup>21</sup> Due to data limitations, this figure may also include instances of re-migration.

<sup>22</sup> “Brain drain” is based on the subcomponent of the fragile state index developed by the Fund for Peace. The indicator combines content analysis, quantitative and qualitative sources to assess incidence and pressure from the brain drain, including pressures and measures related to migration per capita, human capital and emigration of educated population. For further information on data collection and methodology, see [www.fundforpeace.org](http://www.fundforpeace.org).

<sup>23</sup> Based on the first two waves of the EIBIS.

as a major investment barrier, and as a potential source that could make skills harder to find or attract from firms' perspective. The EIBIS allows us to assess how missing skills relate to firm characteristics and firms' activity. In particular, we examine whether more dynamic and innovative firms are more prone to report limited availability of skills as an obstacle to investment by looking at different types of innovators (innovation profiles) and their investment priorities. Table 1 summarises the main results.

**The more competitive and innovative EU firms and those expecting their investment to add employment are more likely to report the limited availability of skills as an impediment.** Firms that invest and expect their investment activity to lead to employment increases are significantly more likely to name the lack of availability of skills as an obstacle for the EU overall (Table 1, column 1) and for each of the three country groups (Table 1, columns 2–4). This also points to a forward-looking component in firms' responses. Effects for exporting and foreign direct investment activity vary with regional specifications. That both effects are not significant for the other EU group may reflect the overall larger share of firms engaging in this activity, as well as the respective firms having fewer difficulties in finding the skills they need in the local market or resorting to alternative options if skill needs persist, e.g. through reorganising supply chains. In contrast, for cohesion countries where the original comparative advantage was based on relatively good availability of labour and skills, exporting firms tend to miss skills more.

**Cyclical effects are apparent across the EU, and particularly in the periphery.** More remaining capacity on labour markets tends to reduce firms' concerns about the availability of skills. This can be due to a mix of lower hiring activity and fewer difficulties in finding staff when hiring if unemployment is higher. A similar result holds for alternative measures of labour market slack based on the NAWRU–unemployment gap. Cyclical effects matter across the EU but more strongly in the other EU group (column 4) and the periphery (column 3). The data also reflect differences within both groups.

**Firms' perception of labour market regulation as a major barrier to investment appears to be positively related to skill concerns.** However, this should be interpreted with caution, as firms can refer to very different types of regulatory barriers, including specific legislation, general red tape and other factors.

**Firms' concerns about skills also have a technology component.** Innovation activity requires high-level expert skills and often technological skills. Our results suggest that companies putting an emphasis on the development and production of new products in their investment activity are more likely to report the limited availability of skills as an investment impediment, particularly the cohesion and other EU groups. For the periphery group, subdued hiring activity and greater availability of personnel may work to reduce concerns. Firms' innovation profiles show that different types of innovative companies miss skills more than those with no innovation or substantial investment in research and development (R&D) and software. Also, effects differ by types of innovator. In the cohesion countries, where a lot of innovation activity is incremental or involves adoption, firms in these groups report the availability of skills as a particular problem. For the periphery group, incremental and leading innovators appear to be more affected. In the other EU group, different types of innovative firms are more likely to find the limited availability of skills to be an impediment. In particular, companies with substantial investment in R&D and software (developers), i.e. firms often at the technology frontier, also miss skills more. Altogether, this suggests a strong technology-related component and potentially points to shortages for specific high-skill profiles. Firms seeking similar skill profiles simultaneously, along with supply constraints influenced by emigration of high-skilled workers, can reinforce this result.

**Emigration can exacerbate skill gap tensions.** The cohesion countries are most subject to the brain drain, whereas this problem is more limited in the other EU group, where countries often tend to be beneficiaries. Results point to tensions from the brain drain as one of the factors in firms missing skills across the EU, but this effect is essentially driven by cohesion countries. Here, the effect also shows within the group. For the periphery group, cyclical effects may dominate. Also, while emigration increased during the crisis, movements have been below the EU average relative to population.<sup>24</sup>

<sup>24</sup> Emigration of home citizens is estimated to be between 0.1% and 0.2% p.a. (2009–15, combined for Greece, Italy, Portugal and Spain) compared with almost 0.6% for Central and Eastern European Countries over the same period (see Batsaikhan et al., 2017).

Table 1

	(1)	(2)	(3)	(4)
Variables	EU	Cohesion	Periphery	Other EU
Dependent variable: lack of skills as investment impediment				
Export	0.0940** (0.0433)	0.203*** (0.0692)	0.0332 (0.0920)	0.00336 (0.0719)
FDI	0.176** (0.0815)	0.0841 (0.196)	0.516*** (0.172)	0.126 (0.108)
Employment increase expected	0.387*** (0.0446)	0.341*** (0.0720)	0.320*** (0.0908)	0.469*** (0.0759)
Investment in new products	0.158*** (0.0469)	0.204*** (0.0787)	0.0682 (0.0950)	0.224*** (0.0765)
<i>Innovation profiles</i>				
Adopting	0.232*** (0.0481)	0.337*** (0.0793)	0.113 (0.0982)	0.214*** (0.0798)
Incremental innovators	0.276*** (0.0778)	0.484*** (0.152)	0.319** (0.148)	0.204* (0.119)
Leading innovators	0.280*** (0.0904)	0.345** (0.175)	0.401** (0.196)	0.219* (0.130)
Developers	0.209** (0.0862)	0.234 (0.152)	0.0936 (0.167)	0.338** (0.138)
<i>Cyclical conditions</i>				
Labour market slack	-0.193*** (0.0181)	-0.0609* (0.0358)	-0.231*** (0.0308)	-0.308*** (0.0456)
<i>Structural conditions</i>				
Pressure from brain drain	0.101*** (0.0186)	0.235*** (0.0474)	0.0839 (0.0616)	
Labour market regulation invest. imp.	1.074*** (0.0482)	1.292*** (0.0882)	1.117*** (0.0887)	0.997*** (0.0829)
Observations	14 921	6 373	3 087	5 461

**Note:** Results reported as coefficients (log odds) for a standard logit model. Standard errors in parentheses. \*\*\*p < 0.01, \*\*p < 0.05, \*p < 0.1. The dependent variable is binary taking on the value of 1 if a firm reports the limited availability of skills as an impediment to investment (major or minor). Independent variables: variables related to firms' business activity (exports, foreign direct investment, firms' expected effect of investment on employment and investment in new products) are based on EIBIS data and operationalised as dummy variables.

*Innovation profiles capture different types of innovators and are operationalised as follows:*

*Basic:* Firms with no substantial R&D + software and no new products, processes or services (baseline category not shown)

*Adopting:* Firms with no substantial R&D + software but developed products (new to the company or country or globally new)

*Incremental innovators:*

*Firms with substantial R&D + software and products new to the company*

*Leading innovators:*

*Firms with substantial R&D + software and products new to the country or globally*

*Developers:*

*Firms with substantial R&D + software but no new products.*

*Cyclical conditions:*

*Labour market slack is measured using unemployment with a Hodrick-Prescott filter with a large value of lambda.*

*Structural conditions:*

*"Brain drain" is based on the subcomponent of the fragile state index developed by the Fund for Peace.*

*Labour market regulation as a major investment impediment is a binary variable taking on the value of 1 if a firm considers labour market regulation to be a major impediment to investment.*

*Several robustness checks were performed to assess the model, including alternative specification of variables and a general misspecification test (linktest).*

**Box C**

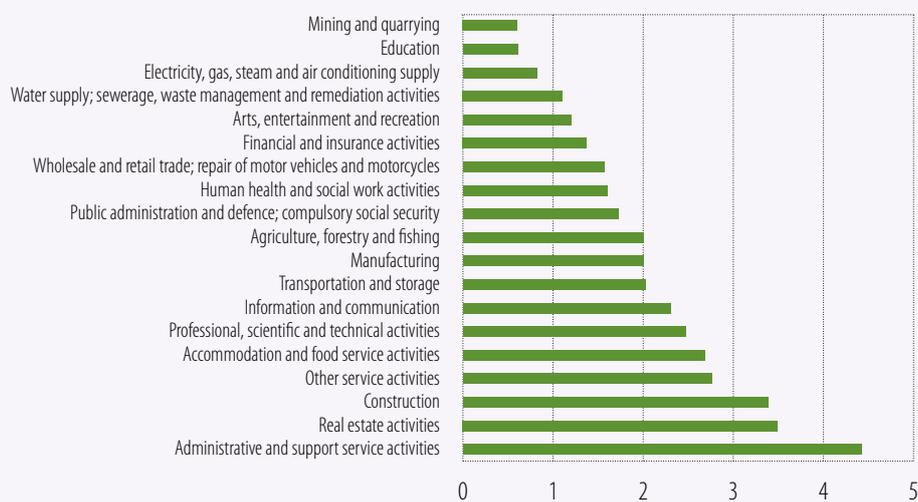
**Missing skills in cohesion countries: what is behind the current shortages and how could they be addressed?**

The EIBIS results and macroeconomic indicators point to skills shortages being particularly pronounced in the cohesion region. Cohesion countries had the highest share of firms reporting skills shortages as an investment obstacle already in EIBIS 2016, and firms' concerns have further increased. Labour markets in cohesion countries are particularly tight for both low-skilled and high-skilled jobs. Wage increases are similar or even higher in many low-skilled job categories, and job vacancy rates are high in some low-skilled activity categories and in certain high-skilled ones.

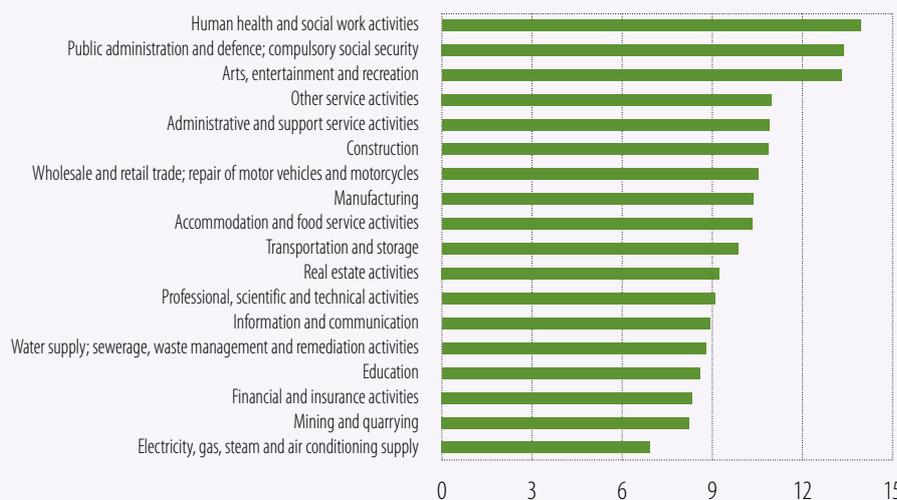
**Figure C.1**

**Vacancies and wage growth in cohesion countries**

a. Job vacancy rates by type of activity, in %



b. Wage growth by type of activity, in %



Source: Eurostat.

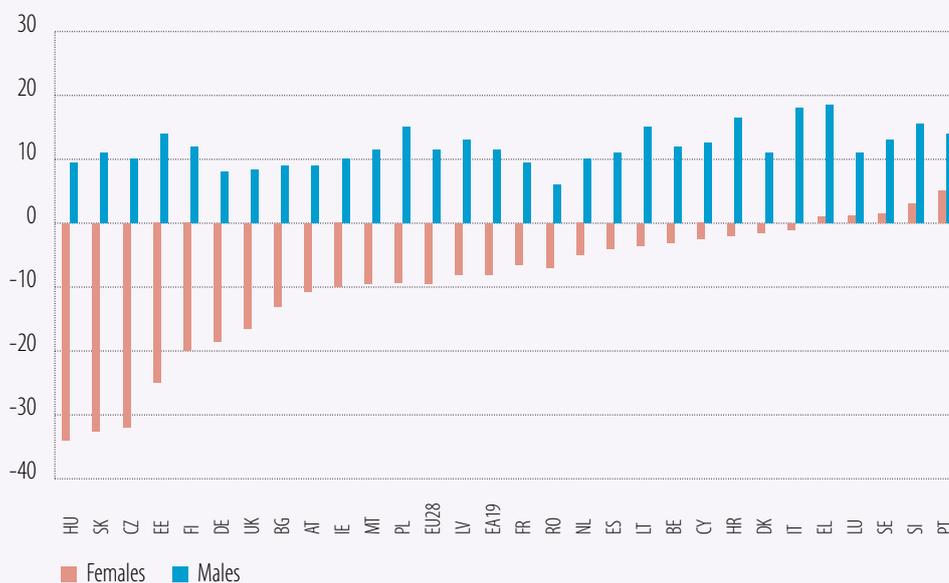
Note: Quarterly averages 2017:Q3-2018:Q2. Growth in wages and salaries compared with the same period in the previous year. Aggregates GDP weighted. Excluding Malta.

The tightness in labour markets is due to a combination of cyclical and structural factors. Growth in 2017-18 has been strong, supported by robust domestic demand, favourable external conditions and EU inflows. The robust recovery rapidly increased labour demand. At the same time, other factors such as negative demographics, structural rigidities and some types of skill mismatch have contributed to a reduction in labour supply.

The reasons behind the shrinking labour supply are structural and include outward migration, population ageing and health. Cohesion countries have experienced significant outward migration in the last decade, with migration of the younger and higher skilled part of the population proportionally higher. In addition, they have fertility rates below the EU average. This has led to a decline in overall population and an increase in the old-age dependency ratio.

At the same time, untapped potential exists, in the form of large unskilled and inactive parts of the population, and there is relatively low female participation in the workforce in some countries. In many countries in the cohesion group, activity rates are still relatively low, and people living in less-developed rural environments often remain inactive. However, due to a lack of labour market experience and a lower skill base, opening up pathways to the labour market for the inactive population requires efficient policies with very high front-end costs. For example, relatively generous benefits for stay-at-home mothers coupled with a lack of early childcare infrastructure make it difficult and/or unattractive for women to re-enter the labour market (Figure C.2). Some countries in the region have both low female employment rates (60% or below) and a large wage gap between male and female employees (European Commission, 2016).

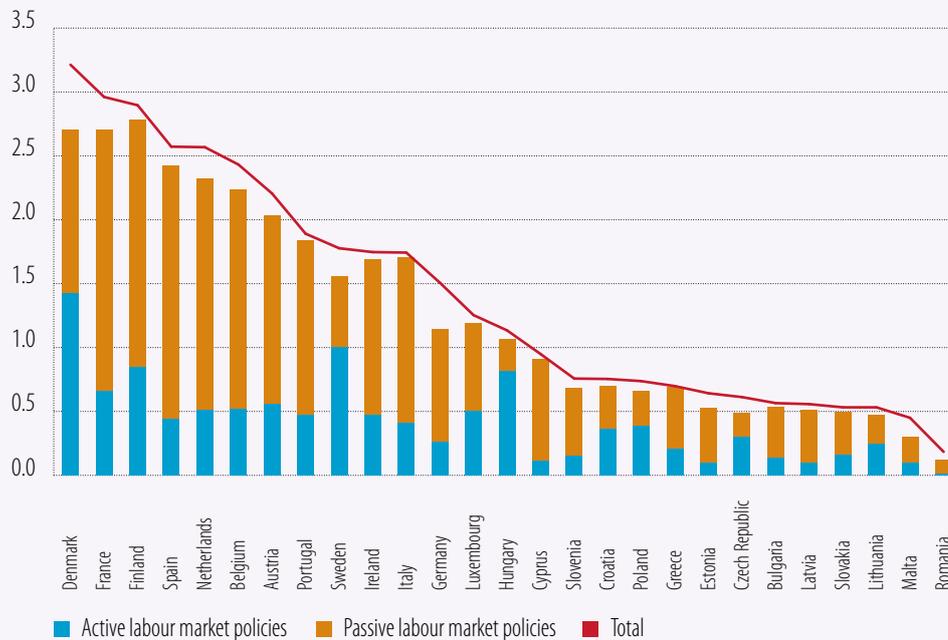
**Figure C.2**  
**Differences in employment rates (male–female) for women with children under six years**



Source: Eurostat, LFS and European Commission.

Note: Data refer to women and men aged 20–64. Note that full-time equivalents are calculated with reference to the working time of a full-time full-year employee. Estimates for 2014.

**Figure C.3**  
Spending on labour market policies (in % of GDP, 2015)



Source: Eurostat.

Note: No data available for the UK. Active labour market policies include training, employment incentives, supported employment and rehabilitation, direct job creation and start-up incentives. Passive policies include income support and early retirement. Total includes labour market services.

The structural component adding to skill tensions in cohesion countries needs a comprehensive policy response. Strategies to maintain and further develop a skilled labour force in the region need to go beyond education and training. While there is room to improve the quality and inclusiveness of education systems and opportunities for life-long learning in the region, effective approaches need to go beyond education and training. Active labour market policies can help to bring parts of the inactive population into the labour market and mitigate some of the negative impact of emigration, but spending in this area remains rather low in the region (Figure C.3).

Creating a more attractive environment also means improving the business environment and institutions. Factors that affect emigration include both differences in unemployment and growth between home and host countries and institutional quality. Here, the higher skilled have been found to respond more sensitively to a weaker institutional environment (Cooray and Schneider, 2016; Atoyan et al., 2016). To move into activities that are more knowledge-intensive and establish successful hubs and creative clusters, the business environment and institutions are particularly key. Strengthening government effectiveness, institutional quality and the business environment can provide multiple benefits as this facilitates local business creation, can help to attract foreign investment and increases attractiveness for both natives and foreigners to work and live in the region.

Increasing quality of life in the cohesion region includes investment in social infrastructure – for example, health, education and childcare. The EIBIS among municipalities showed that about 40% of cities in the cohesion region still register gaps in basic infrastructure (EIB, 2017a). At the same time, many cohesion countries are characterised by strong urban/rural disparities in economic activity, living conditions and the availability of basic services, all drivers of intra-country population shifts and people moving to (capital) cities (see Kollar et al., 2018, for further discussion).

Demography and technological change make it crucial for the region to address skill gaps. Countries in the cohesion group are going to face greater pressure from both demography and potential automation. While the latter can also help to overcome labour shortages, this requires investment in the respective technologies, which might be difficult, particularly for small firms due to a mix of lack of skills and financing constraints. At the same time, where technologies lead to displacing employees with fewer options to find alternatives, the social costs can be high.

## Missing skills – how does Europe compare with the United States?

**The special module of this year's EIB Investment Survey helps to shed further light on what skills firms are missing.** In addition to comparing firms across Europe, we also examine companies in the US to assess how skills-related challenges compare to those in a different institutional and labour market environment.<sup>25</sup>

**The US had a sharper labour market contraction following the financial crisis, but was spared the sovereign debt crisis, and labour market recovery started earlier.** The US labour market is in its ninth year of expansion after the Great Recession, with unemployment at record lows and most labour market measures continuing to improve.<sup>26</sup> Anglo-Saxon labour markets provide for greater labour market flexibility, which typically translates into faster hiring and firing decisions. In the EU, different traditions – Anglo-Saxon, Nordic, Continental, Southern and Eastern European – coexist. The different trajectories and labour market outcomes in EU Member States during the last decade continue to make clear that the EU consists of 28 markets rather than a single labour market.<sup>27</sup>

**Limited availability of skills as an investment impediment is not specific to European firms.** US companies are even more likely than European ones to report missing skills, with about 85% naming it as an investment obstacle in the US. Factors reflected in higher overall levels of reporting missing skills include a more advanced cyclical recovery, and institutional and organisational differences such as greater reliance on hiring instead of promotion from within to fill positions.

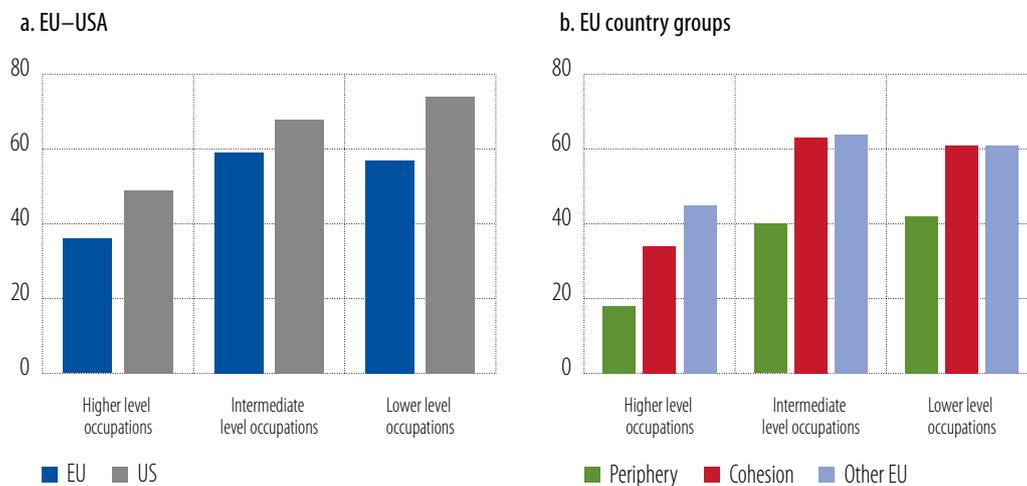
**Strong business cycle conditions and structural features of the US labour market similarly explain more firms posting vacancies compared with the EU.** The share of firms advertising vacancies in the US is higher than in the EU for all three broad occupation levels (Figure 20, panel a). Job mobility and employee turnover tend to be higher compared with most European labour markets, and switching jobs is facilitated by strong economic conditions.

<sup>25</sup> Comparison with the US is based on the (AOM). See Data Annex in this report.

<sup>26</sup> Bureau of Labor Services and Eurostat.

<sup>27</sup> Broad categories based on socioeconomic systems (Esping-Andersen, 1990). See Turrini et al. (2014) for country classifications and also for discussion of labour market reforms.

**Figure 20**  
Share of firms reporting open positions (%)



Source: EIBIS, AOM 2018.

Base: All firms.

Question: In 2017, did your company have any vacancy for [occupational category]?

**Within Europe, vacancy postings show different speeds of recovery.** The share of firms reporting vacancies is lower across all occupational levels in the periphery group.<sup>28</sup> More firms in cohesion and other EU countries report seeking staff, with more firms in the other EU group posting positions at the higher end of the qualification spectrum.

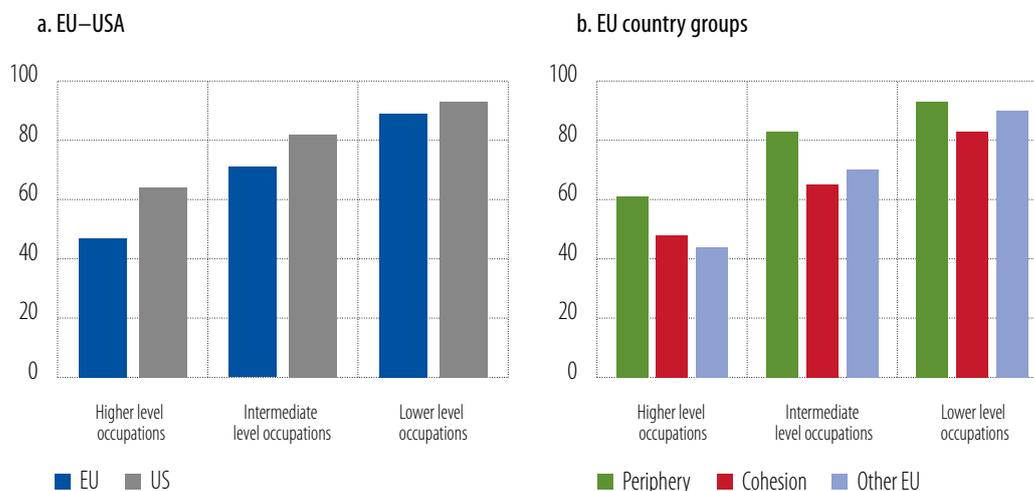
**Firms deploying advanced digital technologies are more likely to report open positions than non-digital peers.** The first group are more likely to report open positions across all skill levels in both the EU and the US. This could add to shortages if firms seek similar talent at the same time or look for skills that are less readily available, e.g. specific profiles requiring advanced digital skills such as data analytics or the ability to use digital technologies in production processes. Our analysis also finds that firms which are more advanced with digitalisation tend to create more jobs in higher-level occupations and often pay better (see Chapter 8).

**Hiring typically takes longer for more skill-intensive jobs.** Notwithstanding differences due to cyclical conditions and the institutional set-up of labour markets, it takes longer for firms to fill positions for higher-level occupations (see Figure 21, panels a and b). Here, skill needs can often be more complex, screening and selection processes for positions take longer and applicants are potentially in a stronger bargaining position.

**US firms can fill positions rather quickly despite a higher share of firms posting vacancies and low unemployment.** Transatlantic differences in hiring speed proxied by the share of firms being able to fill their vacancies in less than three months (12 weeks) on average are largest for high-level occupations, where competition for some talent can also be global. In the EU, 47% of companies report being able to fill vacancies for higher-level occupations in less than 12 weeks compared with 63% in the US. 17% of US firms can fill vacancies for high-level positions in less than a month, reflecting the structural features of the labour market such as shorter notice periods. Compared with analyses looking at vacancies and the time to fill them at an earlier point in the cycle (Ostermann and Weaver, 2014), where fewer firms posted positions, job openings can still be filled rather quickly.

<sup>28</sup> Note that the periphery group contains Ireland, which has structurally different labour markets and has had a steeper recovery.

**Figure 21**  
Share of firms that can fill vacancies in less than three months on average (%)



Source: EIBIS, AOM 2018.

Base: Companies with vacancies in 2017.

Question: Approximately how long did it take to fill the vacancies for [professional category]?

**In the EU, positions fill fastest in the periphery group.** Higher unemployment is typically associated with fewer hiring difficulties for employers (Cedefop, 2015). Correspondingly, at the time of writing, vacancies across all levels fill fastest in the periphery, where unemployment is still elevated and fewer firms report open positions, particularly for higher-level occupations.<sup>29</sup> Comparing the US with the other EU and cohesion groups, where the recovery in labour markets is further advanced, US firms can still fill positions quicker. Direct “benchmarking” with the US is somewhat difficult due to institutional differences influencing hiring speed, but taking the length to fill vacancies as one indicator would point to greater challenges for Europeans to find people with the right skills quickly. Longer-term unfilled vacancies (firms reporting taking more than six months to fill positions) are concentrated in the cohesion and other EU groups, and are most often for higher-level occupations (15% of firms in other EU and 16% in cohesion countries).

**Firms report job-specific skills as the biggest shortage among applicants.** The share of European firms naming job-specific skills as the hardest to find is about 40% for all three occupational categories. Results for US firms are rather similar, with a slightly higher share of job-specific skill shortages for lower level occupations. First, what firms conceive as job-specific skills may also refer to job-specific skill combinations they consider relevant for a position. Second, there is a difference between job-specific skills that take a long time to develop (type-1 shortage), e.g. through university studies or years of work experience, and those that can be learnt relatively quickly (type-2 shortage).

**This does not mean that other skills don’t matter.** Skills that are typically acquired in general education, such as reading, writing and mathematics, may often be regarded as a prerequisite, i.e. a necessary but not a sufficient condition to get a job. About a quarter of firms in the EU (26%, compared with 28% in the US) state that it is hard to find candidates with basic literacy and numeracy skills for lower level occupations, which may point to some gaps for basic skills.

<sup>29</sup> Given the heterogeneity of EU labour markets, there are also institutional differences within the country groups that can affect the speed of hiring in addition to differences in cyclical positions.

**Compared with the US, firms in the EU report that digital skills are harder to find across all country groups and occupation levels.** Digital skills are required in many jobs on a day-to-day basis at different levels (Cedefop, 2018). Firms that are already further advanced in deploying digital technologies miss digital skills more in the EU for higher-level and intermediate qualifications. Small firms in the EU seem to have greater difficulties in finding candidates with sufficient digital skills for higher-level occupations (20% compared with 14% for large firms).

**Within the EU, digital skills are missed more by firms in the periphery group.** Gaps are larger for higher and intermediate-level occupations, with about 25% and 18% of firms missing digital skills the most, respectively. At the same time, most countries in the group score below average when it comes to the availability of basic and advanced digital skills (European Commission, Digital Economy and Society Index, 2018), which could add to the fact that firms experience shortages in this particular area.<sup>30</sup>

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<sup>30</sup> The DESI includes five digitalisation dimensions, including human capital (capturing basic digital skills and use and advanced digital skills and development). With the exception of Ireland, all countries in the periphery group perform below the EU average in the human capital dimension. For further information on the Index and the latest data see European Commission, Digital Single Market.

## What can be done to mitigate skill shortages and gaps in the European Union?

**The skill shortages and skill gaps that firms perceive are not static.** They can arise because of different dynamics in demand and supply, particularly when the latter lag changing market signals strongly. For demand dynamics, cyclical conditions and structural factors such as technological change play a role. Knowledge-intensive sectors and occupations appear particularly prone to frictions, as demand for newer skills may outpace existing supply for longer. Geographical barriers and information gaps – between job seekers and employers – are two other factors that can make skills harder to find.

**Having a responsive system that supports skill development is key.** How to keep up with ever-changing skill needs is simple: it requires learning. To that effect, mitigating skill shortages and gaps is a joint responsibility. An institutional and market environment that facilitates responses to changing market signals provides the basis. Education systems that react to changing needs and equip students with the skills to adapt are a second element. Firm training can also be part of the response, particularly given that firms should have an information advantage when it comes to the specific skills they are seeking and may need in the future. In addition, firm training can form part of firms' strategies to address their skill gaps.

### EU firms' investment in training

**Firm training can play an important role in acquiring and updating skills during professional careers.** Employers are the most common providers of non-formal education and training, providing close to one-third of such activities.<sup>31</sup> In addition, a lot of informal learning takes place at work.

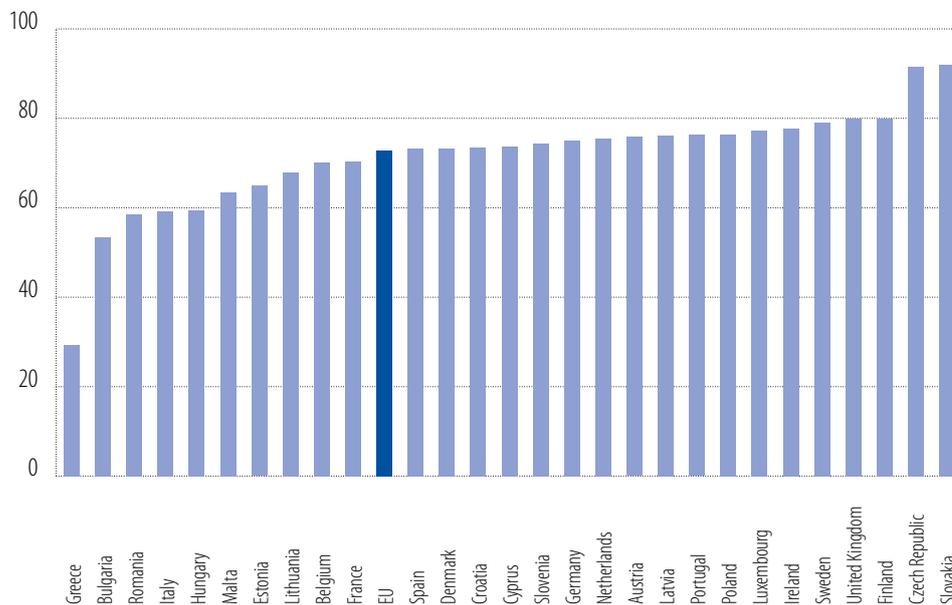
**Firms that invest in training often miss skills more.** According to the EIBIS data, 80% of EU firms with investment in training find the limited availability of skills to be an impediment compared with 71% without. Previous research similarly found a positive association between training incidence and firms' being concerned with skill shortages (Cedefop, 2015). The link between training investment and firms' perception of lack of skills as an impediment can reflect generally greater awareness of human capital topics and human resource strategies within firms that train, and stronger reliance on the knowledge of the firms' workforce for its production. Correspondingly, we find that firms with more investment in other intangibles are more likely to report the limited availability of skills as an obstacle (see Chapter 3).

**Structural factors influence firms' choices to invest in training.** About 73% of firms in the EU report investment in training.<sup>32</sup> By country group, more firms invest in training in other EU countries (76%), compared with the periphery and cohesion groups (65%). A closer look shows considerable country variation and some within-country differences across the EU (Figure 22 and Figure 23). Greece has the smallest share of firms reporting training investment (29%), whereas 92% of companies in the Czech Republic and Slovakia record some training investment.

31 For EU27, based on Adult Education Survey (2011). Non-formal education and training refers to any organised and sustained educational activities that do not correspond to the definition of formal education. See Eurostat (2017).

32 Based on EIBIS (2018) and cleaned for extremely low values (bottom 1% by country).

**Figure 22**  
**Share of firms investing in training, EU**



Source: *EIBIS (2018)*.

Note: *Share of firms with investment in training.*

Base: *All firms.*

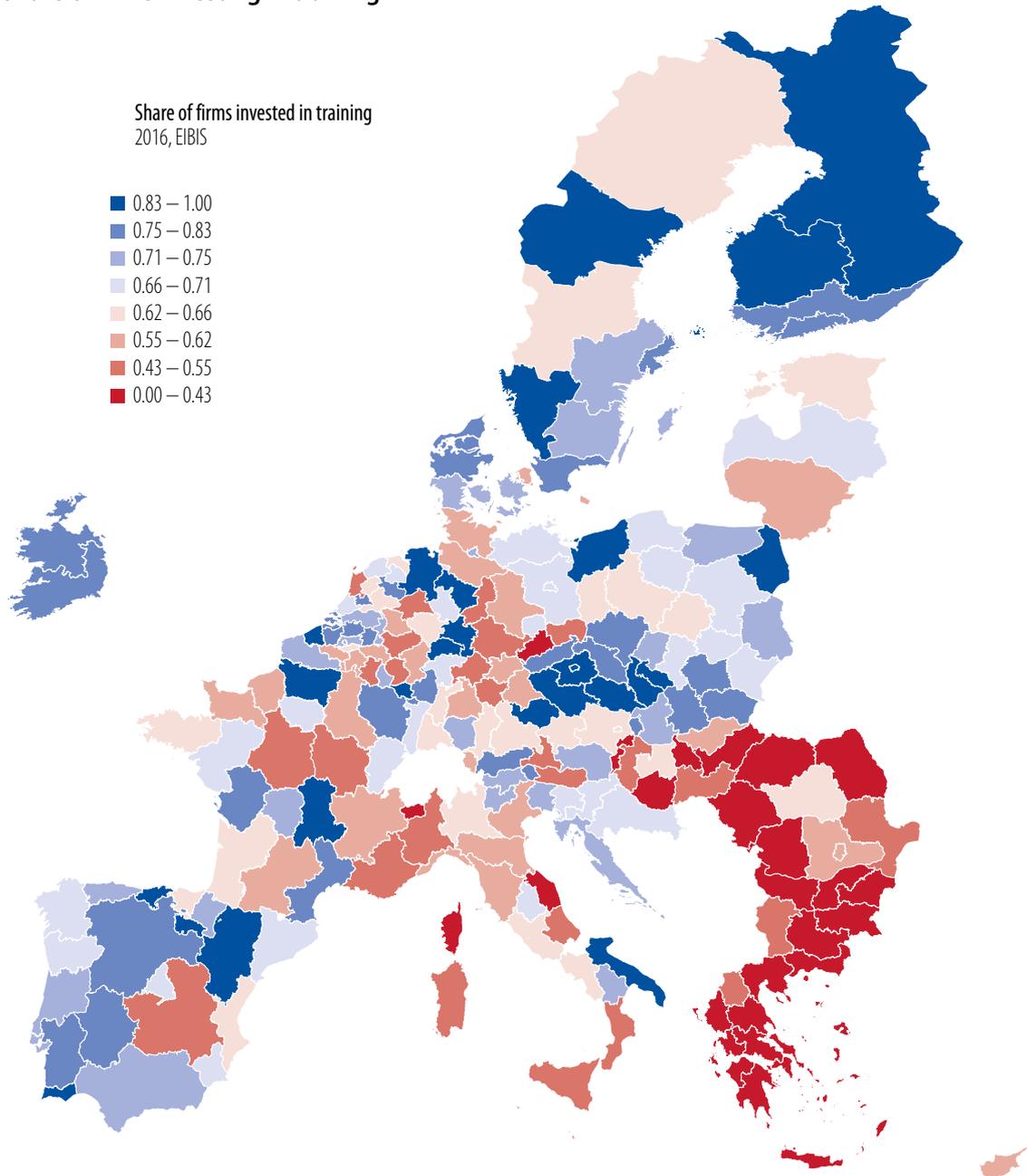
Question: *In the last financial year, how much did your business invest in training of employees with the intention of maintaining or increasing your company's future earnings?*

**The choice of a firm to invest in training reflects both firm- and country-specific factors.** A country's traditions, such as apprenticeship systems and public incentives to train, play into firms' decisions to invest in training. In addition, more local factors such as the availability of suitable training services and training infrastructure play a role. In turn, not investing in training the workforce can be due to limited willingness, i.e. if the firm does not see needs for training or the possibility to realise the gains from it, or limited ability.<sup>33</sup> Factors that affect the expectations of future returns on training include possibilities for retention, perceptions of the firms' business and operating environment and training quality.

**Firms' investment intensity in their workforce varies across Europe.** Training investment per employee and as a share of total investment is highest in the other EU group. In this group training investment per employee shows a procyclical pattern, having picked up over the last three years, whereas in the cohesion group training investment per employee has remained mostly flat (see Figure 24). As a share of investment, firms in the other EU countries spend more than those in the periphery and cohesion groups on training employees (Figure 25).

<sup>33</sup> While training expenses are typically lower than other investment spending items, constraints can negatively affect training investment, e.g. through spending trade-offs within the firm and because a firm in a less advantageous position may face higher uncertainties with respect to realising the gains from training and its overall business development.

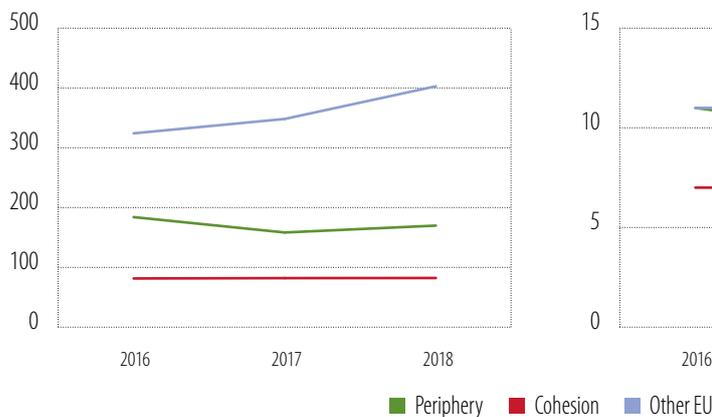
**Figure 23**  
**Share of firms investing in training**



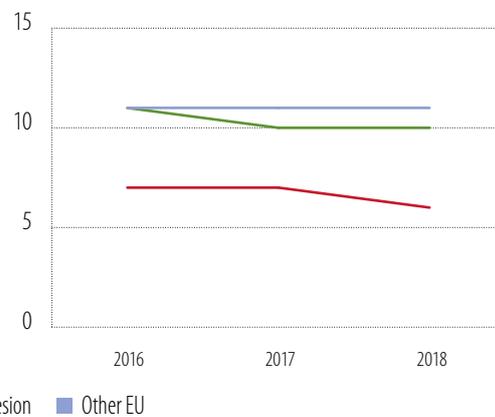
Source: EIBIS 2017.

Note: Mean share of firms with investment in training by region. Values for the UK not displayed due to missing data for regional matching.

**Figure 24**  
Training investment per employee (in EUR)



**Figure 25**  
Share of training investment in total investment (%)



Source: EIBIS 2016, 2017, 2018.

Note: Investment in training per employee in EUR. Simple averages for country groups of shares of training investment.

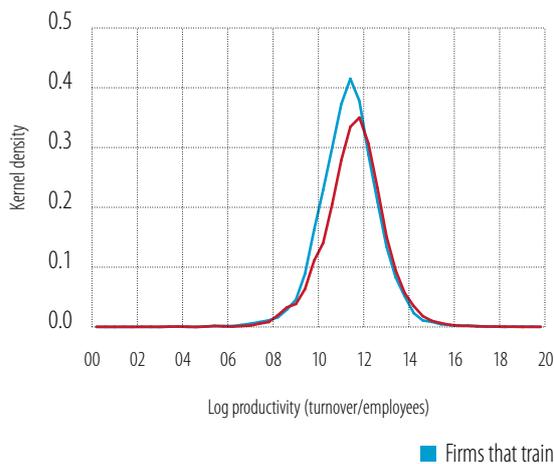
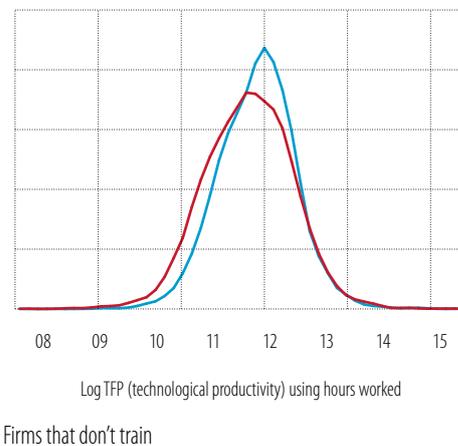
**Firm size influences the probability of investing in training across the EU.** Smaller firms are less likely to invest in training. 69% of small EU firms report training investment compared with 78% of large companies, the difference being slightly larger in cohesion countries (68% versus 81%). Further analysis examining determinants of training investment corroborate the size effect, and suggests that being small particularly reduces the probability of training in cohesion countries.<sup>34</sup> This can be due to greater difficulties with employee retention but also differences in management practices and the availability of a suitable training infrastructure. Given that firm size affects training provision, a higher share of (very) small firms in employment – particularly in the cohesion group – can also mean additional challenges to training and in setting up the structures needed for it, which often requires some coordination and a local ecosystem conducive to it.

**Financial constraints can inhibit firms' capacity to invest in training.** Popov (2014) found that credit constraints negatively affect firms' investment in training. Findings based on the EIBIS data similarly suggest that, in the EU, financially constrained firms and companies reporting inadequate access to finance as a major obstacle to investment are significantly less likely to invest in training.<sup>35</sup> However, limited availability of staff with the right skills and expected employment increases due to investment tend to be positively associated with training activity.

**Further analysis of firms' training investment suggests that firms with investment in training are more productive (Figure 26 and Figure 27).** However, more productive firms may be more willing to invest in training because they can put the acquired knowledge to better use. Along these lines, we also find more investment in other intangibles is associated with a higher incidence of training.

<sup>34</sup> Results are based on the EIBIS General Module data for all EU countries. The dependent variable is binary, indicating whether a firm invests in training.

<sup>35</sup> Based on the EIBIS General Module data (pooled waves for 2017 and 2018) for all EU countries. The dependent variable is binary indicating whether a firm invests in training. The model includes a measure of financial constraints, controls for investment in other types of intangibles (+), the firm's size (-), exporting activity, the share of state-of-the-art machinery, expected employment increases (+), firms' perception of skills as an investment impediment (+) and country fixed effects. Financially constrained firms are defined as companies dissatisfied with the amount of finance they obtained (received less), firms that sought external finance but did not receive it (rejected) and those which did not seek external finance because they thought borrowing costs would be too high (too expensive) or they would be turned down (discouraged). Access to finance as a major investment obstacle based on EIBIS. As they are based on a simple probit model not controlling for other sources of unobserved firm-level heterogeneity, they should be interpreted cautiously.

**Figure 26**  
**Labour productivity****Figure 27**  
**Total factor productivity**

Source: EIBIS 2017 and 2018.

Note: Based on the EIBIS pooled waves 2017 and 2018.

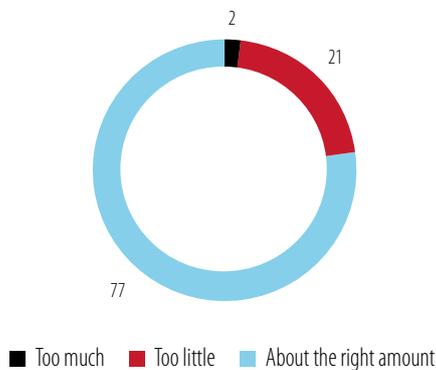
**About one in five firms in the EU report underinvestment in training.**<sup>36</sup> Within the EU, differences in firms reporting underinvestment are rather small across country groups, with the periphery and cohesion groups reporting somewhat lower shares of underinvestment (18% and 19%). Most firms are satisfied overall with the amount they have invested in training. Almost no firm reports having invested too little.

**EU firms seem to react to their own digitalisation efforts and limited availability of digital skills by investing in the digital skills of their workforce.** EU companies with investment in training dedicate about 21% of their budget to improving the digital skills of their staff. Within the EU, firms report similar shares of their training budgets focused on digital competencies.

**On balance, more than 60% of EU firms that expect digitalisation to become more important expect it to increase demand for higher skilled staff.** Changing skill requirements and job tasks due to digitalisation and the (projected) employment shifts that come with it mean challenges for adult learning systems (see Box A). At the same time, they reemphasise the importance of investing in skill formation at an early stage, i.e. in education, providing the basis for learning later in life.

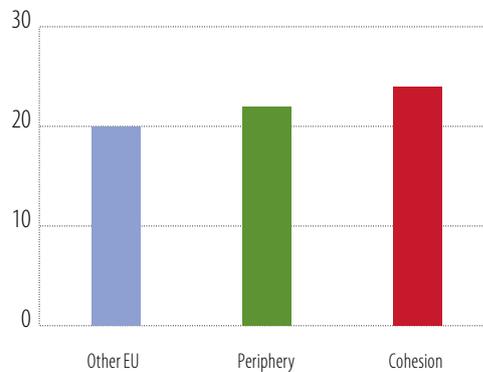
<sup>36</sup> Based on the EIBIS AOM (2018).

**Figure 28**  
EU firms' training investment



Source: EIBIS AOM 2018.  
 Note: Firms' assessment of training investment.  
 Base: All firms.  
 Question: Would you say that your company's investment in training 2017 was too much, too little or about the right amount to meet your business needs?

**Figure 29**  
Firms' training investment for digital skills (%)



Source: EIBIS AOM 2018.  
 Note: Share of training investment with a focus on improving digital skills.  
 Base: All firms investing in training.  
 Question: Could you estimate what proportion was spent on training with the aim of improving the digital skills of your employees (incl. programming and web development, app development, digital design, big data analytics, social media, etc.)?

## Human capital investment: taking a closer look at public spending on education in EU Member States<sup>37</sup>

**Human capital<sup>38</sup> is seen as ever more important for fostering productivity, innovation, economic growth, equality and societal welfare.<sup>39</sup>** Moreover, there could also be a relationship between an economy's stock of skilled workers and its resilience to economic shocks. Better qualifications arguably increase the ability to adjust more quickly to an ever-changing world, thus helping individuals to reduce unemployment risks. Correspondingly, investment in human capital occupies an increasingly prominent place in ongoing policy debates.

**Spending on education is a genuine and decisive investment in the sense that the expected returns are quite high and can materialise over a long period.** This is the basic rationale for (public) spending on education. At the individual level, acquiring skills makes people more productive and thus likely to receive higher wages, i.e. there are private returns to education. At the macro level, a well-educated labour force contributes to economic and productivity growth, advances the innovative capacity of a society and increases economic resilience in times of crisis, which altogether helps to improve the standard of living for the entire population. This is referred to as the social return to education. When social returns to education exceed private returns, market failures and redistribution/equal opportunities concerns are at play and call for public intervention (see, for instance, Poterba, 1996). The economics of education literature emphasises two types of market imperfections: human capital spillovers generally associated with knowledge production and human capital accumulation; and capital market imperfections.

<sup>37</sup> Prepared by Canton Thum-Thysen and Voigt (2018) based on Canton et al. (2018).

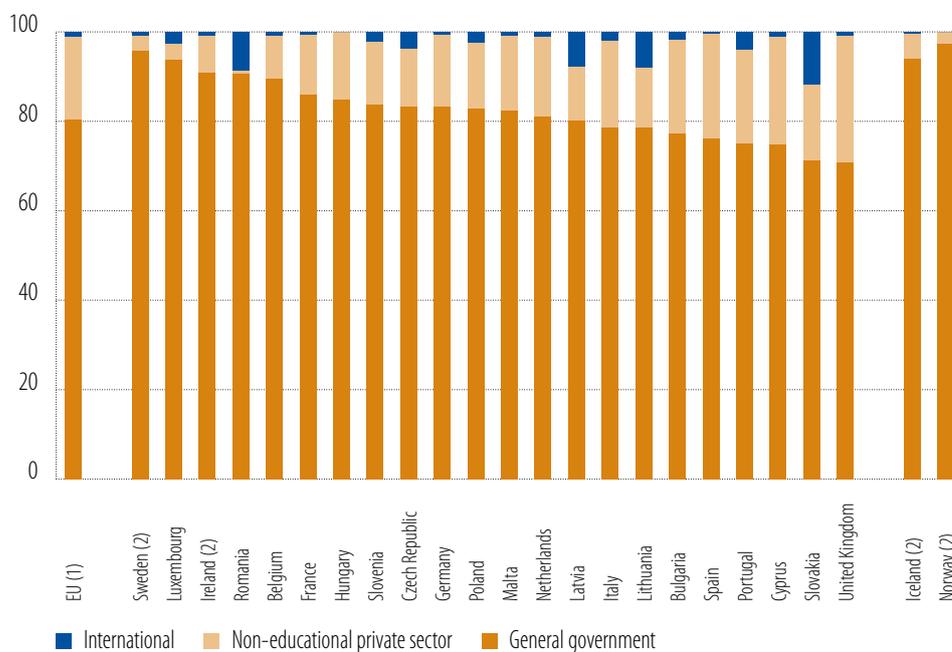
<sup>38</sup> Following OECD (1998), human capital is defined here as «the knowledge, skills, competencies and other attributes embodied in individuals or groups of individuals acquired during their life and used to produce goods, services or ideas in market circumstances».

<sup>39</sup> Bakhshi et al. (2017).

**Another objective of public education is to provide equal access to education as a matter of societal fairness.** Parental resources differ and, even when banks are willing to offer student loans, children from less advantaged families may face other obstacles to going to school or university (see, for instance, Poterba, 1996).

**Public funding is the key source of spending on education in Europe, particularly at the primary and secondary levels (Figure 30).** The situation is more heterogeneous in tertiary education, where private funding – though below 50% on average – plays a bigger role in some Member States (e.g. Hungary, Portugal and the UK). The share of private funding in non-EU countries, however, tends to be significantly higher (e.g. Japan with 65% and the US with 64%).

**Figure 30**  
**Distribution of expenditure on education (excluding early childhood educational development) by sector, 2015** (% of combined public, private and international expenditure on education)



Source: Eurostat (UNESCO–OECD–Eurostat, UOE database).

Note: Subsidies to households and students for other non-educational private entities are excluded. Denmark, Greece, Croatia, Austria, Estonia and Finland: not available.

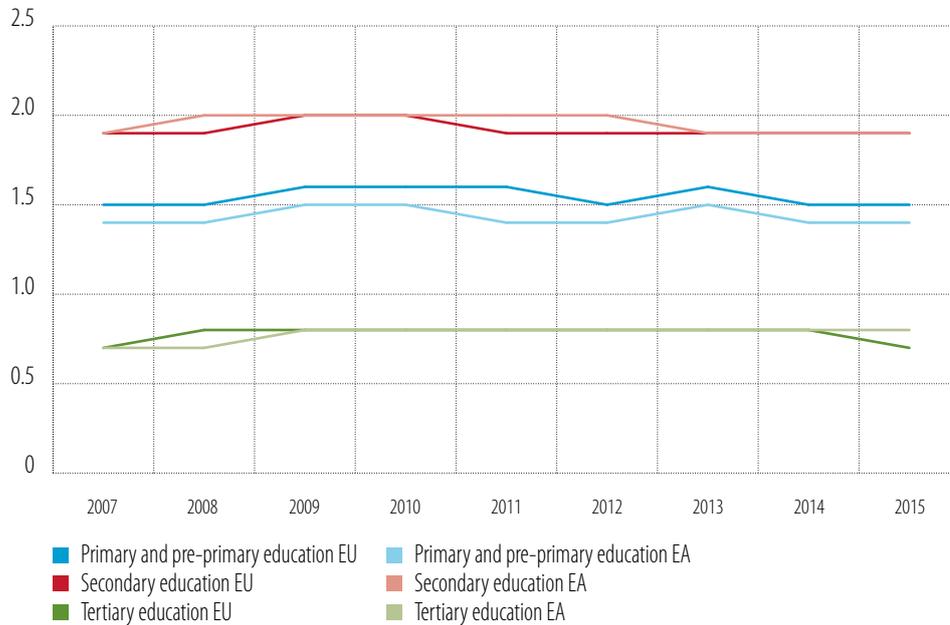
(1) Based on the sum of available data.

(2) Non-educational private sector: 2014 instead of 2015.

**Eurostat figures show that in terms of total expenditure by general government, public spending on education accounts for about 10% in both the euro area and EU28 Member States (on average).** In terms of spending on the various education levels, secondary education is overall the largest spending block, followed by primary and then tertiary education.

**Classifications of the Functions of Government (COFOG) figures show that overall spending on education remained relatively resilient to budget cuts during the years of crisis (Figure 31).** Some EU countries, however – in particular Greece, Ireland, Italy, Portugal, Romania and Spain – experienced temporary declines in education spending that could be attributed to the crisis.

**Figure 31**  
**General government expenditure on education in the EU (2007–15) (as % of GDP)**



Source: Eurostat.

**Currently, 99% of expenditure on education is national, regional or local and only 1% European, notably through the European Social Fund and Erasmus+.** The EU can make a difference in this area by deploying common funding strategically and supporting policy reforms in Member States.

**Public spending on education is not only about the amount of resources allocated to it but also how well they are spent.** The European Commission recently analysed the efficiency of public spending on education in EU Member States (Canton et al., 2018). Their research assesses the efficiency of public spending on the basis of the distance to the estimated optimum – the (education) production frontier – using stochastic frontier analysis (SFA). Three dimensions are considered to measure efficiency: quantity (tertiary educational attainment), quality (PISA scores in the area of science) and inclusiveness (proxied by the inverse of young people not in employment, training or education (NEET rates)).<sup>40</sup> All EU Member States are covered over the period 2002–15.

**The EC analysis shows that in terms of tertiary educational attainment, efficiency of spending differs across Member States but has improved over time.** Inter-temporal efficiency improvements were considerable between 2002 and 2015, while spending remained comparably stable, particularly in Malta and Romania. Cross-country comparisons show that Ireland and Lithuania are setting the frontier based on the ranking of EU best performers in 2015, achieving among the highest tertiary educational attainment rates while spending relatively moderately.

**Results suggest room for improvement in the quality of education (cognitive skills).**<sup>41</sup> The efficiency of public spending in terms of achieving high quality has even declined over time in some Member States. However, a remarkable exception is Portugal, where a significant improvement can be observed. Estonia is an interesting example, as it is close to its own historical best performance and better than other EU Member States.

<sup>40</sup> Arguably, the vulnerability of young people is explained not only by education, but also by factors such as the economic situation, the labour market and other socioeconomic characteristics.

<sup>41</sup> Quality is defined here in terms of Programme for International Student Assessment (PISA) scores. PISA is an OECD project to measure cognitive skills.

**Results also suggest public spending could improve inclusiveness of young people in society and labour markets.** Findings indicate decreasing efficiency in about two-thirds of the Member States, with the exception of Romania, which has drastically improved in this area. Sweden and the Netherlands are also performing relatively well.

**Reinforcing human capital formation in Europe is not necessarily about spending more (public) money on education rather than spending it more efficiently.** In terms of tertiary educational attainment, efficiency of public spending has increased notably over the last ten years. However, empirical analysis also points to significant room for improvement in many countries, especially in terms of “quality” and “inclusion”. It is remarkable that some Member States have managed to achieve high efficiency in all three dimensions assessed, demonstrating that this is feasible and there is not necessarily a trade-off between performing well on “quantity”, “quality” and “inclusion”. In some cases, rethinking national education policies (possibly implying structural reform) appears necessary to attain better performance.

**How to spend smartly and efficiently on human capital is country-specific.** Instrumental in assessing and improving country-specific education policies could be conducting comprehensive sectoral spending reviews on education (proved to be an appropriate instrument to identify and remove inefficiencies and/or achieve savings). Moreover, learning from countries/regions that are seen as appropriate peers – i.e. benchmarking individual solutions against other countries'/regions' best practices – appears to be vital. Closing the gap with the best-performing countries in the EU or euro area should be the ambitious goal.

**To achieve quantity, quality and inclusiveness, and improve efficiency of public spending on education, adult learning should also be considered** – even though the private sector also plays a large role in this area. Digitalisation coupled with rapid technological changes will reinforce the need for adults to learn. The demand for digital technology professionals is growing. Yet, such skills are found to be lacking in Europe at all levels. It is particularly important to ensure that the low-skilled are on a fruitful learning path. In this regard, an initiative by the European Commission termed “Upskilling pathways: New Opportunities for Adults”<sup>42</sup> was adopted by the Council on 19 December 2016. This was a deliverable of the “New Skills Agenda for Europe”,<sup>43</sup> a set of ten actions with the aim of making the right training, the right skills and the right support available within the EU.

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42 See European Commission, Employment, Social Affairs and Inclusion.

43 See *ibid.*

## Conclusion and policy implications

**Strategies to strengthen human capital development in Europe could boost Europe's longer-term growth potential, benefit integration and tackle inequalities.** While crisis repercussions are still being felt, structural changes – global competition, demographic and technological change – are transforming European labour markets and jobs, often requiring new skills. Against this background, upgrading the skills of the European labour force and investing in education are key to reaping the benefits of transformation and minimising the risks.

**Across the EU, firms find the limited availability of staff with the right skills to be an investment impediment.** In this chapter we characterised the firms more directly affected by this obstacle and discussed its drivers and ways to mitigate it.

**Firms' concerns about missing skills as an investment impediment reflect their ambition to grow.** Reporting this impediment less can therefore also point to problems, such as persistent barriers in the business environment that hamper firms' growth prospects. Despite recent improvements, the repercussions of the crisis are still present. Countries and people were affected unevenly, with the young and lower-skilled in particular bearing the costs. This situation raises concerns not only for economic prospects but also for the long-term sustainability of the European social model.

**An environment and a labour market that facilitate firms finding people with the right skills can support a dynamic recovery.** A fluid labour market that facilitates moving from less productive to more productive firms can help to mitigate risks of unemployment and income losses, benefiting employees and overall growth prospects as labour and skills are deployed more efficiently. Policies at European, national and local level can support this by facilitating skills matching, creating possibilities to acquire and upgrade skills, and increasing their visibility and the possibilities for recognition.

**Job-specific skills gaps can be addressed by improving information flows and skills matching, creating possibilities for (re)training, and fostering high-quality learning and cooperation between research and business.** Skills lacked by firms can be due to limits in a (local) supply of potential applicants or information deficits – both on the side of potential applicants and on the side of firms. Primarily local search strategies and barriers that make skills harder to recognise and compare – across jobs, industries and geographic markets – limit more efficient skills matching. Gaps for job-specific skills that can be acquired quickly can be addressed through short periods of (re)training. This can be facilitated through public incentives and support for retraining in bottleneck occupations and a high-quality training infrastructure. Strategies to strengthen job-specific skills that take longer to acquire include fostering a high-quality vocational education with a strong work-based learning component and broadening access to tertiary education. Improving the availability of job-specific skills has an education dimension, as high-quality education not only builds a foundation to further develop specific skill sets but goes beyond this, e.g. by facilitating transition into jobs, and creating jobs that provide conditions for applying and developing skills further. Member States and the EU as a whole already have many such policies in place but there remains room for better evaluation of policy interventions to improve their effectiveness.

**Labour mobility creates economic benefits for the EU and the mobile workforce but does not come without a cost.** A bigger labour market improves the chances for better matching of skills and can create opportunities for people but also increases the concentration of economic activities within countries and within the EU. Mobility between and within Member States is affected by differences in living conditions, wages and labour market conditions. Adverse demographic pressure has typically been less pronounced where conditions were already better to start with. Similarly, while beneficial for the EU as a whole and creating opportunities for individuals, the impact of large-scale emigration on the countries of origin in the Cohesion region is more controversial, and some analyses suggest that it has lowered potential growth (Atoyan et al., 2016).

**With free mobility of workers within Europe, skills challenges cannot be regarded as purely local and national.** Common issues across Europe include strengthening the quality and relevance of education and training, ensuring access to it and creating the possibilities to deploy and develop skills in the workplace. This requires a comprehensive and coordinated approach to skills and consideration of the links between policy areas, e.g. the labour market, social and competition policies.

**Strengthening quality and inclusiveness in education is a common challenge.** Education systems provide the foundation for skills early in life, and increase labour market prospects and chances to develop skills further throughout professional careers. The performance of education systems differs across the EU, with pupils' social background often strongly affecting their chances to succeed. Countering the impact of social disadvantages on education and labour market situations can help people to get into jobs successfully and increase the supply of skilled labour.

**Finally, the fact that firms are reporting missing skills at the moment may be reinforced by the cycle, but the importance for the EU to invest in the skills of its workforce is structural.** Demographic change and ageing will affect Europe in the coming decades and will increase pressure to generate higher productivity gains. Moreover, workforce shrinkage is expected to materialise at a time when global competition will require a more skilled workforce in many industries. This creates the need for education infrastructure, and infrastructure more broadly, to adapt in the light of technological change, labour market demand and societal challenges. Education and training systems need to focus on the quality of outcomes, equipping people with skills that complement technology.

**Technological change is the least predictable factor and will generate the need for adaptation in the years to come.** With digitalisation advancing, polarity between high- and low-skilled workers could be reinforced. A responsive system that provides access to well-calibrated training and education and creates pathways to upgrade skills is central to providing people with the tools they need to benefit from structural transformation rather than getting left behind. Today's policies and actions to strengthen opportunities for skills acquisition will shape the possibilities to benefit from technological change ahead. In the broadest sense, investing in the skills of its people is a European public good. A well-qualified workforce is an asset; underinvesting in it comes at a cost, for firms, individuals and Europe at large.

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## Chapter 8

# The adoption of digital technologies in Europe and the United States

**In the services sector, EU firms lag their US peers in terms of digitalisation activities. Adoption rates in the manufacturing sector are the same on both sides of the Atlantic.** The share of service sector firms that adopted a digital technology is 74% in the EU and 83% in the US. In the manufacturing sector, about 60% of firms adopted a digital technology in the EU and the US.

**Digitalisation is associated with better firm performance.** Digital firms tend to have higher productivity than non-digital firms. When asked about the (causal) effect of having adopted digital technologies, firms report an average boost to sales of about 10%, suggesting that at least part of the performance difference between digital and non-digital firms is due to adoption. Digital firms also report higher investment spending and more innovation activities.

**Barriers to digitalisation that are specific to Europe include an unfavourable firm-size distribution, market fragmentation and a financial system that is largely skewed towards debt finance.** The larger share of small firms in Europe poses a barrier to digital adoption insofar as digital technologies often come with high fixed costs that small firms find difficult to shoulder. Market fragmentation limits firms' ability to scale up their digital activities, and thus reduces their incentive to invest. The heavy dependence of European firms on debt finance adversely affects in particular young firms that want to digitalise, as they often do not have pre-existing relationships with banks or much collateral to access debt finance to fund their digitalisation activities.

**Policymakers need to pay equal attention to measures aimed at facilitating the adoption of digital technologies and the raking in of the corresponding productivity dividends, as well as policy measures that can help manage potential downside risks of further digitalisation.** While the potential gains from digital adoption are large and the risks of missing out on early adoption high, digitalisation also comes with downside risks. We find, for example, evidence that increased automation on the back of digital technologies often leads to a devaluation of "mid-level" jobs/"labour market polarisation". In addition, we find that, while, overall, firms expect digitalisation to lead to more intense competition, there are areas where the opposite is true (with potentially negative effects for consumer welfare, allocative efficiency and innovation activities going forward). Cyber security threats also need to be taken seriously.

## Introduction

**Digitalisation has hit the headlines many times in recent years.** There have been numerous optimistic statements that it will boost growth and productivity. At the same time, many people fear that digitalisation will be a source of disruption, leading to high market concentration and increased unemployment. Some economists have warned that new technologies will destroy jobs, e.g. Frey and Osborne (2017) estimate that 47% of jobs in the US are at high risk of being “automated away” over the next decade or two. In the light of this discussion, Bill Gates called upon governments to tax companies for the use of robots as a way to at least temporarily slow down the spread of automation, and to fund other types of employment.

**Digital technologies are potential drivers of growth and a fourth industrial revolution. So far, however, there is little evidence of a productivity boost.** Innovations such as the steam engine, electricity and automation supported growth in past centuries, resulting in great improvements in living standards. Yet, 30 years after Solow’s (1987) statement “you can see the computer age everywhere but in productivity statistics”, productivity growth is still subdued and, after a further slowdown following the global financial crisis, at a long-term low across most advanced economies; the recent slowdown was particularly pronounced in the EU.

**The fact that digitalisation has not yet caused strong productivity growth has led to discussions around its true impact.** Several working hypotheses have been proposed to explain this: namely, difficulties in measuring the digital economy, the nature of the (associated) innovations, inadequate demand and lack of adoption. According to the first school of thought, the basic problem is that economic measurement has not kept up with today’s digital advancements, in which new goods and services are introduced rapidly (see, for example, Brynjolfsson and McAfee, 2014). However, Byrne et al. (2016) and Syverson (2016) argue that, while real, the mismeasurement of the digital economy cannot explain the productivity slowdown.

The second hypothesis for the sluggish productivity growth (in the light of digital adoption) is that developments in information and communication technology (ICT) simply do not compare with past industrial revolutions in terms of their economic relevance/impact (see, for example, Gordon, 2016). The third hypothesis links the productivity slowdown to the Great Recession. According to this view, many firms do not face enough demand for their products and services to justify new investments in digital technologies, leaving the economy stuck in a low growth/low productivity trap (see, for example, Summers, 2014; Reifschneider et al., 2013).

Related to the third hypothesis, van Ark (2016) argues that only a limited number of firms have organised their whole business around digital technologies so far. Once this introduction phase is over and adoption rates increase, he contends, productivity gains will follow. Andrews et al. (2016) provide some support for this view: they show that the productivity slowdown never affected the globally most advanced firms but (only) the rest. The authors argue that this is due to a slowdown in technology diffusion which, if overcome, will be followed by substantial productivity gains.

**Digitalisation has been linked to concerns of excessive market power and a concentration of big technology companies.** This is because digital technologies often come with features such as scalability, sunkness and synergies, which foster market concentration (Haskel and Westlake, 2017). Indeed, Díez et al. (2018) show a sharp rise in mark-ups<sup>1</sup> in advanced economies and find that this is mostly driven by superstar firms in each sector, the appearance of which they link to digitalisation. From a policy perspective, this matters because, in markets with high concentration, competition tends to be low, deadweight losses high and investments and innovation activities at risk of being reduced.

**Digitalisation is also associated with a decline in labour shares, rising inequality and concerns about privacy rights/cyber-security.** Workers with relevant skills for the digital transformation are reported to do outstandingly well. On the other hand, further technological advancements allow machines to perform tasks that have traditionally been handled by humans. Frey and Osborne (2017) argue that

<sup>1</sup> Mark-up is the ratio of the cost of a good or service to its selling price. It provides a measure of market power.

nearly half of all jobs are at risk of automation. The high demand for highly qualified, technically skilled specialists and low, or negative, demand for poorly qualified employees has fuelled fears of a polarisation of income gains, which, it has been argued, may already be an important driver of rising inequality (see Autor and Dorn, 2013). Furthermore, consumers and companies have become more exposed to digital technologies, and the number of cyber threats has increased rapidly in recent years.

**To help foster an evidence-based debate on the impact of digitalisation, the EIB conducted a survey of 1 700 companies in the manufacturing and services sector in Europe and the US.** We asked firms with at least five employees whether they have heard of, partially or fully implemented one of four technologies in the last few years. This approach allows us to capture adoption rates for very specific technologies and at the same time to assess the impact of digitalisation more generally (see Box A for more details). The survey was administered by telephone in the local language, with most interviews taking place between June and August 2018. Additionally, 20 semi-structured face-to-face interviews were conducted with firms that are digital natives as well as firms that have transformed their business models on the back of new digital possibilities.<sup>2</sup> The idea was to get a more qualitative understanding of digitalisation activities before looking at the survey data. For more details on the survey and accompanying face-to-face interviews see Data Annex.

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**Box A****How we define digitalisation**

For the purposes of this study, we define digitalisation as the adoption of one of four digital technologies in the manufacturing and services sectors. The technologies include “3D-printing”, “advanced robotics”, “Internet of Things (IoT)”, and “big data” in the manufacturing sector, and “digitalisation of internal routines”, “web-based applications for marketing and sales”, “provision of digital products or services over the internet”, and “big data” for the services sector. Table A.1 provides a short description of each technology.

**Table A.1****Definition digital technologies**

Manufacturing sector	Services sector
<p><b>Definition: advanced robotics (also known as advanced manufacturing)</b></p> <p>The development of autonomous robots was the starting point of the initial wave of digitalisation. The main benefit of the first-generation robots was their ability to almost endlessly repeat a specific movement, with great precision. The breakthrough in robotics came with the introduction of more sophisticated sensors combined with data-driven self-learning, which allowed robots not only to operate more independently but to adapt to changing circumstances in their environment, and thus to interoperate with humans.</p>	<p><b>Definition: digitalisation and automation of internal routines</b></p> <p>In the services sector, internal routines such as billing, accounting and logistics management have become increasingly automated with the advent of advanced analytical tools. In industries such as finance and insurance, statistically based decisions on the selection or rejection of customers or the pricing of financial products have gradually come to replace judgement and experience-based analysis of risk.</p>
<p><b>Definition: Internet of Things (IoT)</b></p> <p>The combination of sensors and big data has also been applied outside of robotics. We generally refer to these applications as the “Internet of Things”. This enables communication between machines without interaction with humans. A key contribution to this generation of self-learning machines has been their connection to the internet and to powerful data analysis. A common example is traffic flow information available in a connected car.</p>	<p><b>Definition: web-based applications for marketing and sales</b></p> <p>Web-based applications are software designed to run inside a web browser; typical examples include webmail and online retail sales applications. The technology connects the service provider digitally with its markets, customers and suppliers, thus bringing efficiency benefits by enhancing the firm’s ability to market its services to new geographical areas, sectors and customer types that it could not previously reach.</p>
<p><b>Definition: 3D printing</b></p> <p>Another digital technology in manufacturing is three-dimensional (3D) printing, also known as additive manufacturing. The traditional methods of constructing solid objects have been either to pour a non-solid metal or material into a mould that gives the object its shape, or to machine a solid material into shape with subtractive tools (known as subtractive manufacturing). In contrast, additive manufacturing creates 3D objects from the bottom up in a digital 3D printer, on the basis of a digital drawing under the guidance of a computer. Additive manufacturing has been found to be a cost-effective method for producing prototypes and is also widely used to produce tools used in manufacturing, which are often designed for a specific purpose or in small quantities.</p>	<p><b>Definition: provision of digital products and services over the internet</b></p> <p>The third example of digital technologies in the service sector is the digitalisation of the product/service itself. A well-known example is the sale of music, films, news and even books in digital form. When combined with digitalised and automated platforms for marketing and sales, digitalised products can be replicated, marketed and transported at near-zero marginal cost, again bringing efficiency gains and economies of scale in a number of consumer goods activities.</p>
<p><b>Definition: big data and analytics</b></p> <p>Today manufacturers have multiple resources for data capture and tracking due to sensors and internet-connected devices. Big data is used to help manufacturers predict future events, foresee risks, understand ever more connected value chains, and enhance communication with suppliers and customers. Advanced analytical tools help firms to identify patterns and relationships between different production steps and to improve efficiency. Progress in data analytics allows companies to take previously isolated data sets, aggregate them, and analyse them to reveal important insights.</p>	<p><b>Definition: big data and analytics</b></p> <p>In the services sector, big data and analytics are often used to customise services and products. These include financial products tailor-made on the basis of the customer’s risk profile and revealed preferences, and health services on the basis of a patient’s medical history and wider empirical evidence. Big data and analytics have also been used in the online retail industry to generate tailored marketing based on intelligence collected from customers’ purchasing and search patterns.</p>

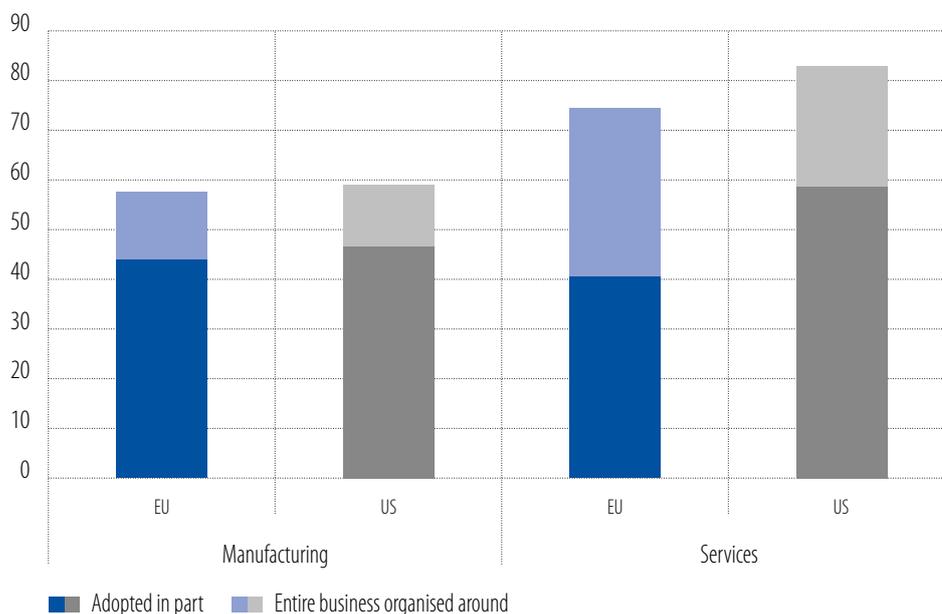
**The chapter contains four sections.** First, we look at where European firms stand in terms of digitalisation when compared with their US peers and at the impact of digital adoption on firm performance. In the second section, we elaborate on what survey data and semi-structural interviews suggest are key motivators for firms when it comes to the adoption of digital technologies. We also look at perceived investment gaps and firms' investment outlook when it comes to digitalisation activities. In the third section we investigate barriers to digital adoption. The fourth section elaborates on inadequate finance as a barrier to investment in digital technologies. The last section concludes with a discussion of the wider impact that firms expect to flow from more digitalisation activities in their market.

## Digitalisation – status quo

### Where Europe stands in terms of digitalisation

**Digital adoption rates in the EU service sector are below those in the US. Adoption rates in manufacturing are similar.** As shown in Figure 1, 74% of service sector firms in the EU and 83% in the US say that they have adopted at least one digital technology to date. In manufacturing, the corresponding shares are 58% and 59%, respectively.

**Figure 1**  
Share of firms that have adopted at least one digital technology (in %)



Source: *EIBIS Digital and Skills Survey 2018.*

Base: *All firms.*

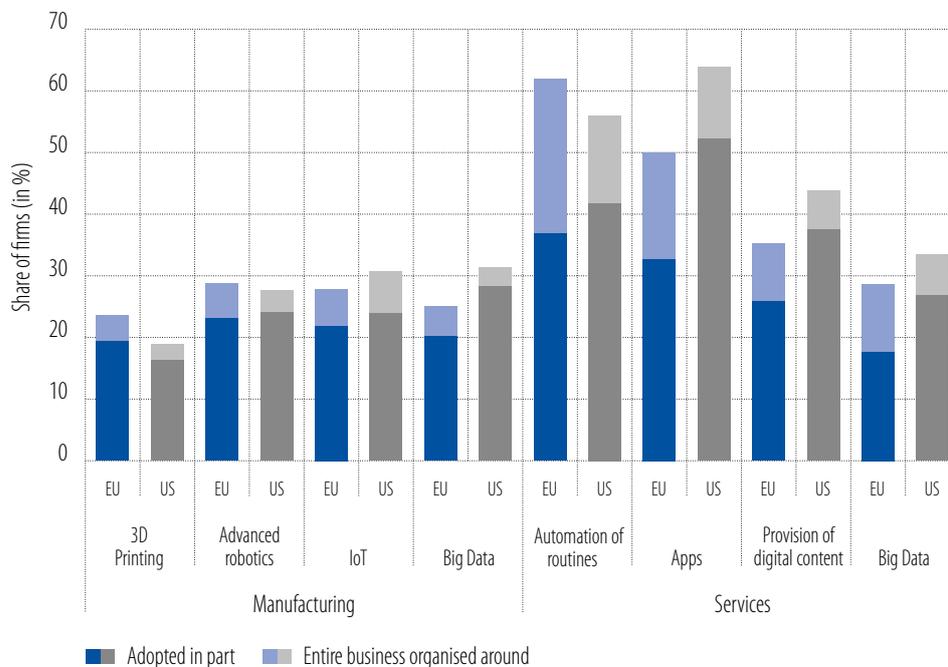
Question: *Can you tell me for each of the following digital technologies if you have heard about them, not heard about them, implemented them in parts of your business, or whether your entire business is organised around them?*

Note: *"Partially" are firms that have implemented at least one of four technologies in parts in recent years and "fully" firms that have organised their business around one of the four technologies.*

**EU service sector firms show lower adoption rates for “web-based applications for marketing and sales” and technologies related to the “provision of digital content over the internet”.** A detailed comparison of adoption rates by specific technologies suggests that in the services sector European firms lag their US peers, particularly when it comes to the use of apps through which customers can order goods and services over the internet (i.e. “web-based applications for marketing and sales”) as well as technologies that allow the “provision of digital products and services over the internet” (such as online streaming platforms), whereas European firms are slightly more likely to have adopted digital technologies related to the “automation of routines” than their US peers.

In the manufacturing sector, differences between the EU and US are less pronounced, with the exception that EU firms appear slightly ahead in the use of 3D printing, whereas the US has a higher adoption rate for big data and analytics (Figure 2).

**Figure 2**  
**Adoption rates by types of technologies**



Source: EIBIS Digital and Skills Survey 2018.

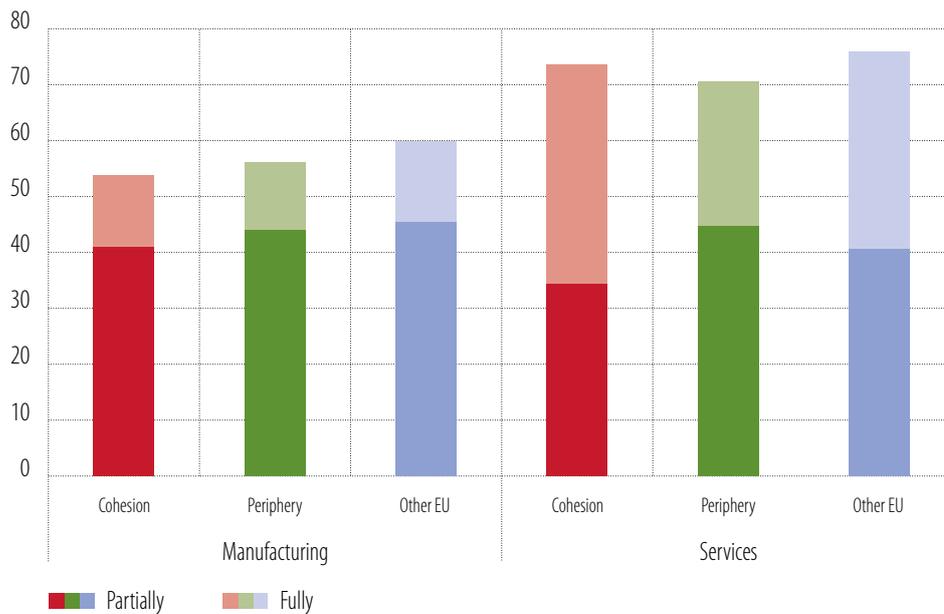
Base: All firms.

Question: Can you tell me for each of the following digital technologies if you have heard about them, not heard about them, implemented them in parts of your business, or whether your entire business is organised around them?

Note: “Partially” are firms that have implemented at least one of four technologies in parts in recent years and “fully” firms that have organised their business around one of the four technologies.

**Within-EU adoption rates are similar.** In the manufacturing sector, 54% of firms in the cohesion region, 56% of firms in the periphery region and 60% of firms in the other EU countries report having implemented at least one digital technology. In the services sector, the corresponding shares are 74%, 71% and 76%, respectively.

**Figure 3**  
Share of firms that have adopted at least one digital technology (in %)



Source: EIBIS Digital and Skills Survey 2018.

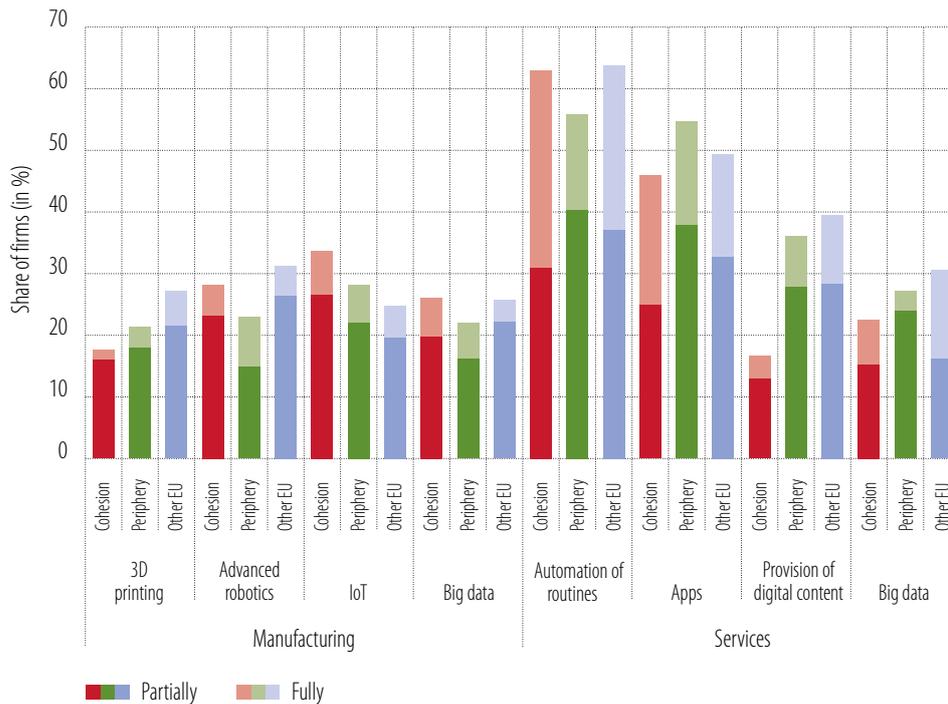
Base: All firms.

Question: Can you tell me for each of the following digital technologies if you have heard about them, not heard about them, implemented them in parts of your business, or whether your entire business is organised around them?

Note: "Partially" are firms that have implemented at least one of four technologies in parts in recent years and "fully" firms that have organised their business around one of the four technologies.

Even if we look at specific digital technologies, we find little variation across the three regions. One exception to this is the cohesion region, which lags notably in the adoption of “web-based applications for marketing and sales” and technologies related to the “provision of digital products and services over the internet”.

**Figure 4**  
Adoption rates by types of technologies, within-EU comparison



Source: EIBIS Digital and Skills Survey 2018.

Base: All firms.

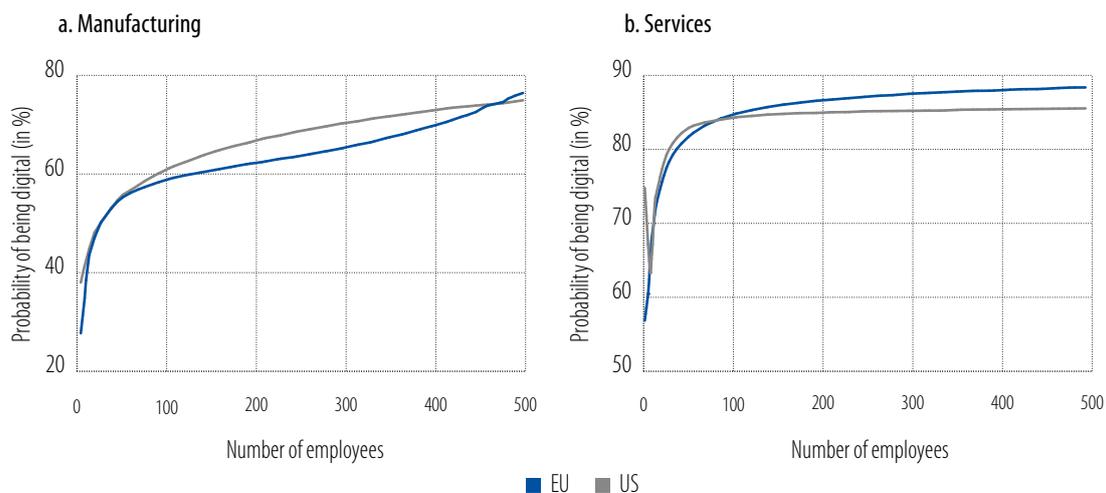
Question: Can you tell me for each of the following digital technologies if you have heard about them, not heard about them, implemented them in parts of your business, or whether your entire business is organised around them?

Note: “Partially” are firms that have implemented at least one of four technologies in parts in recent years and “fully” firms that have organised their business around one of the four technologies.

## Who adopts digital technologies?

Larger firms are more likely to have adopted at least one digital technology than smaller ones. That is, both in the US and in the EU, adoption rates increase with firm size. The “size effect” is particularly pronounced at smaller firm sizes. Panels a and b of Figure 5 plot the relationship between firm size and adoption rates and show that there is a marked increase in adoption as firms pass the 50-employee threshold.

**Figure 5**  
Firm size in EU and US by sector



Source: EIBIS Digital and Skills Survey 2018.

Base: All firms.

Question: How many people does your company employ full- and part-time at all its locations?

Note: Digital firms are those that have implemented at least one of the digital technologies in part or organised their business around at least one digital technology.

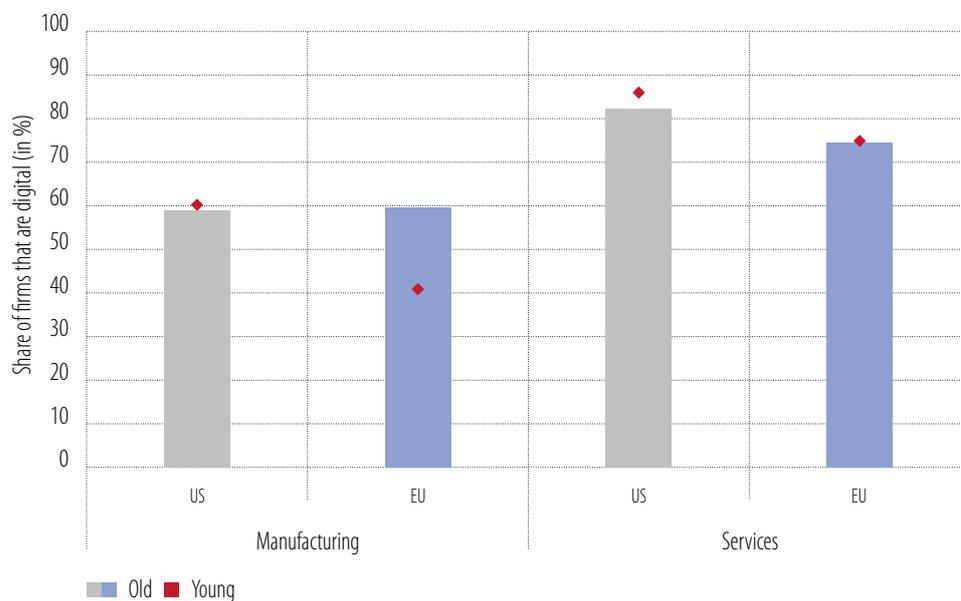
**The size threshold for digital adoption is lower in the services sector.** The main difference between the services and manufacturing sectors is that adoption rates in the former tend to be higher at all levels (by about 30 percentage points). In addition, while adoption rates continue to increase beyond firms with more than 100 employees in the manufacturing sector, they flatten out after this point in the services sector.

The greater importance of size for digitalisation activities in manufacturing can be explained by the fact that investments in digital technologies in this sector entail – more often than in services – high fixed costs which are easier to bear if they can be spread over larger revenue streams. Investment amounts in advanced robotics and even IoT technologies are often very large and, thus, difficult for small firms to raise. Those in new apps or online streaming capabilities, on the other hand, tend to be smaller. Indeed, we find that adoption rates among small firms are lowest for advanced robotics and highest for the adoption of web-based applications.

**Young firms are more prominent adopters in the services sector than in manufacturing.** The lower size threshold for digital adoption in the services sector is reflected in higher adoption rates among young firms. We find that, in both the EU and the US, young firms in the services sector are more likely to have adopted a digital technology than those in the manufacturing sector. In fact, adoption rates for digital technologies are higher among young service sector firms than old ones on both sides of the Atlantic, albeit only very slightly in Europe (Figure 6).

**“Born digital” firms contribute to the high adoption rates of young service sector firms.** These are firms that are digital from day one, with a business model that is centred around one or more digital technologies. They tend to receive a lot of attention in the literature as they often come with high growth potential. According to our data, 80% of born digitals are service sector firms; 20% are manufacturing firms.<sup>3</sup>

**Figure 6**  
**Adoption rate by firm age**



Source: *EIBIS Digital and Skills Survey 2018.*

Base: *All firms.*

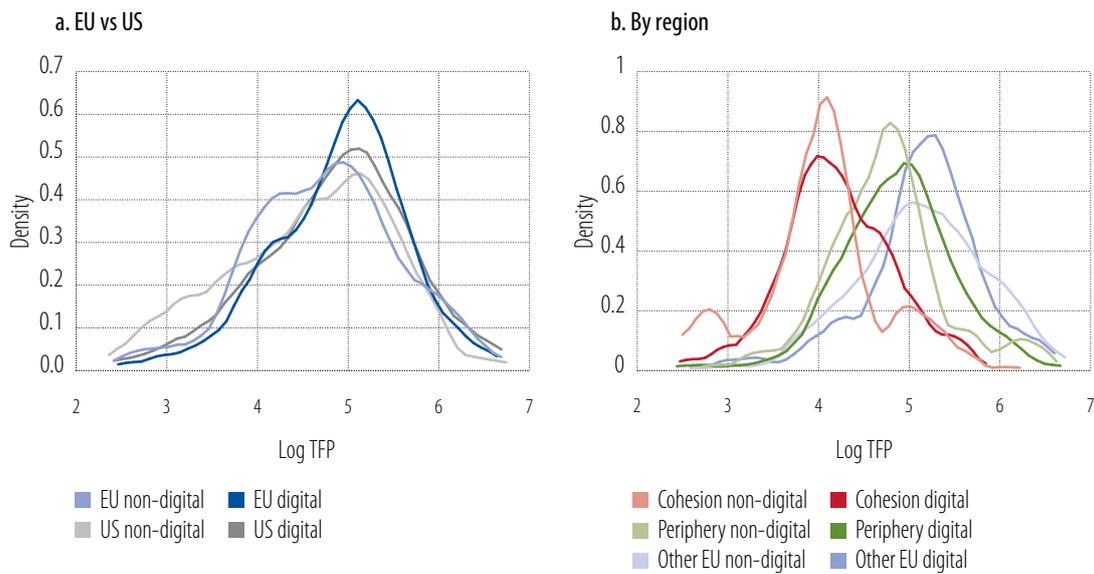
Note: *Old firms are older than 10 years, young firms are younger than 10 years*

<sup>3</sup> It is important to bear in mind that – due to the size cut-off at five employees – our data set can only provide an approximate picture of “born digitals”.

## Digitalisation and firm performance

**Digital firms have higher productivity than non-digital firms.** Figure 7 shows the productivity distribution of digital and non-digital firms in the EU and the US. In both the EU and the US, digital firms tend to have higher productivity than their non-digital peers, with the difference in means being statistically significant.<sup>4</sup> Also across the three EU regions, we find that digital firms tend to perform better than non-digital ones.

**Figure 7**  
**Total factor productivity of digital versus non-digital firms**



Source: *EIBIS Digital and Skills Survey 2018*.

Base: *All firms*.

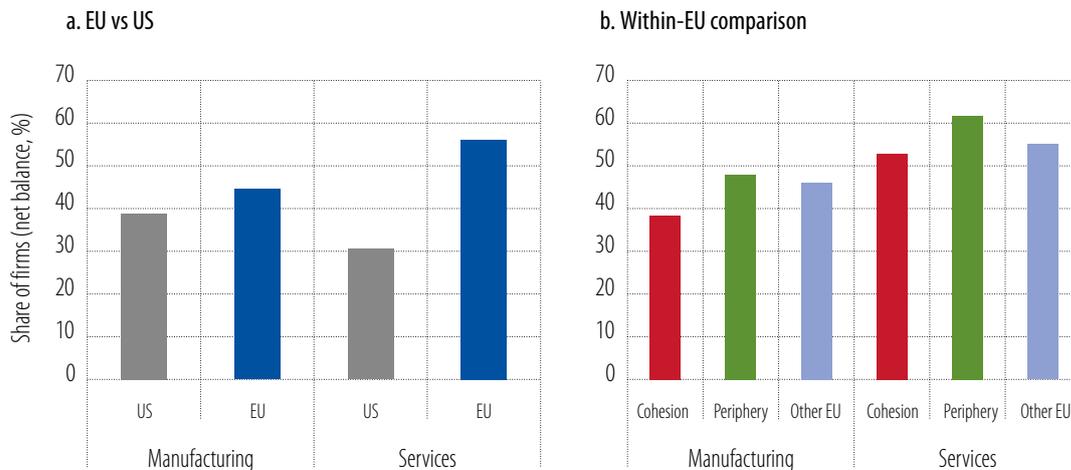
Note: *Total factor productivity is based on sector by sector ordinary least squares (OLS) regressions of value added on number of hours worked and firms' total fixed assets plus country fixed effects. Distribution plots are weighted.*

<sup>4</sup> All the following results hold if we use labour productivity instead of total factor productivity.

**At least part of the difference in performance is “causal”.** When asked about what impact the adoption of digital technologies had had on their sales levels (compared with a situation in which firms had not digitalised), firms generally reported a positive effect of digitalisation: specifically, more than 50% of EU firms and 36% of US firms said that their net sales levels would have been lower had they not adopted a digital technology (Figure 8).

The average boost that firms attribute to the adoption of digital technologies, when asked about the exact impact, is 10% both in the EU and the US.

**Figure 8**  
Perceived effect of digitalisation on sales



Source: EIBIS Digital and Skills Survey 2018.

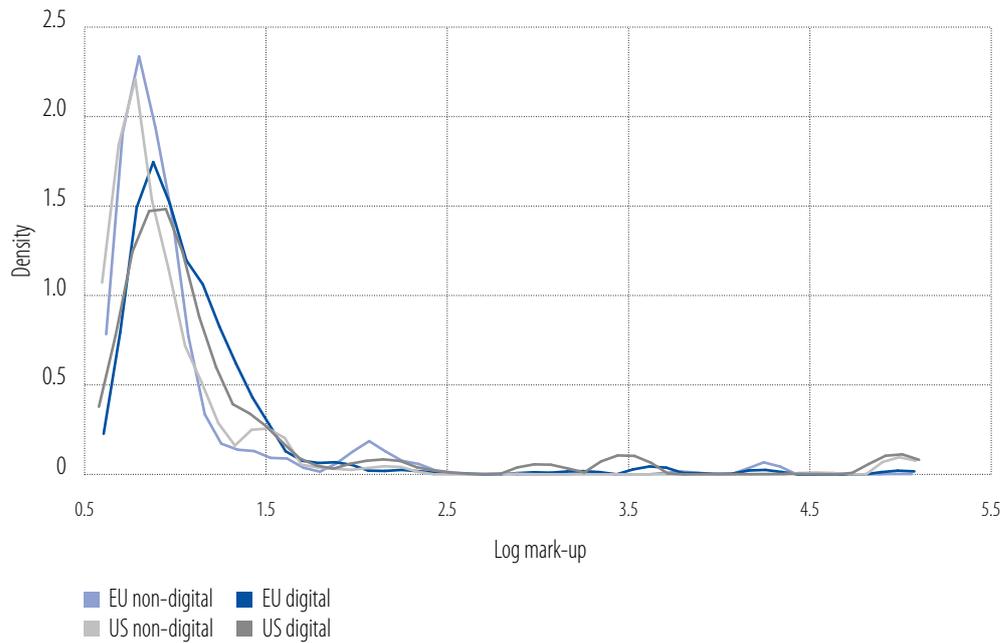
Base: All firms that have implemented digital technologies at least partially.

Questions: If you hadn't invested in digital technologies, to what extent do you believe your sales level today would have been affected? Would sales have been higher, lower, similar?

Note: Net balance shows the difference between firms expecting higher sales level and those expecting lower sales level.

**Digital firms charge higher mark-ups.** While most firms tend to agree that digital technologies lead to more competition (we will return to this point later), those adopting digital technologies are often in a relatively privileged market situation, with above-average mark-ups (Figure 9). This is in line with the literature showing that the adoption of digital technologies often comes with (i) network effects, both direct and indirect, (ii) economies of scope in data collection and analysis, and, due to this data, (iii) high and increasing levels of price and product differentiation which lead to “winner-takes-all” tendencies (see Calligaris et al., 2018).

**Figure 9**  
**Estimated mark-ups by digitalisation status**



Source: *EIBIS Digital and Skills Survey 2018.*

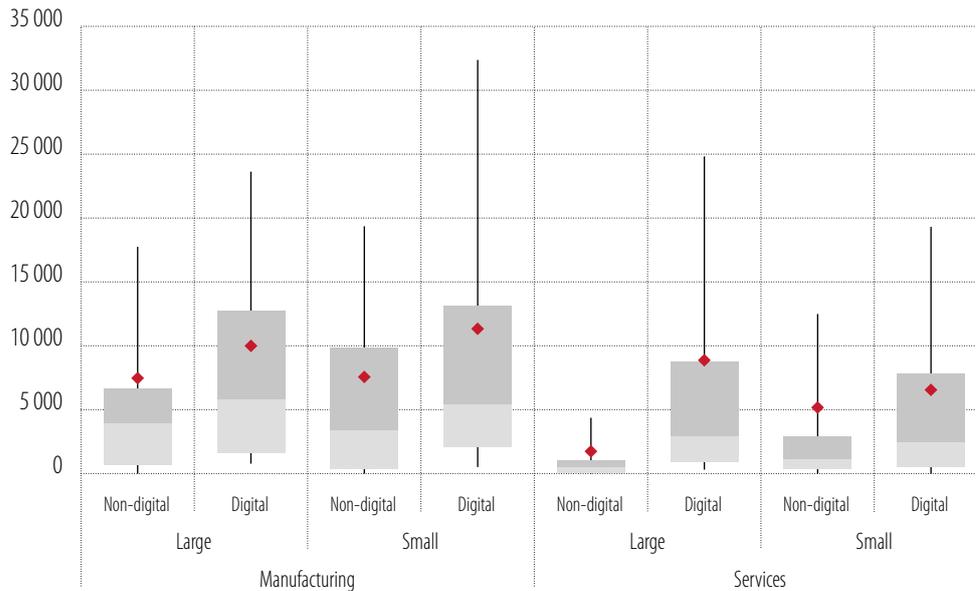
Base: *All firms.*

Note: *Mark-up calculations are based on the approach of de Loecker and Eeckhout (2017). Distribution plot is weighted.*

**Digital firms invest more.** If we compare the distribution of investment intensity (defined as investment spending per employee) for firms that have adopted at least one digital technology and those that have not, we consistently find a higher investment intensity among digital firms than non-digital ones. This is true even if we zoom into sector and size classes. This result is explained by the higher productivity of digital firms and the greater demand for their goods and services that comes on the back of this.<sup>5</sup>

**Figure 10**

**Investment intensity** (investment spend per employee)



Source: *EIBIS Digital and Skills Survey 2018.*

Base: *All firms.*

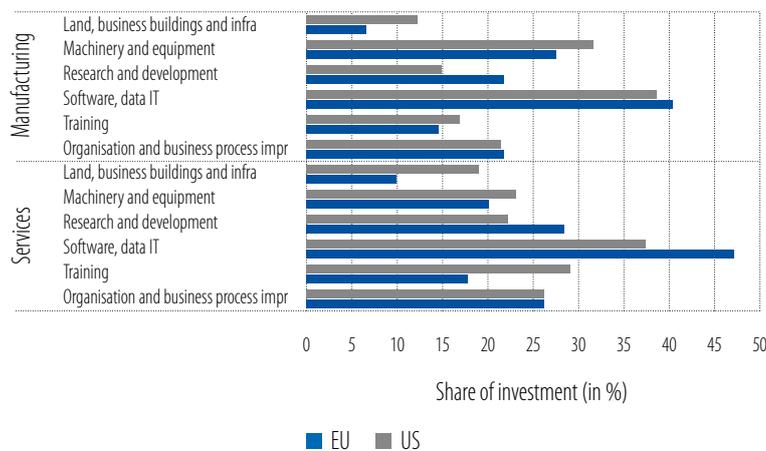
Questions: *What was the value of the business's total fixed assets? How many people does your company employ full- and part-time at all its locations?*

Note: *Investment intensity is defined as investment spending per employee. Wage figures are PPP adjusted.*

<sup>5</sup> In addition, some intangibles – software and R&D – have higher depreciation rates than tangible assets such as buildings. The higher the depreciation, the higher the investment rate to keep the capital stock at a given level.

**Digitalisation triggers investment activities across all asset types.** Digital firms estimate that about one-third of their investment spend on machinery and equipment in the previous financial year is directly related to the implementation of digital technologies. In the area of “Land, business buildings and infrastructure” this share is smaller, but still notable at 10%. When it comes to investments in intangible assets, firms estimate that between 20% and 25% of their investment activities are directly linked to their digitalisation process. For investments in “Software, data, IT networks and website activities”, digitalisation is at the core of about half of all investment (Figure 11).

**Figure 11**  
**Digital content of investment**



Source: EIBIS Digital and Skills Survey 2018.

Base: All firms.

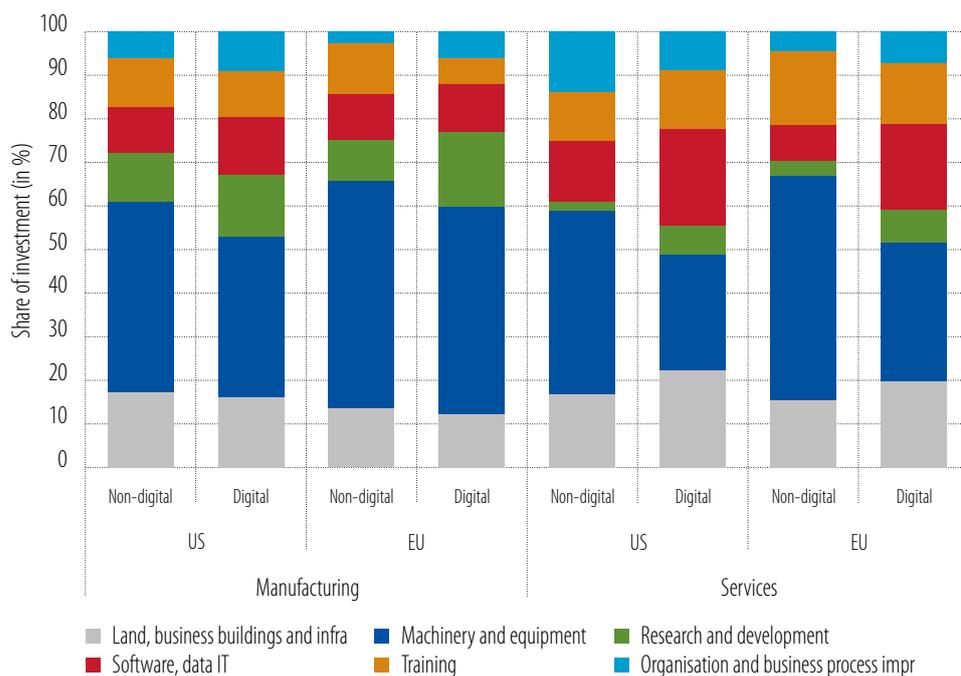
Question: What proportion of investment was related to implementing digital technologies?

**Digital firms tend to invest more in intangible assets.** In terms of firms' investment mix, we find that digital firms tend to allocate a larger share of their investment activities to R&D, software, data, IT infrastructure and website activities and less towards machinery and equipment. The stronger focus on intangibles is particularly pronounced in the services sector (Figure 12).

Our qualitative interviews give some insight into the difference between manufacturing and services. They make clear that digitalisation in the services sector entails doing things in radically different ways or doing completely new things more often than in manufacturing. One example of such a radical change is a publishing house that moves from a world in which it has produced thousands of hard-copies of a magazine a day to one that is dominated by purely online content. Clearly, the investment pattern for this company changes as part of this transformation.

In the manufacturing sector, on the other hand, digitalisation is often more incremental. Take a firm that moves from a system in which it employs industrial robots to one with "advanced robotics". The difference is that the new robots will be smart(er) and able to solve more complex problems and even learn new tasks. While the effect of this can be considerable for firms' performance, the effect on the composition of their investment activities is likely to be small. This is because a large part of investment in "advanced robotics" remains tangible (e.g. machinery and equipment).

**Figure 12**  
**Investment patterns of digital versus not digital firms**



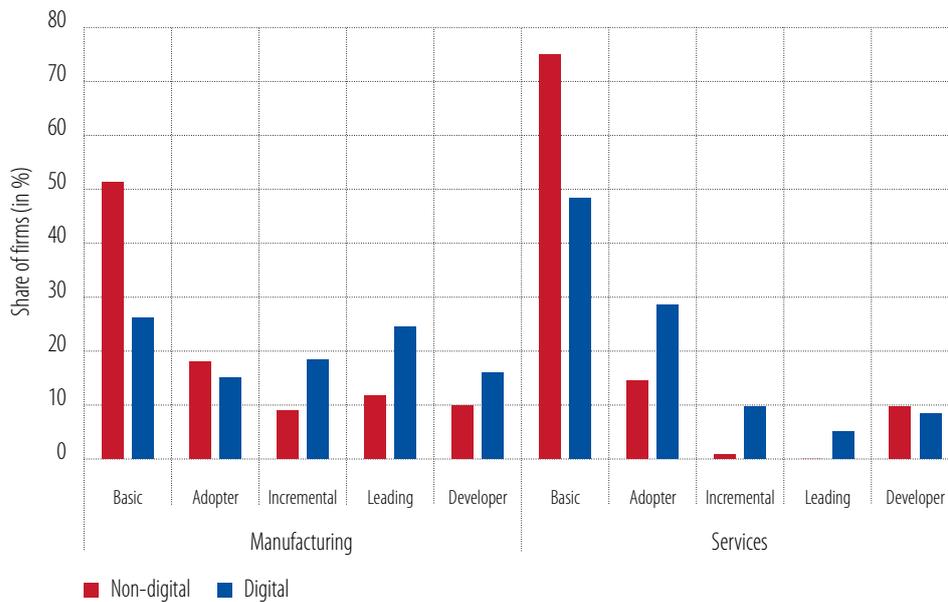
Source: EIBIS Digital and Skills Survey 2018.

Base: All firms.

Question: How much did your business invest in each of the following with the intention of maintaining or increasing your company's future earnings?

**Digital firms are also more active innovators.** If we distinguish between the five innovation profiles introduced in Chapter 3 – basic innovators, adopters, incremental innovators, leading innovators, and developers – we find that digitalised firms are significantly less likely to fall into the “basic” category than non-digitalised ones. In the manufacturing sector, digitalised firms often fall into the “incremental” and “leading” categories; in the services sector it is the “adopter” and “incremental innovator” categories. The differences in innovation patterns (between digital and non-digital firms) persist even if we control for other characteristics.

**Figure 13**  
**Innovation profile of digital versus non-digital firms**



Source: *EIBIS Digital and Skills Survey 2018.*

Base: *All firms.*

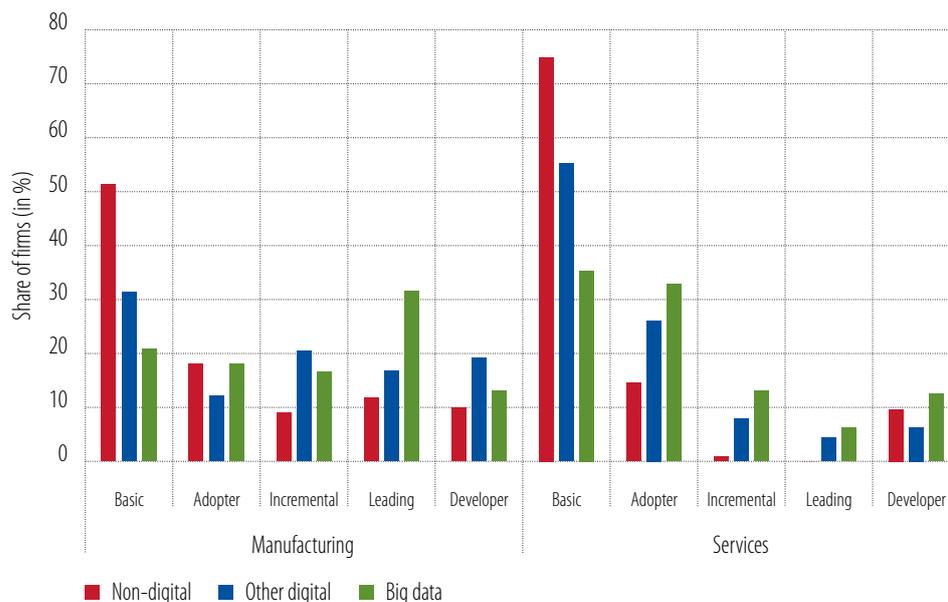
Note: *Innovation profiles are defined as in Chapter 3 and based on the questions: Did your company develop or introduce new products, processes or services? Were the products, processes or services new to the company, the country, the global market? Basic innovators: firms with no substantial R&D activities and no new products, processes or services; Adopters: firms with no substantial R&D activities but that developed new products, processes or services that are new to the company, country or globally new; Incremental innovators: firms with substantial R&D activities that developed products, processes or services that are new to the company; Leading innovators: firms with substantial R&D activities that developed products, processes or services that are new to the country or the world; and Developers: firms with substantial R&D activities but no new products, processes or services (yet).*

**An important explanation for the higher innovation performance is “big data”.** Many digital technologies relate intrinsically to “big data”. To make the most of these technologies, firms have to collect and analyse large amounts of information, whether this be on machine performance, customer shopping patterns or administrative data. Only on the basis of this information can they make their products/services and delivery modes smarter.

But “big data” is not only important for these pre-defined uses; it can also serve as an input into firms’ innovation process more generally. For example: one firm we interviewed built IoT applications for car equipment. Their principal aim was initially to receive performance feedback for these parts (in order to improve them over time). At one point, the firm realised that the information it received allowed it to make inferences about driving patterns. This gave rise to the idea of developing new, tailored insurance solutions that reflect how people drive. In this way, new data led to the birth of a new business idea (innovation).

Indeed, if we compare innovation patterns for firms that did not adopt a digital technology, those that adopted at least one digital technology, but without explicitly analysing the data that comes with it, and those that do exploit big data, we find that the higher innovation performance of digital firms (shown above) is driven to a large extent by the third group, providing further support to the idea that big data can act as a new input into the innovation process (Figure 14).

**Figure 14**  
**Big data and innovation**



Source: EIBIS Digital and Skills Survey 2018.

Base: All firms.

Note: Innovation profiles are defined as in Chapter 3 and based on the questions: Did your company develop or introduce new products, processes or services? Were the products, processes or services new to the company, the country, the global market? Basic innovators: firms with no substantial R&D activities and no new products, processes or services; Adopters: firms with no substantial R&D activities but that developed new products, processes or services that are new to the company, country or globally new; Incremental innovators: firms with substantial R&D activities that developed products, processes or services that are new to the company; Leading innovators: firms with substantial R&D activities that developed products, processes or services that are new to the country or the world; and Developers: firms with substantial R&D activities but no new products, processes or services (yet). "Other digital" are firms that implemented one of the digital technologies except "big data".

### Box B Big Data

Big data refers to the collection and analysis of data on a scale or of a complexity that makes the use challenging. Big data has specific characteristics and properties that lead to both challenges and opportunities. Most characteristics are around the five "V"s: volume, velocity, variety, veracity and value. Volume is probably the best-known characteristic of big data: the amount of data produced worldwide is doubling every two years and is expected to grow from 4.4 zettabytes (4.4 followed by 21 zeros) in 2013 to 44 zettabytes in 2020 (EPRS, 2016). Velocity refers to the speed at which data are generated, created, refreshed and analysed, which is nearly in real time today. The data sets are heterogeneous, coming from different sources in a large "variety" of forms, most being unstructured or semi-structured. Some definitions focus on the need of data to be trustworthy ("veracity"), i.e. the data source needs to be reliable. All these characteristics are necessary to turn big data into "value".

The use of big data requires new methodologies for storage, algorithms and statistical methods to analyse the data. The primary value from big data comes from processing, analysing and the insights that emerge from the analysis. As the volume of data is large, it cannot be processed using standard techniques. High-performance computers and cloud computing help to analyse big data and turn it into value.

Big data has huge potential economic value, as a driver of productivity and profitability and as a way of offering customised products and services to consumers. Companies reported that they use big data mainly to reduce costs, making manufacturing and processes smarter. But, in contrast to the other technologies mentioned in the survey, companies use big data to improve their services (17.8% of manufacturing firms and 24.0% of service sector firms in the EU), e.g. by analysing data on the searches and clicks of users, companies can improve the quality of services and thus increase profits. In addition, big data is used to better target customers and provide them with individualised advertising (21% of US manufacturing companies and 26.0% service sector firms use big data for marketing purposes).

### Characteristics

Personal versus non-personal data: data can be either personal, e.g. information about a consumer's preferences or geographical location, or it can be non-personal, e.g. data generated from sensors in a production process. So far, the discussion and regulation has centred around the former. Personal data are subject to special protection rules, which limit the gathering, processing and use of such data to ensure individuals' privacy. On the other hand, many data are gathered from sensors, which make continuous measurement possible not only during the production process but also during product use. For example, a car producer may collect detailed data on the car driving performance.

Non-rivalrous and (non-)exclusive: data are non-rivalrous goods because someone using a data set does not prevent others from using the same data, provided that they have access. Whether data are exclusive or not is currently being debated in the academic literature. Some (e.g. Sokol and Comerford, 2016) argue that data are non-exclusive as they are easy to collect, inexpensive and ubiquitous. Others argue that no data sets are similar, and firms have technical means to keep their data private, making it an exclusive good.

The next wave of digitalisation will come with artificial intelligence. In this context, the access to algorithms is less of an issue than access to the huge amount of data used to train them. The latter then becomes a crucial element in developing self-learning machines. A poor algorithm if trained may be better than a good algorithm. Thus, access to big data might become a competitive advantage. As online platforms enjoy a favourable position when it comes to the possession of data, the risk of market concentration might arise, which in turn might call for government intervention.

In recent years, big tech companies have grown exponentially, dominating the top ten largest firms in terms of market capitalisation (see Chapter 3 for their impact on innovation). These companies have high profit margins and high mark-ups and it is very difficult for non-incumbents to compete with them. One question is thus whether these tech giants are in monopoly positions, able to abuse their market power.

In order to assess this question, regulators have to assess whether other companies really can compete and enter the market. Many tech companies benefit from network effects. The utility of a single customer increases with the number of other users. The more customers that use Google's search engine, the more the algorithm can be adjusted to better respond to clients' needs. Furthermore, customers do not need to pay for using most of these online services, as money is made through advertising. And the more customers use the search engine, the more attractive it is for firms to launch their advertising there. Thus, it is very difficult for other companies to compete in online advertising with Google.

Regulating these tech companies is proving difficult, as network effects bring advantages as well as disadvantages for consumers. Customers are just one side of these platform markets: although they do not pay for use, it is clear that the service provider needs to make money from advertising. Regulators thus need to assess whether, on the other side of the platform, market power is not becoming too concentrated.

For many innovations in the digital services sector, advertising is a very important source of revenue and funding. As summarised by Wambach and Müller (2018), if ever more advertisers give their money to Facebook and Google, the more complicated it will be for small start-ups to grow independently of big corporates. What is more, tech giants are dominating the market for venture capital. If big tech companies can decide which start-ups will receive support to grow, then they might make use of their dominant position and strengthen their market power.

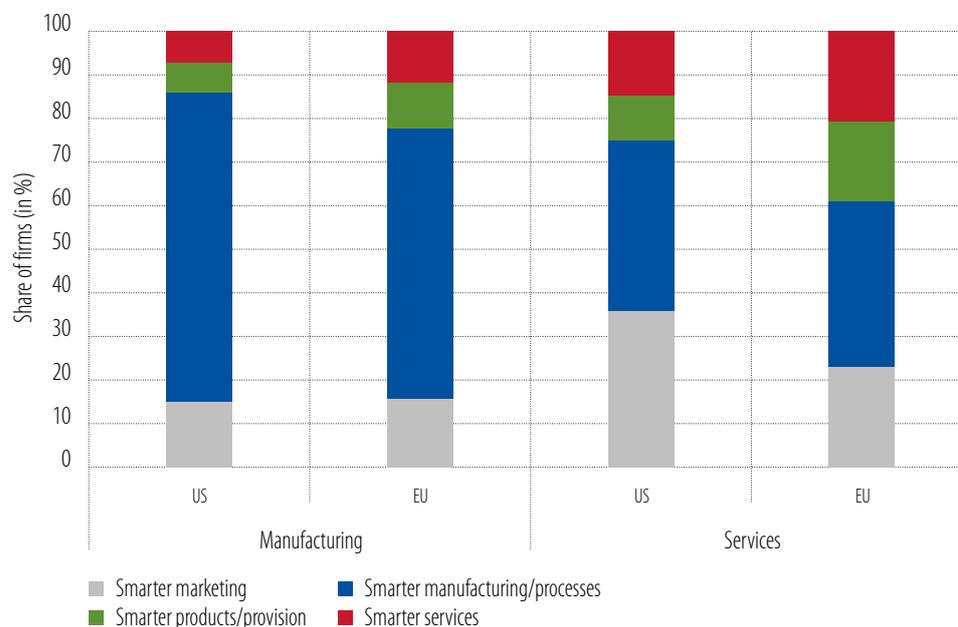
The European Commission proposed an EU regulation on fairness and transparency in online platform trading in April 2018, and launched a pilot project that aims to provide an in-depth policy-relevant study of the role of algorithms in the digital economy, in particular how they filter or personalise the information flows. Together with the General Data Protection Regulation (GDPR), which entered into force in May 2018, these are notable steps in the right direction to ensure access to online activities for individuals and businesses under conditions of fair competition as well as consumer and data protection.

## Motivation, perceived gaps and investment plans

### Motivation

**Digitalisation efforts are primarily efficiency-driven, particularly in manufacturing.** More than 60% of firms in the manufacturing sector responded that the main reason for investing in digital technology was to improve the productivity, quality and flexibility of their production processes (which we label as “smarter manufacturing”). Between 5% and 15% of firms say that digitalisation aims to improve marketing efforts (“smarter marketing”), link products with diagnostic enhancing technology (“smarter products”) or provide a stronger product-service bundle (“smarter services”).

**Figure 15**  
Main motivation for adoption of digital technologies



Source: EIBIS Digital and Skills Survey 2018.

Base: All firms that have implemented digital technologies.

Question: Which of the following was your company's main motivation to use digital technologies?

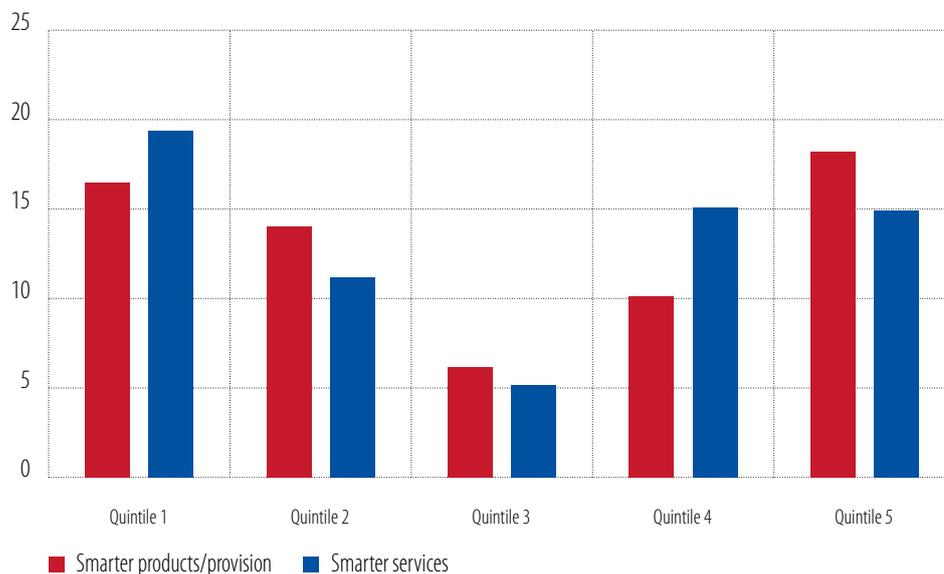
**Firms in the EU more often focus their digitalisation activities on developing “smarter products/services” and ways to deliver them in a smart way.** That is, within both the manufacturing and service sectors, we find that these motives play a more important role in the EU than in the US. In the manufacturing sector, they come at the expense of “smarter manufacturing”; in the services sector they come primarily at the expense of “smarter marketing” (Figure 15). The differences in motivation hold even within individual technologies.

**There is no linear relationship between the motivation to adopt digital technologies and the depth of digitalisation.** If we look at the motives for adopting digital technologies of firms in different productivity classes as a proxy for how advanced they are in their digitalisation effort, we find no linear pattern. That is, often the same motives apply to both advanced firms and firms at the beginning of their digitalisation process (Figure 16).

Our qualitative interviews provide an illustrative example: we interviewed two manufacturers for whom the main aim of their digitalisation effort was to provide their clients with a completely new product-service bundle. In the first case, this meant that the company fitted its products with sensors that fed back performance data to the manufacturer, which allowed it to offer tailor-made service solutions to its client.

In the second case, the company pursued the same goal by placing a simple quick response (QR) code on the product. This allowed consumers to connect to a website with detailed information on additional services related to the product they had purchased. What this shows is that while pursuing a new product-service bundle can be associated with a fairly advanced degree of digitalisation (as in the first case), the same motive can also reflect a more basic approach to digitalisation (as in the second case).

**Figure 16**  
Motivation for adoption by productivity performance (% of firms)



Source: *EBIS Digital and Skills Survey 2018.*

Base: *All firms that have implemented digital technologies.*

Question: *Which of the following was your company's main motivation to use digital technologies?*

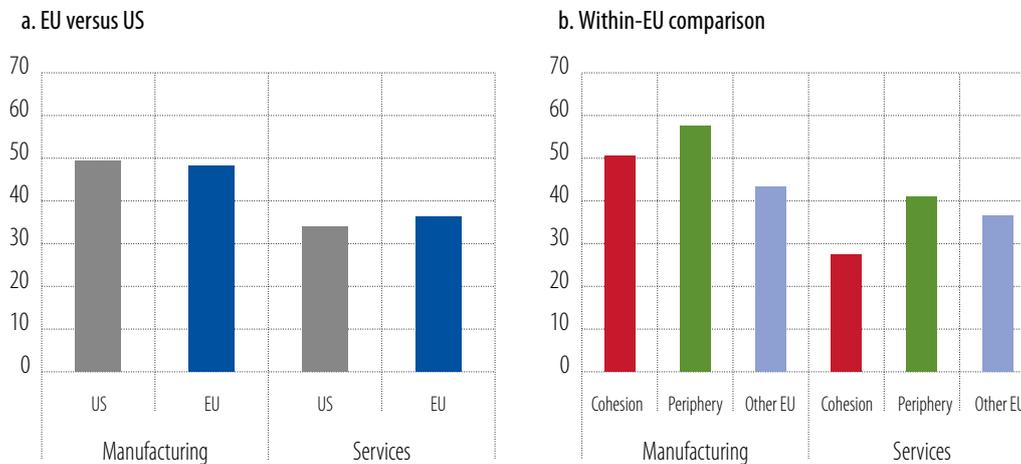
Note: *Quintiles are based on within-region productivity (TFP) quintiles. TFP is estimated using a sector by sector OLS regressions of value added on number of hours worked and firms' total fixed assets plus country fixed effects.*

## Perceived gaps

**Nearly 50% of firms in the manufacturing sector and more than 33% of firms in the services sector consider their past investment activities related to digital technologies to have been too low.** Looking back at their digital investment activities over the past three years, on balance 48% of European and 49% of US manufacturing firms stated that their investments were below their needs. In the services sector, we found that 36% of European firms and 34% of US firms considered their investment activities to have been too low.

Within the EU, reported investment gaps were most pronounced among firms in the periphery, where 58% of manufacturing firms reported too little investment in digital technologies. This compares with 51% in cohesion countries and 43% in the other EU countries. For firms in the services sector, investment in digitalisation was below their needs for 41% of firms in the periphery, 27% in the cohesion, and 37% in the other EU countries. Overall, only around 5% of companies reported that they invested too much in digital technologies.

**Figure 17**  
Share of firms stating that they invested too little in digital technologies (in %)



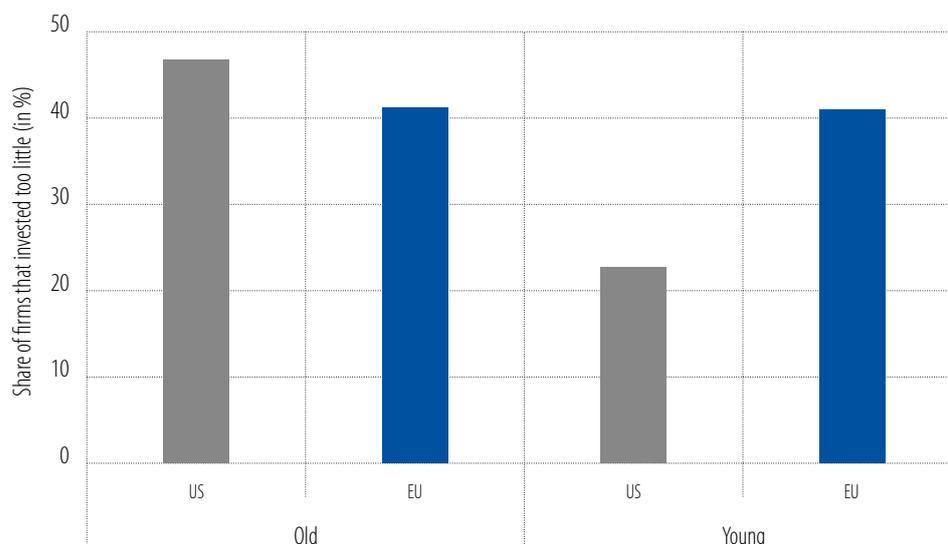
Source: EIBIS Digital and Skills Survey 2018.

Base: All firms.

Question: Looking back at the last three years, would you say your investments in digital technologies were in line with needs/you should have invested in digital technologies?

**Gaps are similar across technologies.** When looking at perceived investment gaps by technology we found only small differences. In the manufacturing sector, gaps were smallest for firms that adopted IoT and big data and largest for firms that invested in advanced robotics. For firms in the services sector, perceived investment gaps were largest for firms that invested in big data and smallest for firms that used “web-based applications for marketing and sales”. Differences between the EU and US were small.

**Figure 18**  
Perceived investment gap by age (in %)



Source: EIBIS Digital and Skills Survey 2018.

Base: All firms.

Question: Looking back at the last three years, would you say your investments in digital technologies were below needs/you should have invested in digital technologies?

Note: Old firms older than ten years, young firms younger than ten years.

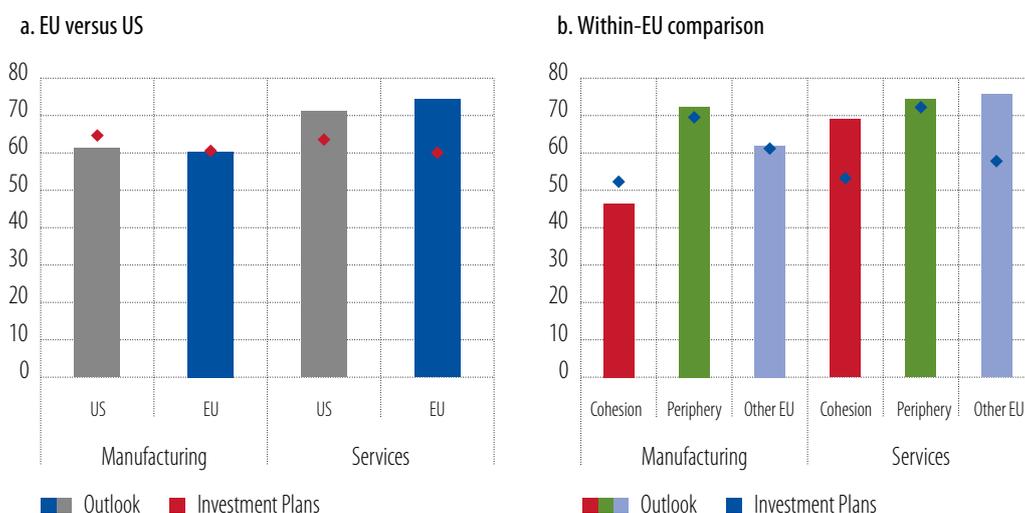
**Young firms in the EU are more likely to report underinvestment than their US peers.** Nearly 41% of young European firms report that they invested below needs. This compares with 23% of young firms in the US (Figure 18).

## Investment plans

**Reported investment gaps are driven by firms' expectations of an increase in the importance of digital technologies.** On balance, about 60% of manufacturing and 70% of service sector firms expected digital technologies to gain in importance in the next three years (see Figure 19, Panel a). Firms that expected digitalisation to increase in importance were particularly likely to report underinvestment.<sup>6</sup> Differences in firm perception between the EU and US were small. Within the EU, firms in the periphery countries were most optimistic about the future of digitalisation; firms in the cohesion region – in particular in the manufacturing sector – were the least optimistic (Figure 19, Panel b).

**Firms' expectations of an increasing importance of digital technologies are mirrored in their investment plans.** When asked whether they expected their investment spend on digital technologies to increase, decrease or stay the same over the next three years, the answer was overwhelmingly: "increase". Regional differences reflect differences in firms' expectations about changes in the importance of digital technologies, with firms in the periphery countries standing out as most bullish, and firms in the cohesion countries as least bullish.

**Figure 19**  
**Outlook for digitalisation and investment plans** (net balance, %)



Source: EIBIS Digital and Skills Survey 2018.

Base: All firms.

Questions: Do you expect digital technologies to increase in importance in your market, decrease, or stay the same? Do you expect your investment spend in digital technologies to increase, stay the same or decrease; or do you have no investment planned in digital technologies?

Note: Net balance show the differences between firms expecting an increase and firms expecting a decrease in importance of digital technologies and their spending on digital technologies, respectively.

<sup>6</sup> The share of firms that report a gap is 40% by those that expect an increase in importance, 19% by those that do not expect a change in importance and 3% by firms that expect a decrease in the importance of digital technologies.

## Barriers to investment

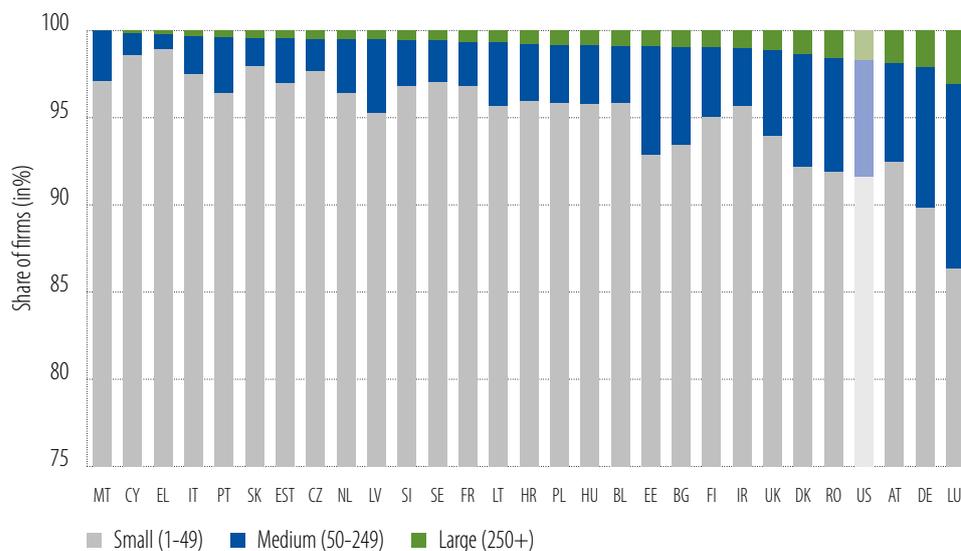
There are important barriers to the adoption of digital technologies. We divide them into structural, economic environmental and firm-specific obstacles.

### Structural barriers

**One structural disadvantage European firms face when it comes to digital adoption is firm size.** Digitalisation, particularly in the manufacturing sector (Link et al., 2016), often entails high fixed costs, which make adoption easier for larger firms that can spread such costs over a larger revenue stream. Indeed, we saw earlier that larger firms are, on average, more likely to adopt digital technologies than smaller ones, with a strong increase in adoption rates around the 50 employees threshold. The fact that more firms in the EU fall below this threshold than in the US is therefore likely to be a disadvantage for further adoption.

Figure 20 shows the share of small firms by country: the US economy has a smaller share of small firms (< 50 employees) than most EU countries. The countries with the largest share of small firms are located in the periphery region.

**Figure 20**  
**Business size (in %)**



Source: OECD (2018); *Enterprises by business size (indicator)*.

**The literature suggests various explanations for differences in firm size.** These include market fragmentation, differences in funding as well as regulatory disincentives to grow. As for the latter, Garicano et al. (2016) show, for example, how in France firms stay below 50 employees to avoid the additional taxes and regulatory requirements that come with being medium-sized. This creates a clear disincentive for firms to grow and may, therefore, hamper the adoption of digital technologies.

The same mechanism has been shown at work in a wide range of other EU countries; see, for example, Schivardi and Torrini (2008), who study Italian employment legislation on firm size, or Braguinsky et al. (2011), who look at Portuguese firm size distribution.

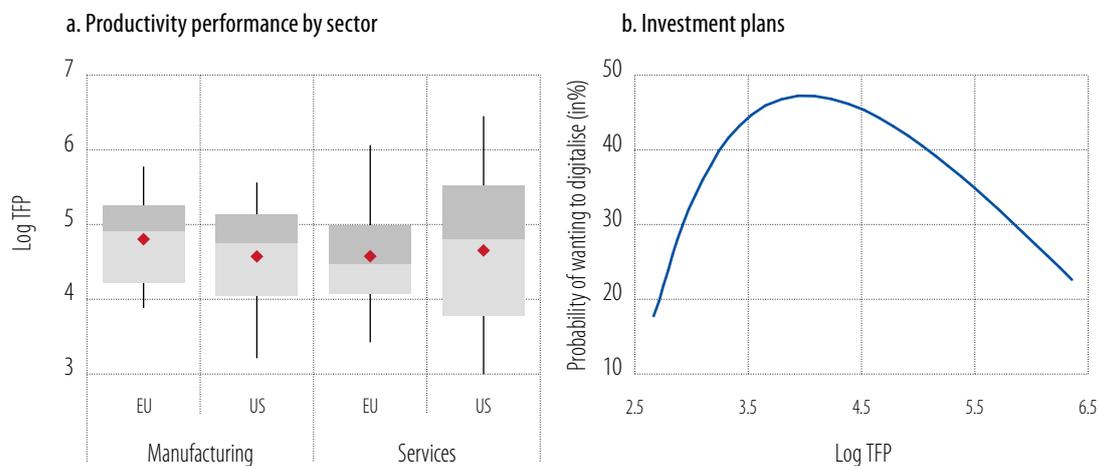
**A second structural disadvantage is market fragmentation.** A smaller effective market size affects the adoption of new technologies, as it means less room to scale up technologies. While the EU Single Market is larger than that of the US, it still is subject to many invisible borders. For example, a small online business wishing to trade in another EU country faces value-added tax (VAT) compliance costs of at least EUR 5 000 annually for each Member State it wishes to supply. The costs associated with operating in multiple languages add to this problem.

Feedback from “born-digitals” highlights that the cost of certification can also be an issue, particularly where there are no European standards. The Digital Single Market Strategy championed by the European Commission aims to address these obstacles and enable better digitalisation. It recognises that market fragmentation is indeed (still) a key obstacle to digitalisation.

**A third structural disadvantage is the lower share of high productivity performance by non-digital firms in the services sector.** The EU has a much smaller share of non-digital firms with high productivity in the service sector than the US (see Figure 21, Panel a). This result is important as successful digitalisation requires a minimum level of productivity. As firms face sunk costs when it comes to the adoption of digital technologies as well as the prospect of potentially fiercer competition, they need above-average performance to adopt these technologies.

Indeed, if we look at firms in our sample that have not yet adopted any digital technology, and plot their plan to do so against their level of productivity, we see a sharp increase in adoption plans as firms become more productive (Figure 21, Panel b). If we assume that firms can anticipate reasonably well their odds of succeeding with the adoption of digital technologies, this suggests a threshold effect in terms of productivity when it comes to the successful adoption of digital technologies.<sup>7</sup>

**Figure 21**  
**Productivity performance and investment plans of non-digital firms**



Source: EIBIS Digital and Skills Survey 2018.

Base: All firms that have not adopted any digital technology.

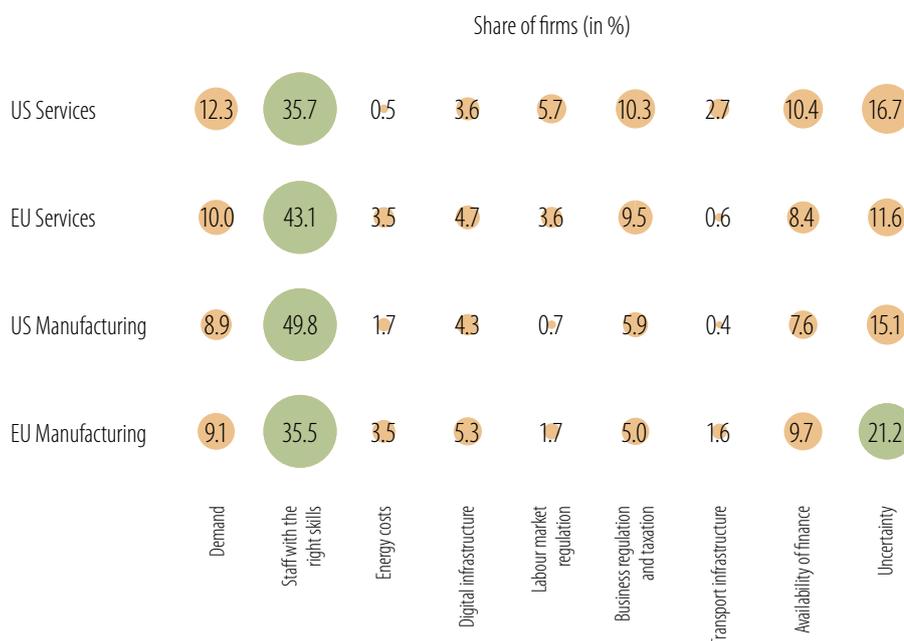
Note: Total factor productivity is based on sector by sector OLS regressions of value added on number of hours worked and firms' total fixed assets plus country fixed effects.

<sup>7</sup> The fact that adoption plans decrease beyond a certain point can most likely be explained by the fact that these firms are highly specialised: high productivity firms could digitalise, but have – given their superior performance – not yet seen the need or possibility to do so.

## Economic environment

**“Lack of staff with the right skills” is the most frequently mentioned obstacle to digitalisation.** As part of our survey, we asked firms what challenges to their investment activities they face and which was, in their view, the main barrier to the adoption of digital technologies. The answers to the second question are plotted below. “Lack of staff with the right skills” is the barrier most cited as the main obstacle to digital adoption (40% of EU firms and 46% of US firms). “Uncertainty about the future” and “availability of finance” are the next most cited obstacles (16% of EU firms and 9% of US firms, respectively).

**Figure 22**  
**Main obstacles to digitalisation**



Source: EIBIS Digital and Skills Survey 2018.

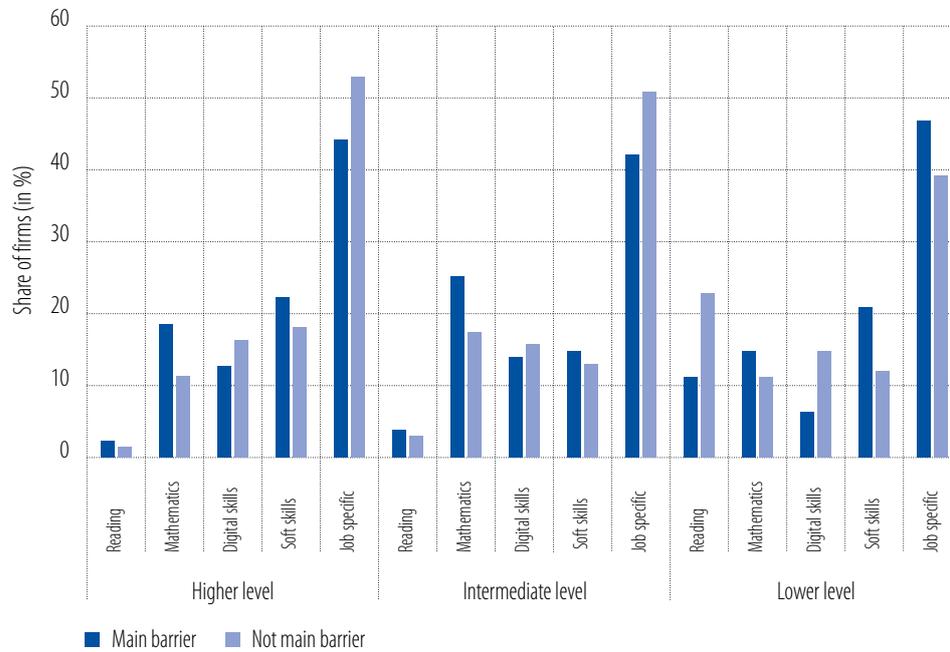
Base: All firms.

Question: Thinking about your investment activities in digital technologies, which is the main obstacle to adopting digital technologies?

Note: An orange circle means that the share of mentions of a particular obstacle is below 20%; and a green circle means that it is above 20%. The size of the circle and the number inside indicate the share of firms mentioning an area as major obstacle.

**“Lack of staff with the right skills” predominantly reflects difficulties in hiring new staff,** whereas firms overall are satisfied with their current staff (see Chapter 1). When it comes to finding talent, the quality of applicants more than the quantity seems to be the issue. If we look at how long it takes firms to fill their vacancies, we find that most are filled in less than six months (see Chapter 7). This suggests the difficulties firms report in finding staff with the right skills are generally not about finding someone but rather about finding the people that exactly fit the profile firms are looking for, particularly for “higher level” occupations.

**Firms primarily miss “job-specific” skills.** When we look at what skills firms miss most, both for those that report “lack of staff with the right skills” as the main obstacle to digital adoption and others, we find that – across skills levels and irrespective of whether “lack of staff with the right skills” is the main barrier to digital adoption – firms want more “job-specific skills”. Secondly, firms highlighting lack of skilled staff to be the main barrier to adopting digital technologies are more likely to report a greater need for mathematics, sciences and other technical skills than other firms. This is true for both “higher level” and “lower level” occupations.

**Figure 23**  
**Skills shortage by occupation level**

Source: EIBIS Digital and Skills Survey 2018.

Base: All firms that reported vacancies.

Questions: Thinking about your investment activities in digital technologies, which is the main obstacle to adopting digital technologies? When thinking about recruiting activities in 2017, for which of the following skills did you experience the biggest shortage of applicants?

**“Uncertainty” is the second most frequently named barrier to investment in digitalisation**, reflecting concerns about the macroeconomic environment, idiosyncratic risks (related to firm performance) and “regulatory uncertainty”. About 16% of firms name “uncertainty” as the main barrier to the adoption of new technologies. A simple regression analysis suggests that the macroeconomic environment, which remains more fragile in the periphery countries than elsewhere in the EU, together with the firm-specific performance situation (with higher uncertainty reported among firms doing less well) and the regulatory environment drive firms’ perception of uncertainty.<sup>8</sup>

**Our qualitative interviews suggest that technological uncertainty also often plays a role.** While further quantitative analyses show no direct link between “uncertainty” as a barrier to investment and any one technology that firms adopted, our key informant interviews suggest that firms often hesitate to adopt digital technologies because of the fear of picking the wrong one. The hold-out problem is particularly relevant for companies engaged in publicly financed projects that look for long-term solutions and are sensitive to the potentially high political cost of not choosing the best solutions.

What adds to the problem is that firms often find it difficult to estimate the costs and benefits of digital adoption. One of the companies that we interviewed provides a good example: the service it offers is a visualisation tool for large complex data infrastructure. This allows firms to plot how different data sources in their organisation are interlinked, enabling the firm to check for vulnerabilities and interdependencies. What makes it challenging to sell the product is that it is hard to quantify the benefits of these possibilities, as it boils down to quantifying the benefits of more transparency.

<sup>8</sup> We regress whether firms consider uncertainty to be the main barrier to the adoption of new technologies on the region in which they are located, their productivity levels, whether they consider regulation to be a barrier to investment, and a series of controls.

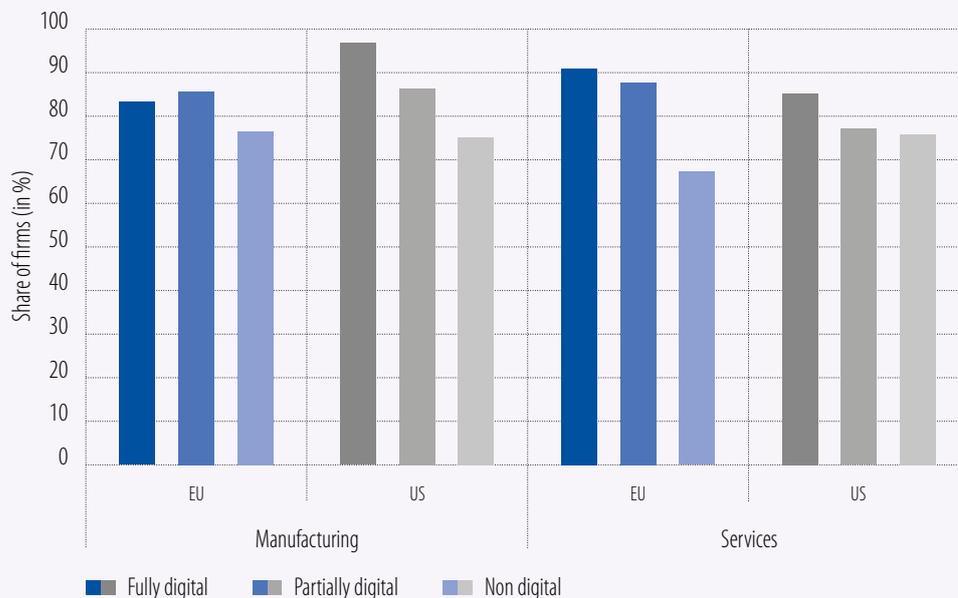
The same goes for costs: while the cost of the software itself is fixed, it is difficult to estimate the costs linked to implementation, which depend on the technological readiness of the firm and the complexity of its data infrastructure as well as potentially higher (cyber) security vulnerabilities (see Box C for a discussion on how firms deal with cybersecurity threats more generally).

**Box C**  
**Cybersecurity**

Cyberattacks are becoming more common. According to the European Commission (2017), in some Member States cybercrimes account for 50% of all crimes committed, 80% of European companies experienced a cybersecurity incident in the last year, and the economic impact of cybercrimes rose fivefold between 2013 and 2017 and could increase further.

The most important cost of cybercrime comes from its damage to company performance and its negative effects on trade, competitiveness, growth and innovation. Estimating the exact cost of cybersecurity threats is difficult to assess, as we need consider not only direct costs (such as preventative safeguarding equipment, regulatory compliance) but also indirect costs (such as losses in revenues and customers, reputational damages, loss of strategic information), which account for the largest share of the total cost. McAfee (2014) estimates the annual cost from cybercrime to the global economy to lie between USD 375 billion and USD 575 billion. However, substantial uncertainty regarding the potential financial impact of cybercrime remains because the true cost of cyberattacks become manifest only over time. Figure C.1 shows that many firms are aware of the risk and have a cybersecurity strategy in place.

**Figure C.1**  
**Implementation of cybersecurity**



Source: EIBIS Digital and Skills Survey 2018.  
Base: All firms.  
Question: Do you have a cybersecurity strategy in place?

Investment in cybersecurity equipment creates positive externalities (see Moore, 2010). From a single firm's perspective, the cyber risk decreases with additional investment in own equipment and additionally reduces the risk for firms that are connected to the same network. This might lead to underinvestment in cybersecurity by the private sector and the socially optimal level of cybersecurity will not be reached. This externality might be particularly crucial in sectors with large spillover effects to the wider economy.

But, due to information asymmetries, markets are prevented from providing socially optimal levels of security. Information asymmetries are driven by inexperience with cyber risk (e.g. firms have difficulties assessing the risk *ex ante*), and information sharing about cyber risk is limited due to concerns about reputational cost. The proposed EU cybersecurity framework thus provides a step in the right regulatory direction.

In the manufacturing industry, production processes hinge on data for digitalised companies. For these firms, data are very valuable as they contain knowledge and distinctive information about products. While the physical parts of the production process are well protected, production data are more difficult to protect. During our interviews, suppliers of digital technologies to manufacturers stated that it was difficult to convince conservative clients to become digital as they feared the risk in terms of cybersecurity. One services sector company mentioned that data protection is for them one of the main issues of the coming years and they were surprised that regulators are not more worried about this, as many businesses depend on their data and their security.

**A well-functioning digital infrastructure – although the absence of which is not the most important obstacle to digitalisation – is key to the adoption of digital technologies.** Box D shows that firms – particularly innovative firms – often remain below their potential in terms of investment activities and firm performance if they are located in regions with a poor digital infrastructure. This illustrates the importance of a well-functioning digital infrastructure as a key prerequisite for making the most of the possibilities that come with new technologies.

## Firm awareness and culture

**Firm awareness and culture matter for digital adoption.** Apart from structural factors and the economic environment, our interviews revealed the importance of awareness and culture for the adoption of digital technologies. Providers of digital technologies often reported, for example, that a key challenge for selling their technology is often a lack of awareness by potential clients.

**Corporate culture and staff attitude matter for digital adoption.** Nearly all the CEOs we interviewed said that successful adoption of digital technologies depended on the motivation and buy-in of staff. Staff support becomes even more crucial in situations in which digital technologies can potentially challenge existing products/services and job profiles, which is when leadership and strong communication are needed.

Our interviews suggest that a promising way of implementing digital technologies is a hybrid model of top-down versus bottom-up digitalisation. The idea of this is to have a small centralised digitalisation team that oversees all digitalisation activities and can act as a champion for new initiatives, but to give key responsibility in the implementation process to the business units themselves. This allows firms to fully exploit not only the granular understanding and knowledge the units hold but also their buy-in as they become the “owners” of change.

**Box D****Digital infrastructure development and firm sentiment**

Is the state of digital infrastructure in Europe an obstacle to firms' investment activities? This box aims to answer this question by combining data on:

- the state of digital infrastructure at the regional (NUTS2) level (from Eurostat); and
- firms' perception of whether inadequate access to digital infrastructure poses an obstacle to their investment activities.<sup>9</sup>

*Access to digital infrastructure varies across regions in Europe.* Figure D.1 plots the share of households with access to broadband by NUTS2 region in 2016. It shows significant differences in terms of infrastructure quality both within and across countries.<sup>10</sup> The regions with the lowest share of households with broadband access are located in cohesion countries and some periphery nations.

We plotted the quality of digital infrastructure (household access to broadband) by NUTS2 (sub-national) region against firms' view of whether inadequate access to digital infrastructure poses a barrier to their investment activities and found a strong negative correlation: the better the infrastructure, the lower the perceived effect on firms' general investment activities. Unsurprisingly, this effect is most pronounced among those firms most engaged in innovation (see Figure D.2).

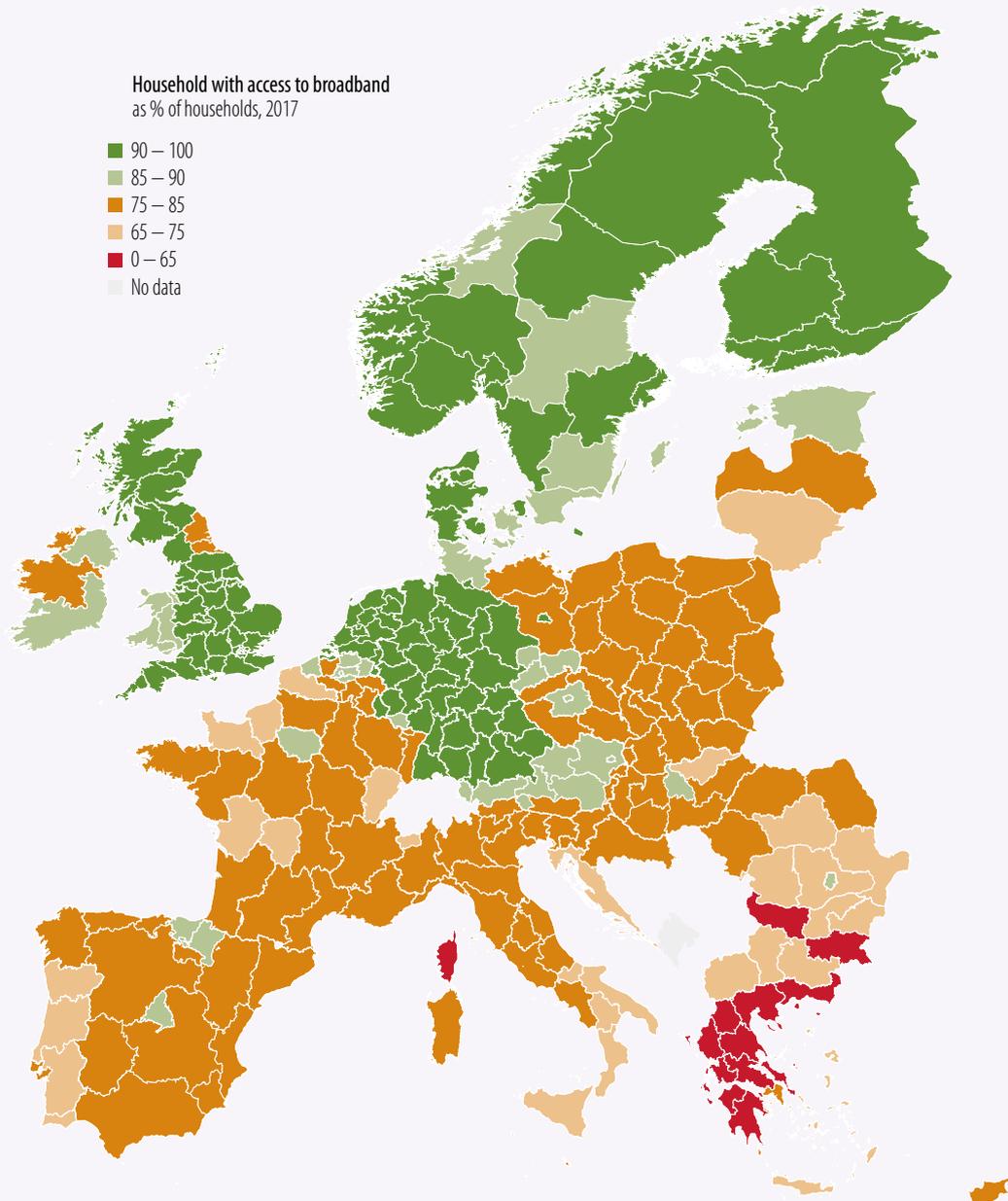
Access to digital infrastructure also influences firms' decisions on whether to invest specifically in digitalisation. Figure D.3, again from our investment survey, plots the quality of digital infrastructure against the share of firms investing in digital assets (defined as software, database, website activities, etc.). It illustrates a clear positive relationship between the two, highlighting the importance of putting in place the right infrastructure for firms' adoption of new technologies.

EU governments have made efforts to invest more in digital infrastructure in recent years. In "new" Member States in Central and Eastern Europe, the EIBIS provides evidence that firms' concerns are being assuaged. This is likely to reflect the slowness of the digitalisation process among many firms, as household access to broadband is not particularly high in most cases. In the "old" Member States of western and southern Europe, by contrast, it seems that the need firms perceive for digital infrastructure is racing ahead of efforts to meet this need (see Figure D.4).

<sup>9</sup> To avoid our analysis being driven by regional differences in what firms consider to be routine or non-routine, we centred firms' answers around the median firm per region. All results are robust to using "absolute" cut-off points, however.

<sup>10</sup> Note that the share of households with access to broadband is a proxy of infrastructure quality only. Quality may be a better measure in some countries and worse in others.

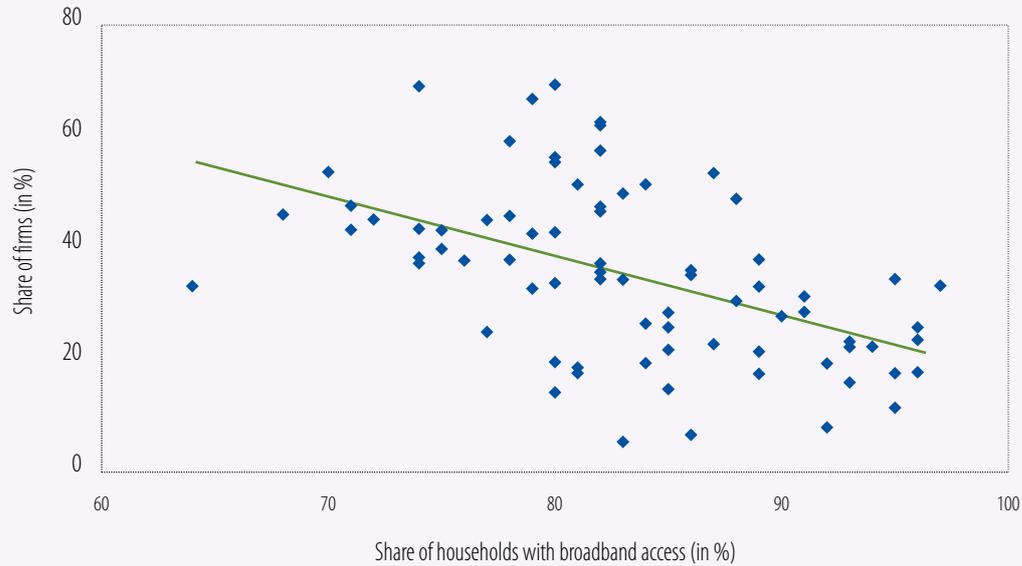
**Figure D.1**  
**Share of households having access to broadband in 2017 (NUTS2)**



Source: Eurostat.

Note: For this map only, where NUTS2 level information is not available (Germany, Poland, Greece and the UK) we plot NUTS1 level data.

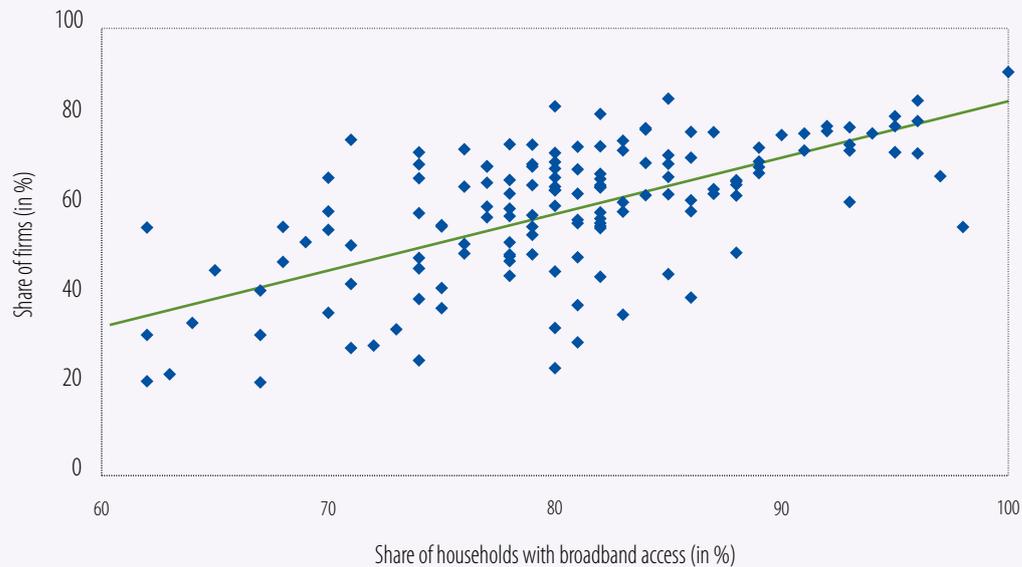
**Figure D.2**  
**Firms perceiving inadequate access to digital to be an obstacle, against share of households having access to broadband (NUTS2, innovative firms)**



Source: EIBIS 2016 and 2017; Eurostat.

Note: Firm-level statistics are weighted for value added. Firms in DE, GR, PO and UK are excluded due to missing information at the NUTS2 level. Innovative firms are defined as firms developing new products and active in R&D activities.

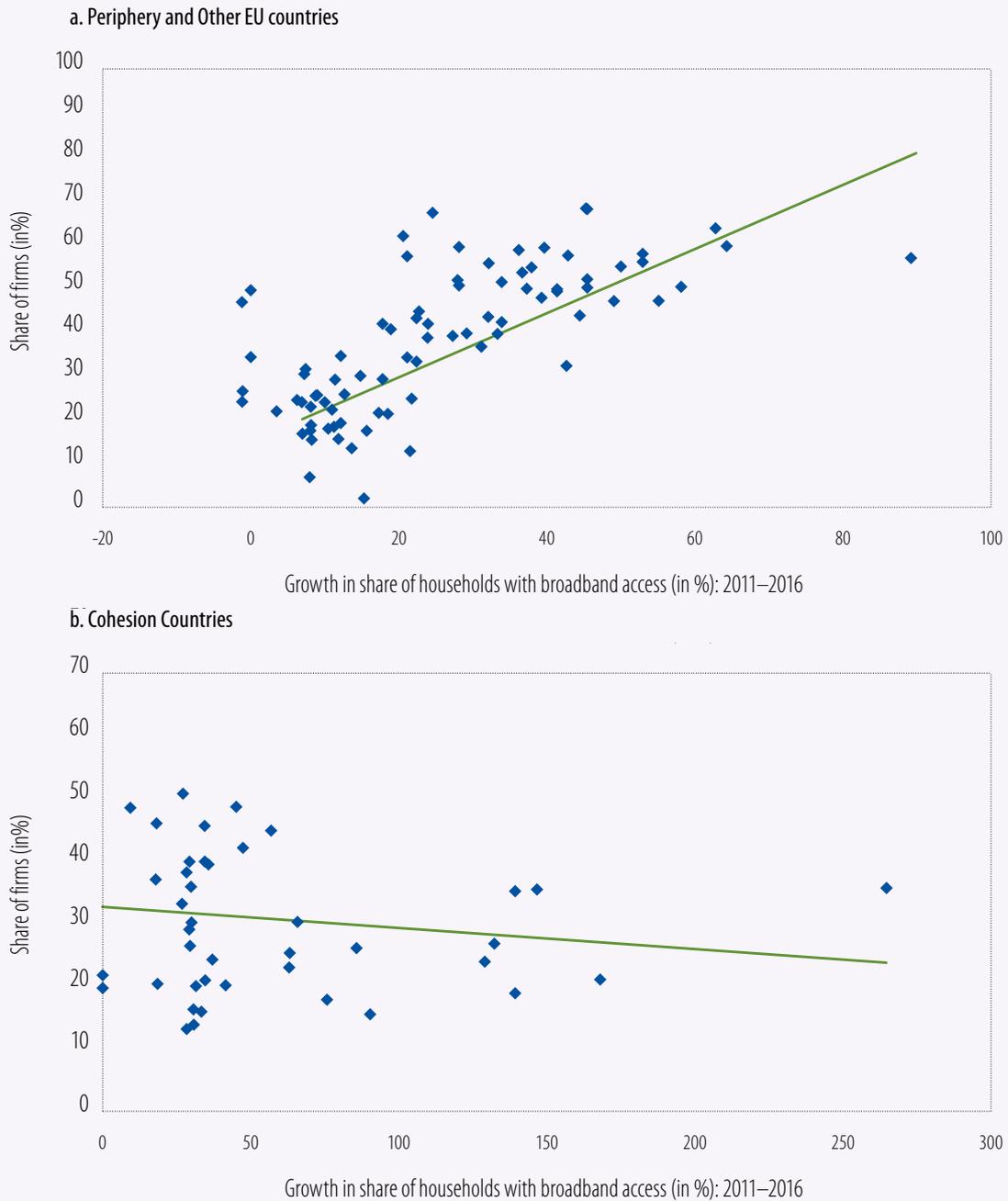
**Figure D.3**  
**Share of firms investing in IT correlates with household access to broadband (NUTS2)**



Source: EIBIS 2016 and 2017; Eurostat.

Note: Firm-level statistics are weighted for value added. Firms in DE, GR, PO and UK are excluded due to missing information at the NUTS2 level. Each dot represents a NUTS2 region. A firm is considered to be an IT investor if it has allocated more than EUR 50 per employee to investment in IT and digital equipment.

**Figure D.4**  
**Firms perceiving inadequate access to digital to be an obstacle, against growth of the share of households having access to broadband between 2011 and 2016 (NUTS2)**



Source: EIBIS 2016 and 2017; Eurostat.

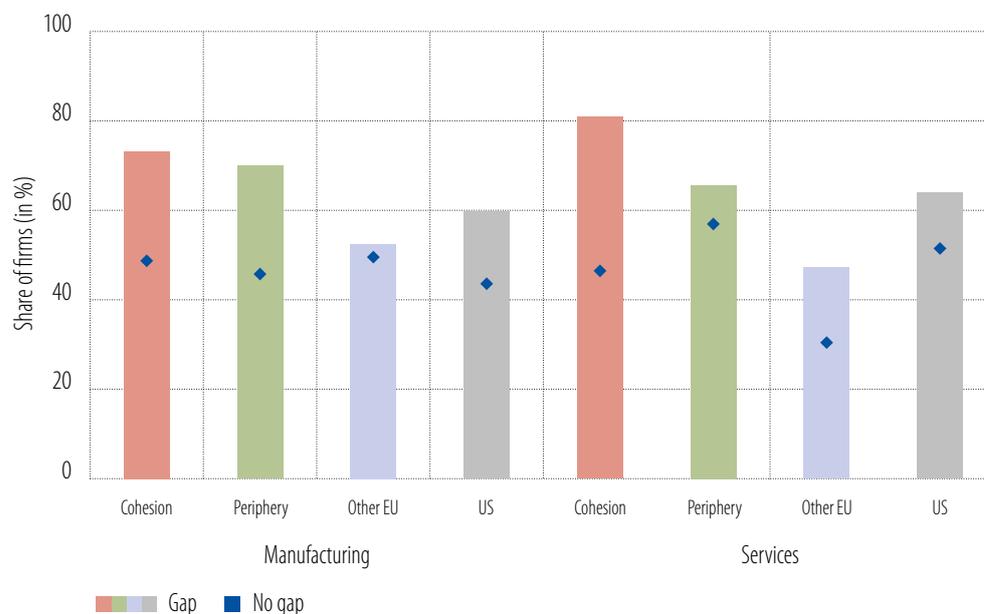
Note: Firm-level statistics are weighted for value added. Firms in DE, GR, PO and UK are excluded due to missing information at the NUTS2 level.

## Access to finance

**Inadequate access to finance is a barrier to the adoption of digital technologies.** While relatively few firms name inadequate access to finance as the main barrier to adopting digital technologies, we find evidence that finance matters for digitalisation. Figure 24 shows the share of firms that name inadequate access to external finance as a barrier to their investment activities – as opposed to the main barrier – separately for firms that invested enough when it comes to their digitalisation efforts (no gap) and firms that invested below their needs (gap).

Across all regions in our sample, firms that under-invested in digitalisation are substantially more likely to say that inadequate access to finance is a barrier to their investment activities. This suggests a link between successful digitalisation and access to finance. Indeed, the difference in answering patterns persists even if we control for sector, size, age and region.

**Figure 24**  
**Inadequate access to finance as barrier to investment**



Source: EIBIS Digital and Skills Survey 2018.

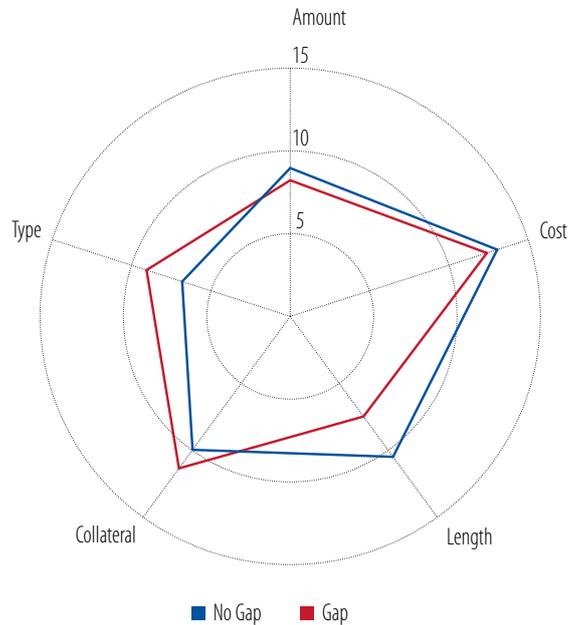
Base: All firms.

Questions: Thinking about your investment activities in digital technologies, to what extent is the availability of external finance an obstacle?

**All aspects of finance are critical for the digitalisation process.** When asked how (un)happy firms are with the finance they received, we find that firms that invested too little are relatively unhappy about collateral requirements and the type of finance they received. Companies that invested enough complain more often about the tenor of available external finance. Figure 25 illustrates this.

**“Born digital” firms face particularly high access to finance barriers.** If we compare the access to finance for born digitals with that of other firms, we find that they tend to face substantially more issues in accessing finance than their older and/or non-digital peers (Figure 26).

**Figure 25**  
**Dissatisfaction with external finance**



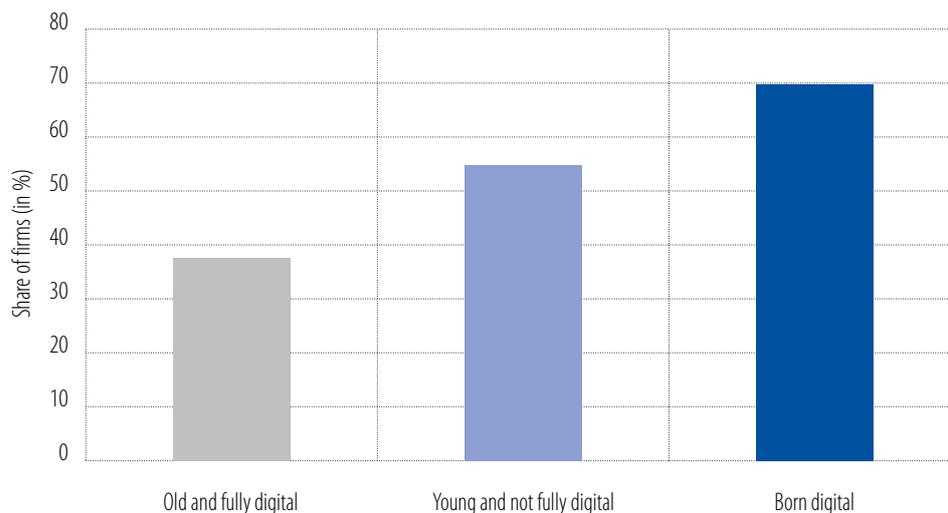
Source: EIBIS Digital and Skills Survey 2018.

Base: All firms that used external finance.

Question: Thinking about all of the external finance you obtained for your investment activities in 2017, how satisfied or dissatisfied are you with it in terms of ...?

Note: The figure shows the share of firms that either say they are unsatisfied or very unsatisfied with the amount, cost, length, collateral requirements and/or type of finance that they received (in %).

**Figure 26**  
**Finance as constraints for born digitals**



Source: EIBIS Digital and Skills Survey 2018.

Base: All firms.

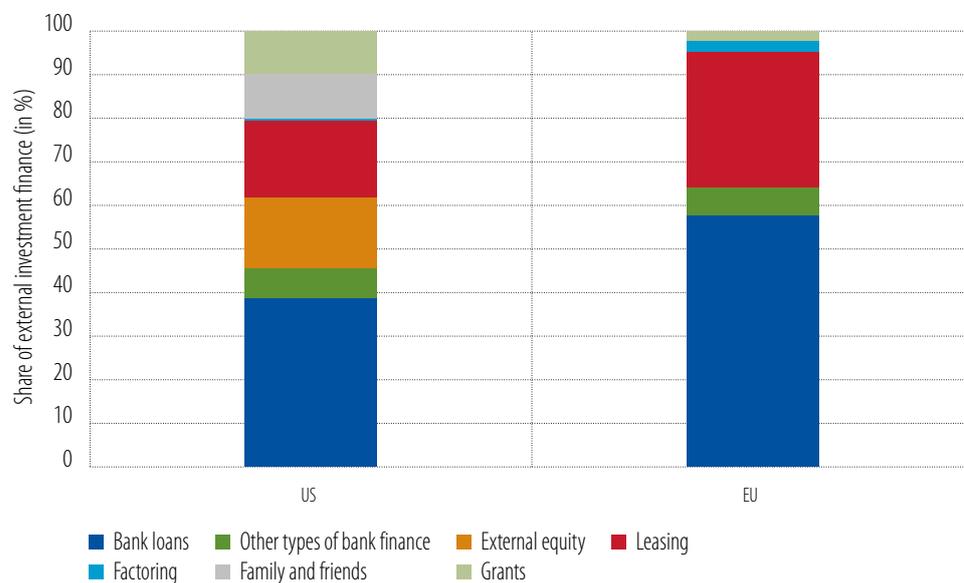
Questions: Thinking about your investment activities in digital technologies, to what extent is the availability of external finance an obstacle? How long has your company been operating?

Note: Born digital firms are firms that are younger than ten years and are fully digitalised. Young and not fully digital firms are younger than ten years and have not adopted any digital technology yet. Old and fully digital are firms that are older than ten years and that are fully digitalised.

**Young firms in the EU are at a funding disadvantage more generally.** In Chapter 5, we plot the share of firms that consider inadequate access to finance to be a barrier to investment for young firms in the EU and US. What that plot shows is that – despite little differences among old/mature firms on both sides of the Atlantic – young firms in the EU, of which born-digitals are a sub-group, are much more likely to report access to finance problems than their older peers in the EU and their young US counterparts.

**One possible explanation for this is differences in access to growth capital.** Figure 27 plots the investment financing mix of young firms in the EU and US. It shows that young firms in the EU tend to rely a lot more on bank finance and leasing than their peers in the US, who make much greater use of external equity and loans from family and friends as well as grants.

**Figure 27**  
**External financing mix among young firms (in %)**



Source: EIBIS Digital and Skills Survey 2018.

Base: Firms younger than ten years.

Questions: Did you use any of the following sources of finance for your investment activities? What share of your external financing does each type account for?

**The difference in availability of growth finance matters for firms' access to finance and affects the type of investments they pursue.** Firms that aim to scale up their activities very quickly by means of digital technologies are dependent on equity-type finance. The risky nature of their project – due to low cash flows, few tangible assets than can serve as collateral and the uncertainty associated with doing something completely new – mean that more traditional lenders/investors hesitate to get involved.

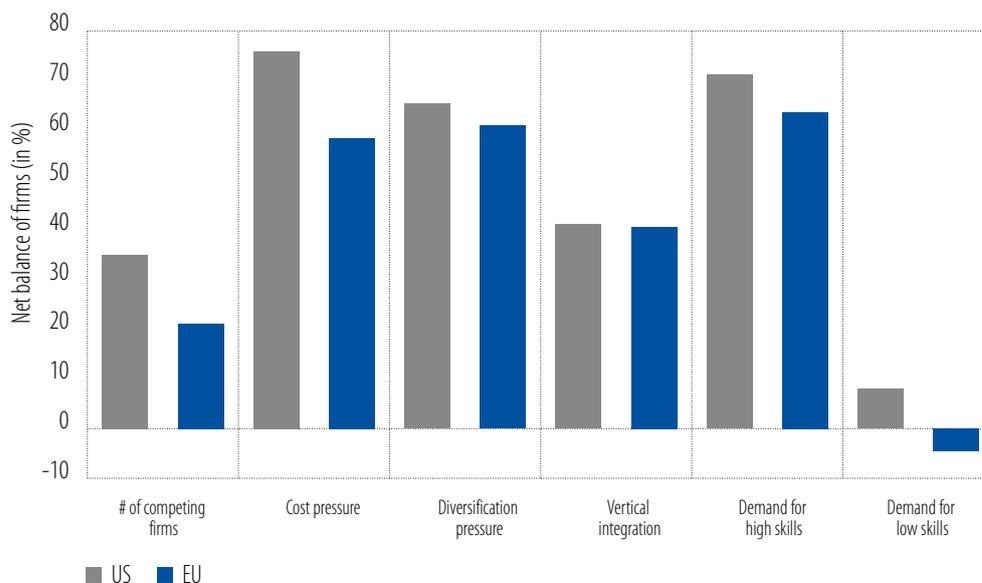
As a result, not having access to the type of finance most suited to funding (new) digital activities may not only lead to more access to finance problems (explaining the difference between young firms in the EU and US) but discourage such activities from the outset.

## Digital technologies' wider impact on skills, market structure and firm strategy

**Firms expect digital technologies to affect market structure, labour markets and their corporate strategy.** We asked firms that expect digitalisation to increase in importance what they expected the impact of further digitalisation to be on their market. Specifically, we wanted to know how they assessed the impact on cost pressure, market entry, demand for high- and low-skilled staff, vertical integration pressure and the need to diversify their product and services offering.

Overall, firms in the EU and US were relatively similar in their assessment. The most common perception was that digitalisation will lead to more cost pressure and an increased need to diversify firms' product/service offering as well as higher demand for high-skilled staff. The main differences between firms in the EU and US is that fewer EU firms expected firm entry and high cost pressure (market structure) to follow from further digitalisation and were, on average, more negative about the effect of digitalisation on the demand for low-skilled staff.

**Figure 28**  
Effect of digitalisation (net balance), EU versus US



Source: EIBIS Digital and Skills Survey 2018.

Base: All firms that expect digital technologies to increase in importance.

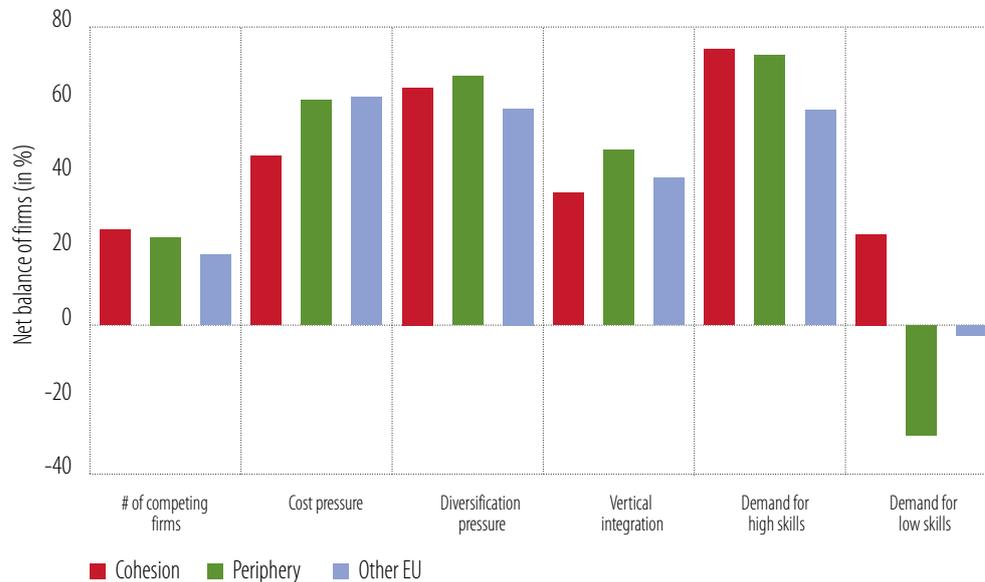
Question: Do you expect that this will lead to an increase, decrease or no change with respect to ...?

Note: Net balance shows the differences between firms expecting digitalisation to lead to an increase and those expecting a decrease from digitalisation for each category.

**Within the EU, firms' expectations on the impact of further digitalisation are largely similar.** Firms in the cohesion countries expect a slightly more pronounced effect of digitalisation on the demand for high-skilled staff; in the periphery countries, it is diversification pressure that is expected to increase. In the other EU countries firms expect a particularly high impact on costs; however, none of these differences is significant.

The main difference across regions is demand for low-skilled staff. While firms in the periphery expect a net negative effect of further digitalisation, firms in other EU countries and the cohesion region are on balance positive about the impact of digitalisation on low-skilled staff. We will come back to this point in the following sections.

**Figure 29**  
Effect of digitalisation within-EU comparison, (net balance, %)



Source: *EIBIS Digital and Skills Survey 2018.*

Base: *All firms that expect digital technologies to increase in importance.*

Question: *Do you expect that this will lead to an increase, decrease or no change with respect to ...?*

Note: *Net balance shows the differences between firms expecting digitalisation to lead to an increase and those expecting a decrease from digitalisation for each category.*

## Digital technologies and the “hollowing out” hypothesis

**The literature suggests that digitalisation comes with a risk of “hollowing out” mid-level wage jobs.** The basic idea is that firms’ primary motivation to digitalise is to achieve efficiency improvements (as seen earlier). To the extent that they manage to do this largely through automation, this entails a risk of substitution of what were traditionally mid-level jobs, in terms of salary, by digital technologies. Therefore, these jobs disappear, or at least fall in value.<sup>11</sup> One way to illustrate this is by plotting (firm) employment growth across the wage spectrum. Figure 30 does exactly this, showing for the first time both EU and US survey data on the same plot.<sup>12</sup>

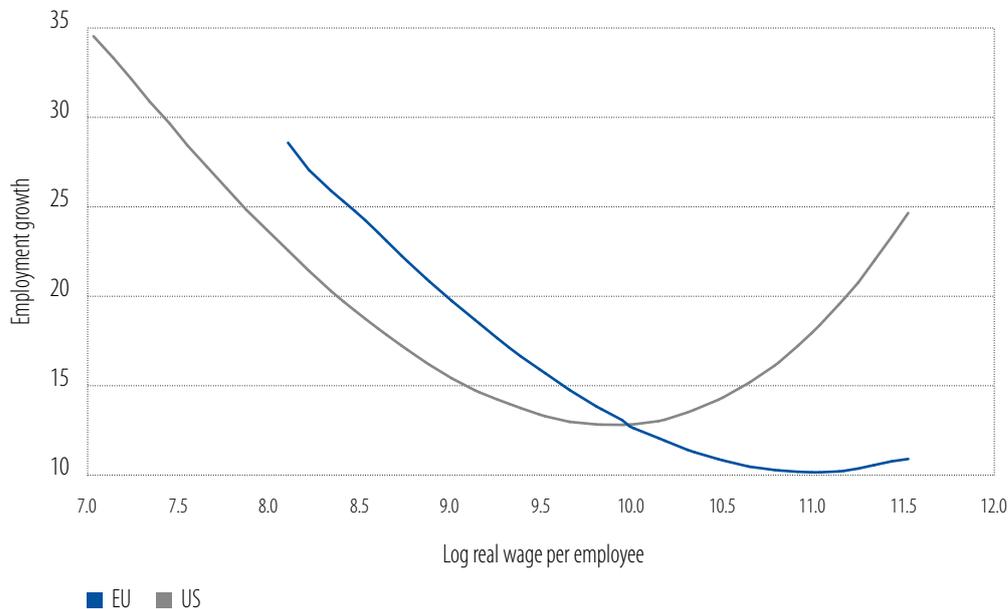
Both in the EU and the US mid-level firms (in terms of wages) grew least. Firms with low levels of wages – and, in the US, to some extent those with higher wage levels – grew most.

The U-shaped relationship between wages and employment growth in the EU holds for the cohesion region as well as the other EU countries. In the periphery countries, on the other hand, job growth was concentrated among mid-level wage jobs, which is likely to be the result of the recovery process following a prolonged crisis. Since the global financial crisis hit the middle segment the hardest, it is this segment that is now seeing the strongest bounce back.

<sup>11</sup> Technological change is favouring certain skills and devaluing others or making them redundant. In the literature this has also been labelled “skill-biased technological change” (see, for example, Acemoglu and Autor, 2011) and “job polarisation” (see, for example, Autor et al., 2006; Goos and Manning, 2007; Goos et al., 2014).

<sup>12</sup> Michaels et al. (2014) analyse the hollowing-out hypothesis looking at industry-level data across 11 countries (nine EU countries, the US and Japan); Arntz et al. (2016) estimate “automability” of jobs for 21 OECD countries, following a task-based approach, using data from the Programme for the International Assessment of Adult Competencies (PIAAC).

**Figure 30**  
Change in employment over wage spectrum



Source: EIBIS Digital and Skills Survey 2018.

Base: All firms.

Questions: How much did your company spend on wages? How many people does your company employ full- and part-time at all its locations? How many employees did you employ three years ago?

Note: Wage figures are PPP adjusted.

So far, “hollowing out” has been primarily associated with “routine” activities, but is expected to increasingly affect “non-routine” tasks. The literature starting with Autor et al. (2003), argues that over the previous decade digital technologies had the biggest impact on “routine” or repetitive tasks. Going forward, the focus will increasingly be on “non-routine” activities such as car navigation, hand-writing recognition and translation with the use of data analytics. Frey and Osborne (2017) expect that in the near future even tasks such as diagnosis of chronic diseases or determining cancer treatments will be partially or even fully automated using digital technologies.

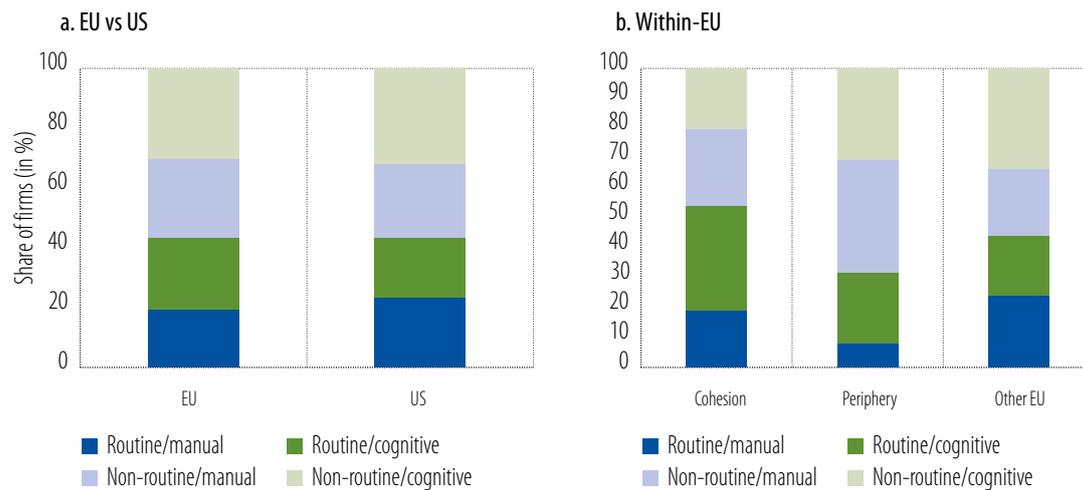
Our data allows us to distinguish between different firm types depending on the perception of the work they are engaged in. We asked firms about the time that their staff allocates to “cognitive”/“manual” and “routine”/“non-routine” tasks. Depending on their replies, we then divided them into four firm types (following Acemoglu and Autor, 2011):

- routine/manual firms (assembly line worker, receptionist);
- routine/cognitive firms (accountant, para-legal);
- non-routine/manual firms (mechanic, concierge); and
- non-routine/cognitive firms (engineer, editor).<sup>13</sup>

<sup>13</sup> As cut-off points, we use the median in our sample. The cells should, therefore, be interpreted as relative categories. Firms falling into the cell cognitive/non-routine, for example, can be characterised as allocating a greater share of their time to cognitive/non-routine tasks. It does not mean that they allocate most of their time to these tasks.

We found that the EU and the US were relatively similar in terms of firm profiles. Within the EU, the cohesion region recorded mostly “routine” firms, particularly routine/cognitive ones. The periphery region recorded the largest share of firms that considered their activities to be primarily non-routine/manual. The other EU countries resemble the US, with most firms falling into the non-routine/cognitive category.<sup>14</sup>

**Figure 31**  
Firms by skill category



Source: EIBIS Digital and Skills Survey 2018.

Base: All firms.

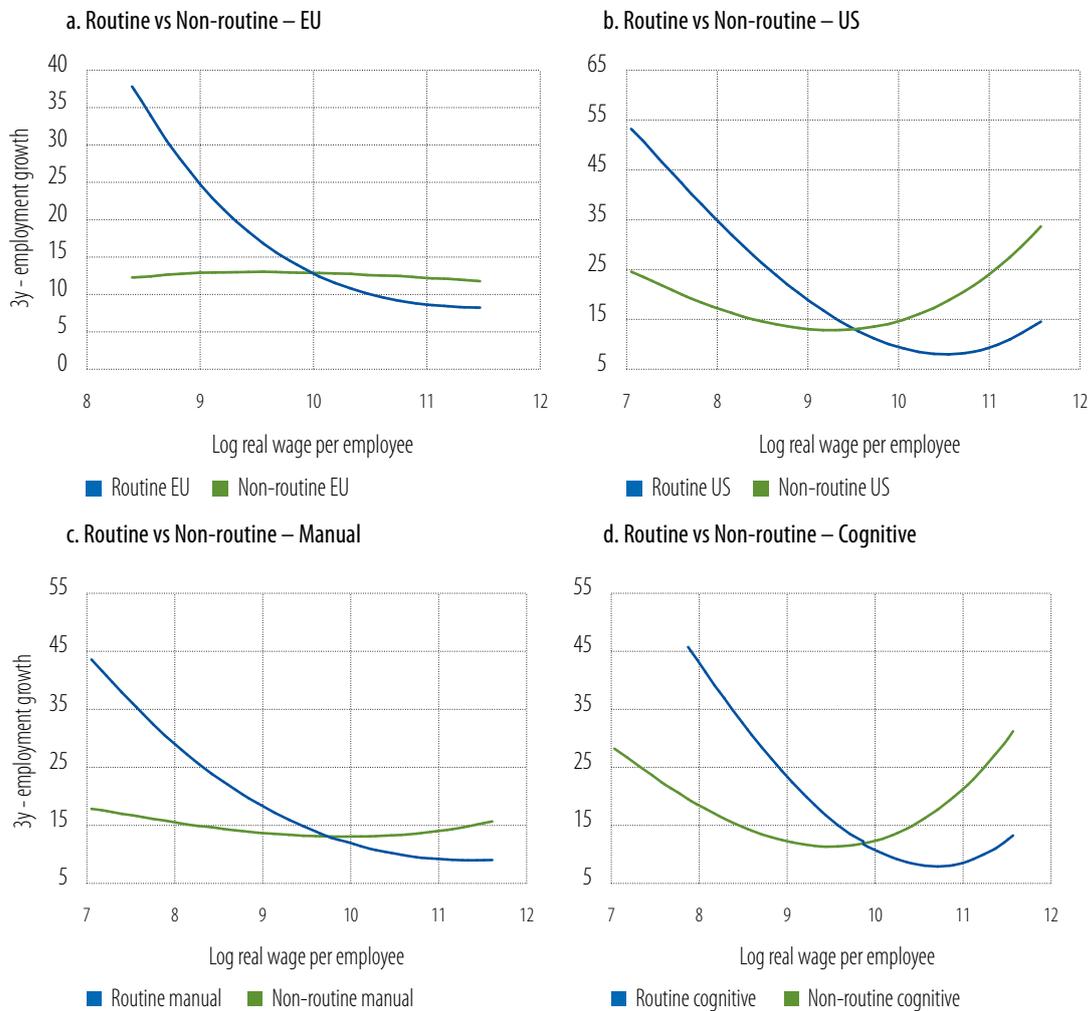
Question: Could you estimate what proportion of your staff is mostly engaged in “routine” tasks/“manual” work?

**Hollowing out of mid-level jobs is most pronounced among “routine” firms.** If we plot the graph in Figure 30, linking firm wages and employment growth, separately for “routine” and “non-routine” firms as in Figure 32, we find that for “routine” firms employment growth was practically absent for mid-level firms in terms of salaries in the EU, but positive among firms with low wages (more so than for non-routine firms). In the US, we find less growth of mid-level routine and non-routine firms relative to low-wage-firms; the growth-differential is, however, much more pronounced in routine firms. This confirms the idea of a hollowing out of “routine” activities on both sides of the Atlantic.<sup>15</sup>

14 To avoid regional differences driving our results, from here on we refer to the different skill-categories defined within each region. That is, we will account for differences in geographic perceptions by allocating firms to the four skill categories relative to the median firm in that region. The categories should hence be interpreted as “high”/“low” within a region.

15 To avoid our analysis being driven by regional differences in what firms consider to be “routine” or “non-routine”, for the following analysis, we centred firms’ answers around the median firm per region. All results are robust to using absolute cut-off points, however.

**Figure 32**  
**Employment growth for routine versus non-routine job categories**



Source: EIBIS Digital and Skills Survey 2018.

Base: All firms.

Questions: How much did your company spend on wages? How many people does your company employ full and part time at all its locations? How many employees did you employ three years ago? Could you estimate what proportion of your staff is mostly engaged in "routine" tasks/"manual" work?

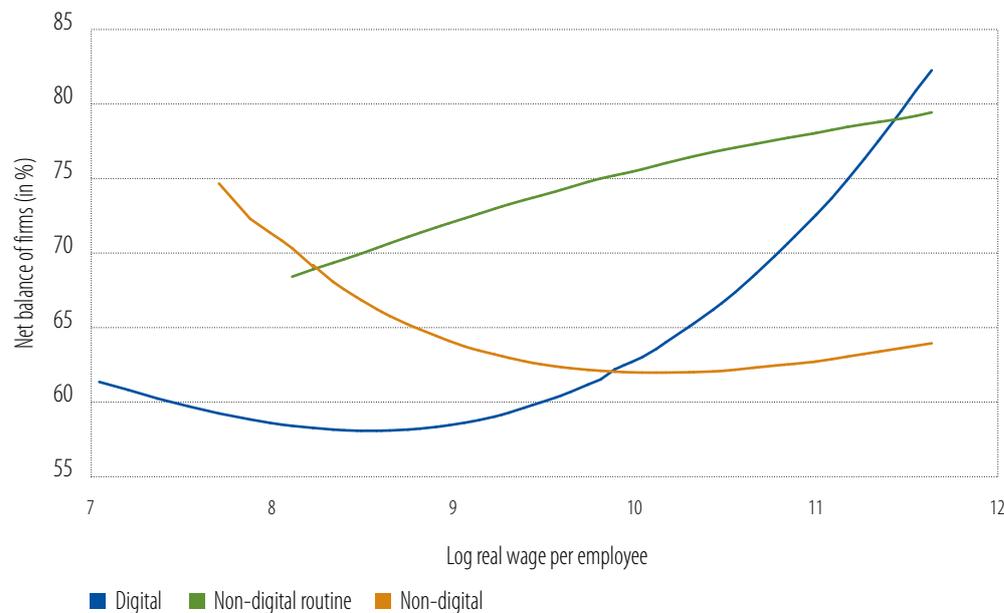
Note: Wages have been purchasing power parity (PPP) adjusted.

**We can link the disappearance of mid-level jobs to digitalisation.** In the literature, the hollowing out of "routine" tasks is generally linked to automation. If a machine can do routine tasks – potentially with a higher level of precision/lower margin of error – firms relying on staff carrying out these tasks will only be able to survive if they pay very low wages, or manage to distinguish themselves in some other way from the rest of the market.

While intuitive, making the link between automation and the disappearance of mid-level jobs explicit is difficult. We have to show that the lack of growth among mid-level "routine" firms is due to competition from firms that rely on digital technologies rather than humans to do the same work. One survey question that helped us to discover this was whether firms expected digitalisation to become more important in their market, and if so what they thought would be the impact on costs.

We found that non-digital firms engaged in routine tasks tended to have much stronger views about the effect that further digitalisation will have on costs (Figure 33).

**Figure 33**  
Cost pressure for companies employing mainly “manual” versus “cognitive” staff (net balance)



Source: EIBIS Digital and Skills Survey 2018.

Base: All firms that expect digital technologies to increase in importance.

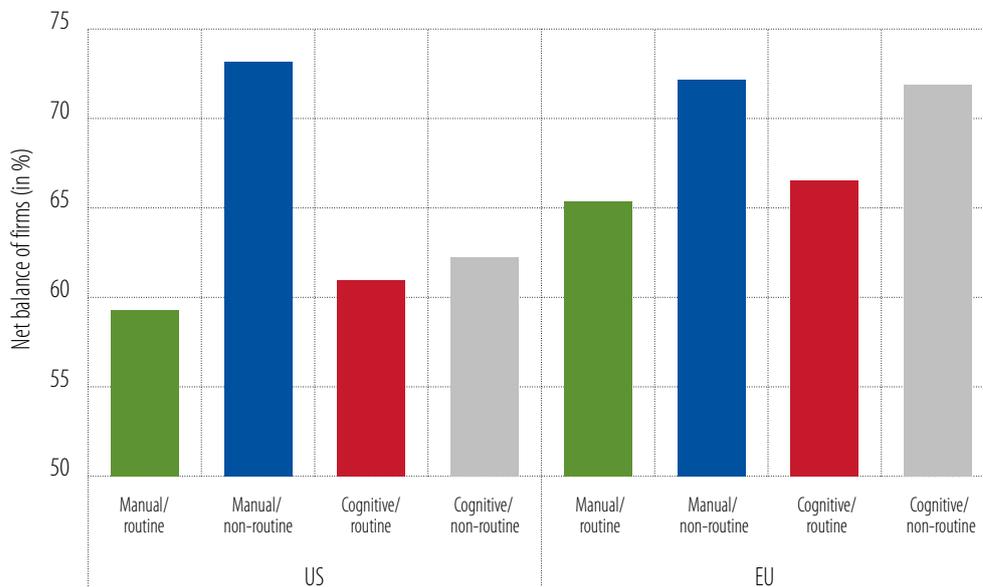
Questions: How much did your company spend on wages? How many people does your company employ full and part time at all its locations? How many employees did you employ three years ago? Could you estimate what proportion of your staff is mostly engaged in “routine” tasks/“manual” work? Do you expect that the pressure on firms in your market to reduce costs is going to increase, decrease, stay around the same?

Note: Wages have been PPP adjusted. Net balance shows the differences between firms expecting an increase and firms expecting a decrease in cost pressure.

“Non-routine” firms expect digital technologies to increase in importance in their market in the next three years more than “routine” firms (Figure 34). In addition, both non-routine firms and “routine” peers intend to focus their digitalisation efforts on more automation activities (with 53% and 54% of responses stating this was the main aim of future digitalisation, respectively). This is in line with the idea that while it has hitherto primarily been “routine” tasks that have been automated (Autor et al., 2003; Goos et al., 2007; Autor and Dorn, 2013), some non-routine firms have already become subject to this trend and many more non-routine activities will be automated in the future.<sup>16</sup>

<sup>16</sup> Examples include legal review, translation and autonomous driving tasks.

**Figure 34**  
Outlook of digital technologies' importance by skill category



Source: EIBIS Digital and Skills Survey 2018.

Base: All firms.

Questions: Do you expect digital technologies to increase in importance in your market, decrease, or stay the same? Could you estimate what proportion of your staff is mostly engaged in "routine" tasks/"manual" work?

Note: Net balance shows the differences between the share of firms expecting digitalisation to become more important in their market minus the share of firms expecting it to become less important (in %).

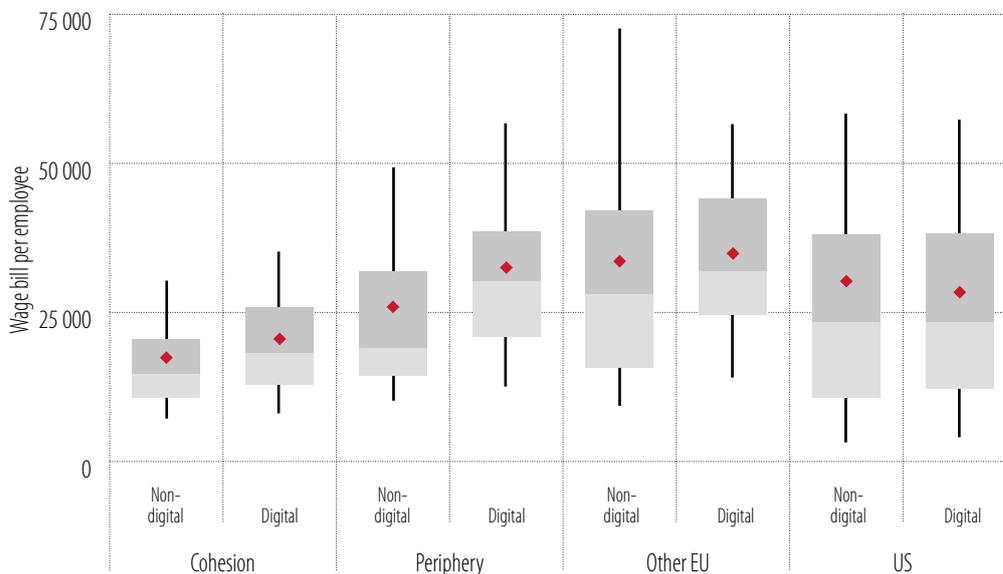
## Digitalisation and the demand for skills

The literature suggests digitalisation has had a marked impact on the demand for skills. As we have seen above, digitalisation often goes hand in hand with the automation of "routine" and increasingly "non-routine" tasks. This often comes at the expense of demand for low and medium-skilled jobs. On the other hand, in order to use digital technologies, firms need to have a pool of qualified personnel with the right skills. Forecasts by Ansip (2015) for the European Commission indicate, for example, that by 2020 Europe will lack more than 900 000 ICT professionals.

Our survey provides evidence for the idea that digitalisation generally comes with lower demand for "low-skilled" staff and a higher demand for "high-skilled" staff. We found that in all regions firms expect further digitalisation to have a strong positive effect on the demand for "high-skilled" staff, but a very modest (or even negative) effect on the demand for "low-skilled" staff (see Figure 28).

The higher demand for "high-skilled" staff is reflected in higher wages among digital firms. Figure 35 shows the wage distribution across firms in our four regions, both for firms that have not adopted any digital technology to date and firms that have adopted at least one. Digital firms tend to pay higher wages on average. This suggests that, while digitalisation can lead to the disappearance of entire professions, the jobs these firms create are – in line with the higher productivity of these firms – often relatively well paid "high-skilled" ones, potentially fuelling the polarisation of "low-skilled" and "high-skilled" workers even further.

**Figure 35**  
**Wage distribution across regions**



Source: EIBIS Digital and Skills Survey 2018.

Base: All firms.

Questions: How much did your company spend on wages? How many people does your company employ full- and part-time at all its locations?

Note: Wages have been PPP adjusted.

**Differences in expectations about the impact of digitalisation on the demand for “low-skilled” staff are driven by the overall labour market situation.** When it comes to the reported effect of digitalisation on the demand for low-skilled staff, we find a positive effect for the US and cohesion countries and a negative one for the periphery and other EU countries. This can be explained by differences in labour market dynamics across regions insofar as the US and cohesion countries experience particularly strong overall labour market booms, which are likely to influence firms’ perceptions of the effect of digitalisation.<sup>17</sup>

**The aims of digitalisation matter in the demand for “low skilled” staff.** Figure 36 shows that the expected effect of digitalisation on the demand for “low-skilled” jobs varies with the purpose of firms’ digitalisation efforts. Digitalisation that aims to streamline processes and to increase efficiency gains is often associated with negative demand for “low-skilled” staff. “Smarter marketing”, on the other hand, generally comes with a positive demand for “low-skilled” staff.

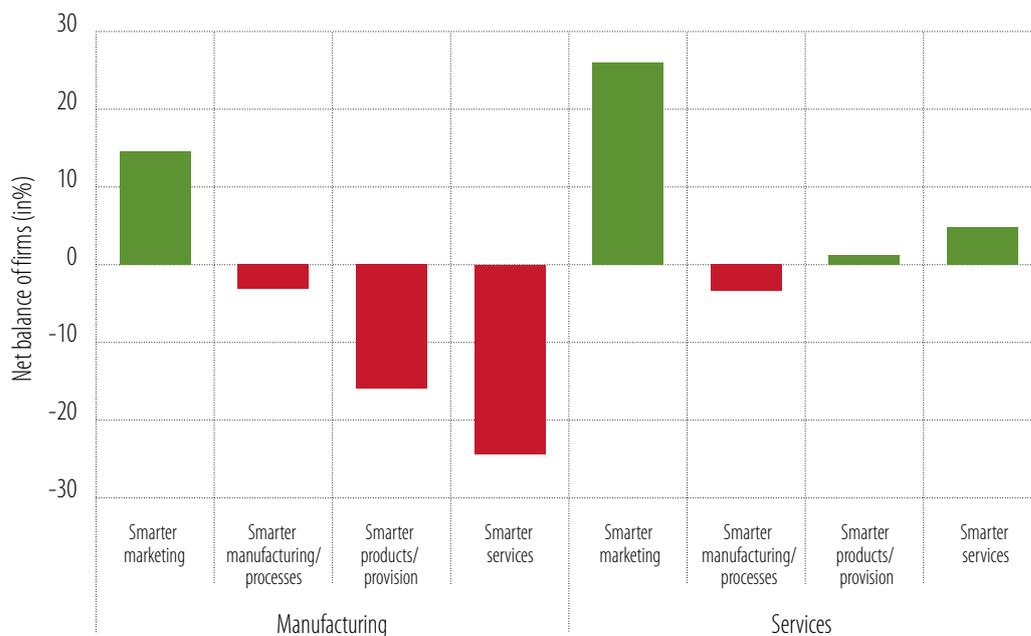
When it comes to the provision of “smarter services”, we find different results for the manufacturing and services sectors. While in the manufacturing sector this motive is associated with, on average, a negative effect on the demand for “low-skilled” staff, it is associated with a positive effect in the services sector. Our key-informant interviews suggest that offering “smarter services” often means very different things in the two sectors.

In the manufacturing sector, “smarter services” tends to mean offering high-end services based on performance data that firms receive from their customers. The new services could include a better maintenance contract or customised testing and simulation of new manufacturing processes. The staff required to provide these services tend to be mostly “high-skilled” workers. In the services sector, on the other hand, “smarter services” often means “low-skilled” services that exist because of the better ability

<sup>17</sup> Indeed, there is a clear negative correlation between firms’ assessment of the impact of digitalisation on the demand for “low-skilled” staff and the level of unemployment in the country in which they are located (relative to its long-term average).

to match supply and demand via digital technologies: chauffeur services, delivery apps and services related to the matching of freelance offers are well-known examples.

**Figure 36**  
Effect of digitalisation on low-skilled staff by purpose of investment



Source: EIBIS Digital and Skills Survey 2018.

Base: All digital firms that expect digital technologies to increase in importance.

Questions: Do you expect that this will lead to an increase, decrease or no change with respect to demand for low-skilled staff in your market? Which of the following was your company's main driver to use digital technologies?

Note: Net balance shows the differences between the share of firms expecting an increase in the demand for "low-skilled" staff minus those expecting a decrease.

## Perceived impact of digital technologies on market structure

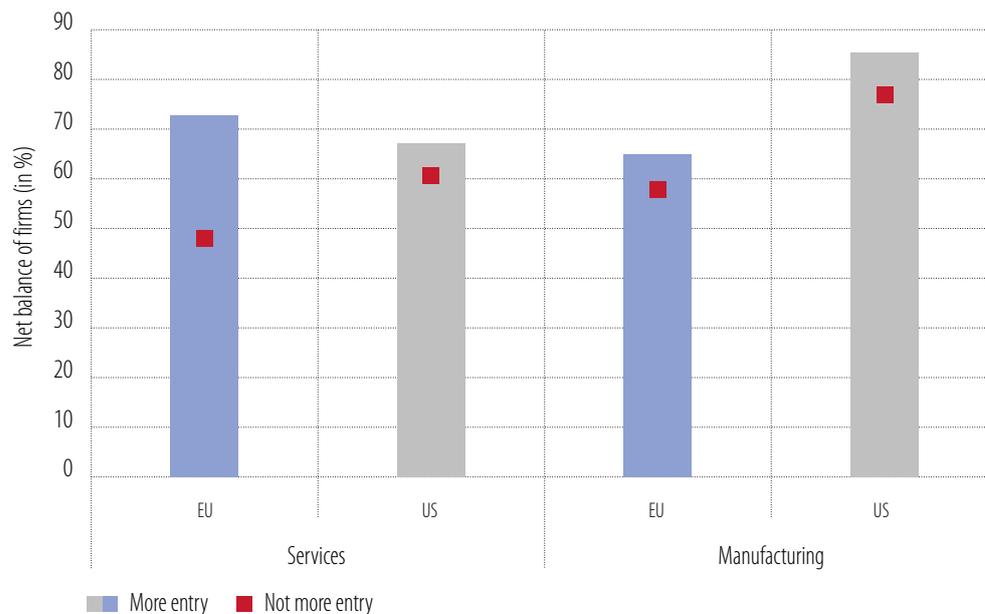
**The relationship between digitalisation and competition is hotly debated.** Some argue that digitalisation leads to more intense competition; others fear increasing market concentration on the back of digitalisation. Which is right is highly relevant: the degree of competition determines mark-ups and therefore consumer surplus as well as overall efficiency (through a potential deadweight loss). In addition, competition is key to innovation and productivity growth (at least up to a point). There is a large literature following Aghion et al. (2005) showing that firms' fear of being left behind by (new) competition is an important driver for them to seek new ways of becoming more productive and innovative.

**At first sight, our survey results seem to suggest digitalisation leads to more competition.** When firms were asked what they thought the impact of digital technologies would be on the cost structure in their market, we found that, on net, 76% of US firms and 58% of EU firms expected digitalisation to lead to increased cost pressure. This is partly a correlate of increasing market entry and partly due to expectations of more intense competition between existing market participants.

Figure 37 plots the share of firms expecting digitalisation to lead to more cost pressure (net balance) for firms that also expect market entry to increase and those that do not. The former tend to report a stronger effect of digitalisation on cost-pressure. This means that part of the reported impact on costs can probably be linked to competition through new market entry.

Even firms that do not report more market entry state that cost pressure increases as a result of digitalisation, which suggests that it affects costs not only through increased market entry but also through increased competition between existing market participants.

**Figure 37**  
**Expected effect on cost pressure (net balance) by market entry**



Source: *EIBIS Digital and Skills Survey 2018.*

Base: *All firms that expect digital technologies to increase in importance.*

Question: *Do you expect that this will lead to an increase, decrease or no change with respect to the number of firms/pressure to reduce costs?*

Note: *Net balance shows the difference between the share of firms expecting an increase in cost pressure and firms expecting a decrease.*

A closer look reveals that the relationship between digitalisation and competition is rather nuanced.

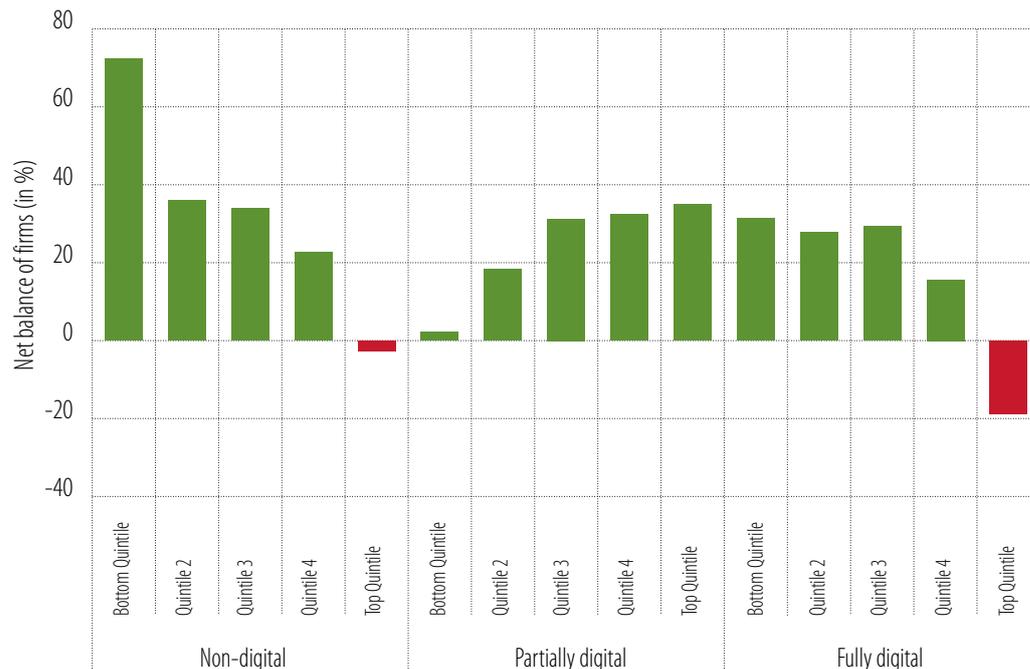
**Geography matters.** The impact of digitalisation on market structure is more pronounced in the US than in the EU, with a larger expected effect of digitalisation on market entry, cost pressure and expected competition between existing market participants. Within the EU, periphery and other EU countries expect, on balance, higher cost pressure than firms in the cohesion region.

**Firm type matters.** In Figure 38, we divide firms by level of implementation (“has not implemented any technology” up to “has fully implemented one technology”) and productivity performance (with the least productive firms in each category on the left-hand side of the x-axis and the most productive ones on the right-hand side of the x-axis). In line with our earlier finding that digitalisation often entails automation of “routine” activities, the effect of digitalisation on costs/competition is highest among non-digital, low productivity firms.

The effect is smallest for high-productivity non-digital firms and high-productivity firms that are fully digital. In the first case, this most probably reflects market areas that are not yet strongly challenged by digitalisation, such as some parts of the hospitality sector or the health-care sector. In the second case, the negative reported effect of digitalisation on competition is likely to be due to network effects. The idea of network effects is that the more users a digital service (such as Google) has, the more attractive it becomes for others to also use it (see Box B). The same holds for manufacturers. The more customer data a manufacturer can draw upon, the better and more appealing its products.

These positive feedback effects can lead to less entry/competition over time – a fact that has often been linked to the limited number of tech giants (see, for example, OECD, 2016; Bourreau et al., 2017; Autorité de la Concurrence and Bundeskartellamt, 2016). It has also spurred a big debate about the best way to regulate these firms and their data. For a discussion of this topic, see Box E.

**Figure 38**  
**Expected effect on market entry by implementation profiles**



Source: EIBIS Digital and Skills Survey 2018.

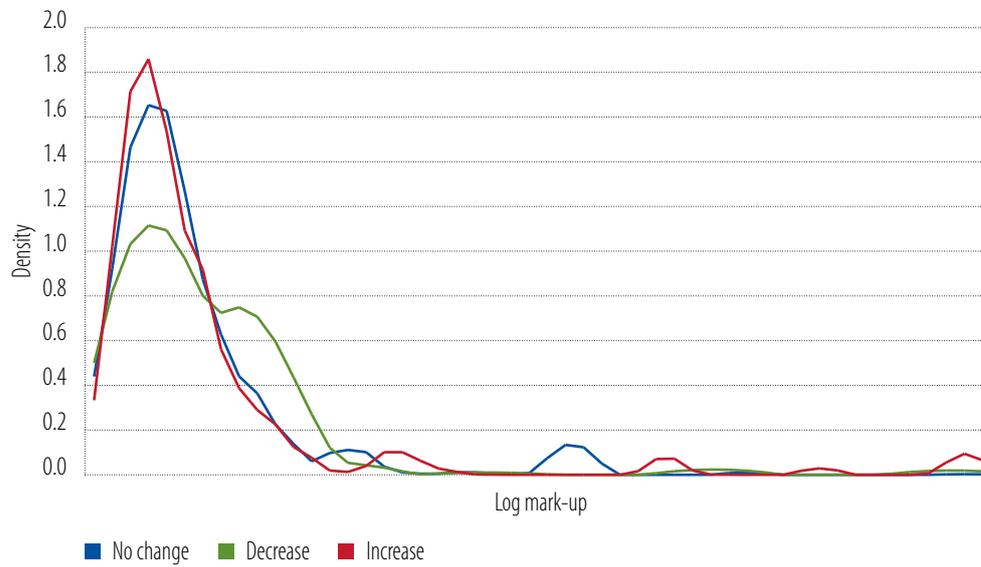
Base: All firms that expect digital technologies to increase in importance.

Questions: Do you expect that this will lead to an increase, decrease or no change with respect to number of firms? How many people does your company employ full and part time at all its locations? What was the approximate turnover of the company?

Note: Net balance shows the difference between the share of firms expecting the number of competing firms in their market to increase minus the share of firms expecting it to decrease (in %).

**Firms that expect digitalisation to reduce competitive pressure are often already in a privileged market situation.** Figure 39 plots estimated mark-ups for firms that expect digitalisation to lead to more, less or no change in competition. Firms that expect digitalisation to reduce competitive pressure tend to have higher mark-ups (illustrated by a lower share of firms on the left-hand side of the distribution). This suggests that – in line with the literature (see, for example, De Loecker and Eeckhout, 2017; Gutiérrez and Philippon, 2017; Weche and Wambach, 2018) – digitalisation risks will lead to more market power for firms that are already in a privileged market situation, reinforcing the idea of winner-takes-all tendencies on the back of digitalisation.

**Figure 39**  
**Mark-ups by firms' perception of competition**



Source: *EIBIS Digital and Skills Survey 2018.*

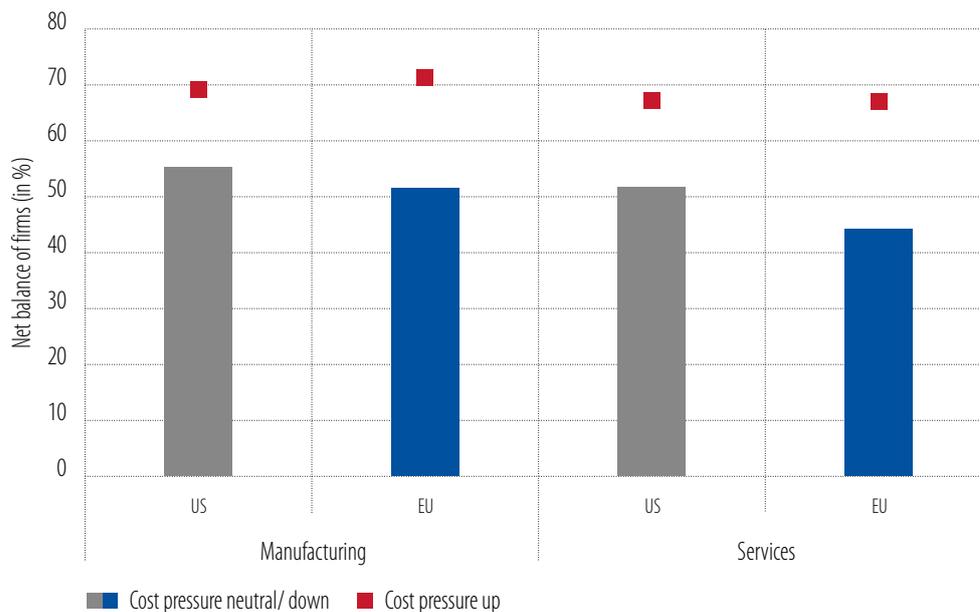
Base: *All firms.*

Note: *Mark-up calculations are based on the approach of de Loecker and Eeckhout (2017). They are presented in logarithms. Distribution plots are weighted.*

## The impact of digitalisation on firm strategy

**Firms expect that further digitalisation will have an impact on their strategic orientation.** Specifically, 63% of firms expect that digitalisation will lead to increased pressure to diversify their product/service offering, and 41% of firms that it will lead to more pressure for vertical integration. Differences between the EU and US are small.

**Figure 40**  
Perceived diversification pressure (net balance)



Source: EIBIS Digital and Skills Survey 2018.

Base: All firms that expect digital technologies to increase in importance.

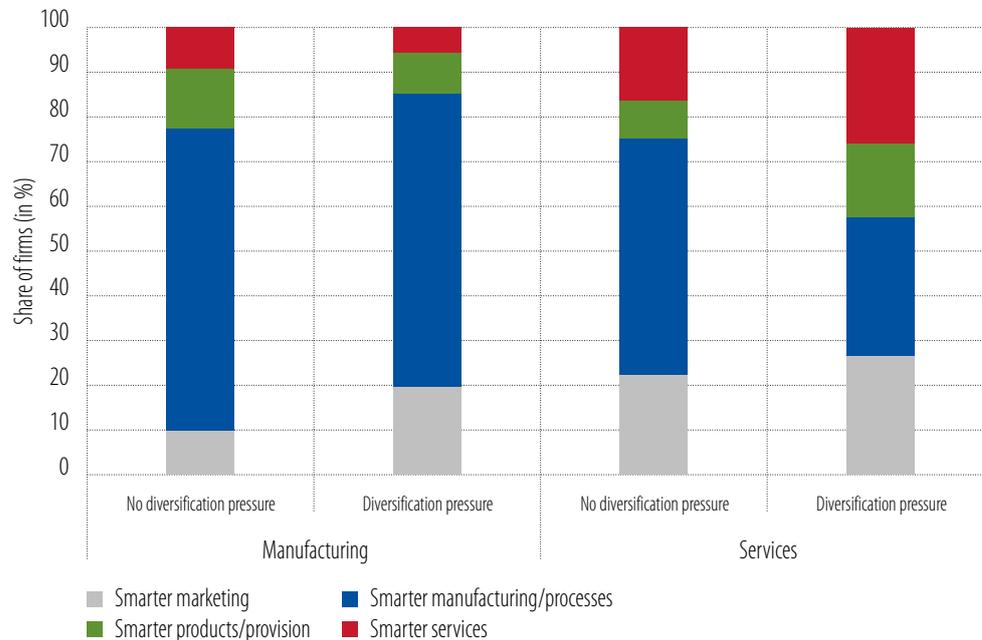
Question: Do you expect that this will lead to an increase, decrease or no change with respect to pressure to reduce costs?

Note: Net balance shows the differences between firms expecting an increase and those expecting a decrease in diversification pressure. Cost pressure neutral/down refers to firms that expect digitalisation to have no effect on the cost pressure in their market or leads to a reduction in cost pressure. Cost pressure up refers to the share of firms that expect digitalisation to lead to more cost pressure in their market.

**Digitalisation is associated with pressure to diversify the product/service offering due to increased competition.** Firms that see digitalisation leading to increased cost pressure in their market also expect the need for diversification to increase. Figure 41 illustrates this: across sectors and both continents, firms that anticipate more cost pressure in their market also state that the necessity to diversify their product/service offering will increase. The numerous mentions of “diversification pressure” can, therefore, be interpreted at least in part as a strategy to deal with more competition.

**Firms deal with increased diversification pressure through targeted marketing or customisation of their existing offer.** If we compare the main motives for firms to invest in digitalisation, regardless of diversification pressure, we find different patterns for manufacturing and for service sector firms.

**Figure 41**  
**Firms' strategies to deal with diversification pressure**



Source: *EIBIS Digital and Skills Survey 2018.*

Base: *All firms that expect digital technologies to increase in importance.*

Questions: *Do you expect that this will lead to an increase, decrease or no change with respect to diversifying your product/service offering? Which of the following was your company's main motivation to use digital technologies?*

Note: *"No diversification pressure" refers to firms that expect digitalisation to have no effect on the need to diversify their product/service offering (or even to reduce it). "Diversification pressure" refers to firms that expect diversification pressure to increase as a result of further digitalisation activities.*

In the manufacturing sector, diversification pressure is associated with a greater focus on marketing efforts, which presumably allows firms to highlight different aspects of the existing product offering in a better, more targeted, way.

In the services sector, firms expecting the pressure to diversify their product/service offering to increase are more likely to name "smarter provision" of existing services (e.g. through "web-based applications") and "smarter services" as the main motives for future digitalisation. Responses are similar in Europe and the US and suggest that diversification pressure in services – more than in manufacturing – entails a change in the actual service offering.

**The link between digitalisation and the pressure to vertically integrate<sup>18</sup> other businesses/activities can be explained by the new complementarities of business activities arising from the use of "big data".** Almost all firms that have adopted one of the digital technologies (other than big data) state they also make use of big data, as it is a key ingredient in the functioning of these technologies; "advanced robotics", for example, is different from traditional robots only if the robots are fed with data that allow them to learn.

Similarly, "IoT" applications are based on the very premise that data from one device (such as our mobile phones when driving) can be aggregated with that of other devices (like those of millions of fellow drivers) analysed in near real time and fed back to us in a way that can help us make better decisions (e.g. by using the right route to get to work).

<sup>18</sup> By vertical integration we mean integrating companies that control different stages of the same supply chain.

One key implication of the central role that big data takes in the digitalisation process is that access to such data becomes a critical determinant of success. The problem is that often data resides outside companies. This explains the need for more vertical integration. The mechanism was nicely explained by one of the CEOs we interviewed, who described how, in the area in which her company operates, it typically does so following at least two other firms in a chain of processes. They all provide specialised machinery and equipment. So far, none of the firms had collected and analysed performance data from their machines.

As they are now starting to do so, it is becoming increasingly clear that to get the most out of this analysis, it will be important to not only have access to the information their respective machines collect, but also that of the other companies. In other words, the firms are becoming increasingly aware of the potential complementarities between different data in organising the use of tools and ways of operating efficiently; increasing the pressure to vertically integrate.

### Box E Regulation

Companies across all industries are benefiting from the collection, analysis and manipulation of a massive amount of data from a wide variety of sources. As highlighted above, big data will continue to grow exponentially in the near future. Given its importance and its potential to increase economic performance, as well as the potential privacy and cybersecurity concerns, big data has received a great deal of attention from policymakers. For example, as mentioned in Box B, the EU implemented a major new data privacy regulation, the European GDPR, in May 2018 to protect consumers' data from misuse. Beside privacy concerns, big data is associated with potential market failures such as high market share of technology companies and externalities.

To assess whether governments should intervene, one has to determine whether markets are unable to maximise social welfare. According to the first fundamental theorem of welfare economics, the private market equilibrium maximises social efficiency if

- no externalities are present;
- firms operate in conditions of perfect competition;
- perfect information is provided; and
- all agents are rational.

Should one of these assumptions be violated, a market failure arises. In this case, regulatory interventions may be particularly desirable because they can potentially improve welfare. This raises the question of whether digitalisation and big data lead to market failures and what possible governmental interventions to correct them might be.

Digitalisation and big data can, for example, be associated with the following:

- market concentration, particularly around networks;
- innovations based on big data;
- new technological devices, to help to overcome asymmetric information;
- externalities resulting from cybersecurity issues.

Market concentration is well documented by a growing body of literature. On the one hand, the internet and new technological developments have allowed firms of all sizes and ages to reach customers around the globe. This increased competition with incumbents comes from foreign firms, as well as from digital firms entering non-tech sectors. On the other hand, the digital industry is vertically and horizontally concentrated in the hands of big tech enterprises such as Google, Apple, Facebook

and Amazon. If digitalisation and big data can be associated with higher market concentration and possible price discrimination, then this warrants further exploration.

Big data can provide an input into innovation, since it allows companies to gain insights and to empower autonomous machines and systems. It therefore relates to the question of whether big data can be associated with positive externalities. When a single firm invests in sensors that collect data, it takes private profits into account but might neglect the beneficial spillovers to third parties.

New technological devices predominantly affect insurance markets in various ways: they allow insurance companies, for example, to analyse driving behaviour, so that prices can be made dependent on drivers' characteristics. Furthermore, new technologies might help to overcome adverse selection problems, i.e. the problem where the car seller has an interest in hiding information such as former accidents from potential buyers.

Finally, increased digitalisation has brought cybersecurity challenges. Large-scale data breaches and cyberattacks now occur more frequently and have gained attention in the media. Although consumers and firms are aware of the risk, they have difficulty in assessing potential costs related to cybersecurity issues and systemic risk. Due to information asymmetries and externalities, cyber risk is probably underestimated, and thus there is a role for the public sector in regulating the market.

#### Regulation of market concentration

Market power itself is not necessarily a problem, but the abuse of a dominant position reduces welfare and is therefore not allowed. The abuse of market power can lead to a reduction in innovation incentives, negatively affecting future productivity growth. Regulation becomes necessary if companies with market power can use their dominant position to exclude competitors; e.g. by preventing new entrants from accessing data, a market leader can use the network effect to widen the quality gap, attracting more users and advertisers or by increasing the switching cost for consumers through a reduction in interoperability with other systems.

For a regulatory intervention, the scarcity of data and the contribution of data to market power need to be assessed. Moreover, to avoid consumers facing high switching costs, regulators could facilitate interoperability by demanding common standards for data capturing and storing, as this would lead to a reduction in costs and facilitate data sharing. Our structural interviews with firms revealed that missing standards are an obstacle to further investment. And standardisation could help to cut costs, as the universal standard for cell-phone chargers demonstrated some years ago.

#### Big data and innovation (positive externality)

Big data will become a core asset as an input good that fosters innovation, ultimately leading to competitive advantages. The availability of large data sets and the ability to analyse them not only helps to speed up the introduction of new inventions but also reduces the time it takes to develop improved products or services, as digital technologies enable, for example, new testing and quality control. We want to look at whether externalities are present in the context of machine-generated data and assess whether the introduction of intellectual property rights can help to reduce market failures.

If a firm builds a new factory or a piece of equipment, it will receive all the economic benefits that are associated with the investments. However, if the firm invests in new technologies, the private profit that the firm receives is only a proportion of the overall social benefit. The social benefit of an innovation considers the value not only of the firm's private profit but also of the positive externalities (i.e. beneficial spillovers to third parties) of the new idea.

The presence of positive externalities leads to under-production of data gathering. The private costs of data gathering are those of installing sensors on machines and the analysis and storage of the data. These costs are passed on to consumers as a positive price. Data gathering produces positive externalities; for example, it can lead other firms to innovate and develop new products. These positive externalities result in a divergence between the private marginal benefit and the social marginal benefit. As firms consider only their private costs and benefits, the divergence between the social marginal benefit and the private marginal benefit of data gathering results in under-production. Thus, the equilibrium output level is lower than the social efficient output. It follows that more data should be gathered, but as firms do not consider external benefits, these are not produced, which results in a deadweight loss (DWL) equal to the unrealised net social welfare gain. The DWL can be reduced with governmental interventions.

*Regulation: what is the effect on innovation?*

To correct market failures due to positive externalities, the regulator could provide subsidies to increase supply. For example, a price for data generation could be paid and the information could be stored and provided publicly, so that all firms could benefit from this knowledge. With the introduction of the subsidy, the price for data gathering would decrease for firms, which would lead to an increase in data gathering. In this way, a subsidy on data gathering could induce firms to internalise the external benefits.

Problems might arise if firms have an incentive to keep the gathered information private. If firms that generate the data are given the ownership right, they are protected, which creates an incentive for a single firm to innovate in the first place. If the generated data are not protected for a long time, and can quickly be used as an input by other firms, dynamic welfare gains can be achieved.

A fundamental characteristic of innovation is that discoveries might come with large investments, whereas using the knowledge obtained after the discovery might involve little effort. For example, the costs of sensors, the cleaning and structuring of data and analytical tools to analyse the gathered data are higher than those of accessing the information. If a firm copies an algorithm or readily available data set, it has not endured the often high R&D cost of development, and hence might be able to sell any product at a significantly lower price than that of the original developer. The prospect of this happening might discourage innovation in the first place, as without any protection from copying the inventor cannot be sure of recovering their initial investment in the R&D process. If the discoveries are not protected for a long time, the knowledge can be used by other firms and may thus be conducive to innovation. There is hence a trade-off between giving ownership rights to gather machine-generated data in the first place and dynamic innovation arrivals due to spillover effects of knowledge sharing.

The ownership right to a data set gives the owner the decision-making power regarding the right. The firm will set a price for selling the right of use to others. Given the market power, this price will be higher than the competitor's, leading to a DWL. This DWL would disappear with price discrimination but the latter is probably difficult to put into practice. The simplest way is to give the owner intellectual property rights. This might result in short-term welfare losses as not all firms can benefit from the knowledge from the beginning, but these welfare losses might be compensated by long-run gains generated by a continuous stream of innovations in the future.

The aim of the regulator is to minimise the DWL by choosing the right timing to assign intellectual property rights. The simplest way of protecting a new invention is through patenting. However, in the EU, copyright law is linked to human creative work. With the arrival of machine-generated data and analytical technologies that lead to new products and services, humans are no longer the only "creators" able to process information and learn from it.

## Conclusion and policy implications

**Digitalisation is well underway in the EU and the US.** In this chapter, we reviewed the evidence on where the EU and US corporate sectors stand in terms of digitalisation activities using a novel firm-level data set. Our key findings are that digital adoption rates are not that different between the EU and the US. By contrast, who is adopting digital technologies differs, with service sector firms less likely to adopt in Europe than the US, and young firms in the EU lagging their US peers.

**Digitalisation has a clear upside.** Digital firms have higher productivity than non-digital firms. When asked about the (causal) effect of adopting a digital technology for their turnover, firms report an average boost of 10%. We also find that digital firms tend to invest more and tend to be more active innovators. While most firms expect digitalisation to lead to more competition in the market in which they operate, digital firms benefit from higher mark-ups and are less likely to anticipate increased competition to change this situation, suggesting strong path-dependency/first-mover advantages in adopting digital technologies.

**Digitalisation also has a downside.** Its positive aspects notwithstanding, the chapter shows that automation (on the back of digital adoption) comes with labour market polarisation, where former mid-level jobs either lose value or disappear, while new, often high-skilled job-profiles linked to digital technologies are in high demand. This flags a need for policymakers to foster a system of lifelong learning that extends from basic skills in formal education to social and emotional skills in vocational training and higher education, and continuous training throughout the working life.

**Europe should act promptly to reap the benefits of the digital era, addressing its long standing structural issues.** Areas where Europe compares less favourably to the US (from the perspective of adopting digital technologies) include: a disadvantageous firm size distribution; market fragmentation; and a higher share of medium-/low-productivity non-digital firms that are not yet ready for digital adoption. The most important obstacles to digital adoption in terms of the economic environment are “lack of skilled staff” and “uncertainty”. These are equally important in the EU and the US. In addition, we find a strong link between “digital infrastructure” and firm adoption activities. In terms of access to finance, our data – while overall similar in both the EU and US – suggest the lack of access to risk capital puts young European firms at a disadvantage compared with their US peers.

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## The EIB: achieving impact through investment in Europe

**The EIB – the EU bank – plays an important catalytic role in promoting sound investment projects in support of EU policy goals in Europe and beyond.** In 2017, the EIB provided EUR 69.9 billion in long-term finance to support private and public productive investment, with the EIF providing EUR 9.3 billion. At a first estimate, together this helped realise investment projects worth roughly EUR 250 billion.

**The EIB is both a bank and a public institution.** As a bank, it raises money on the international capital markets, using its AAA credit rating. As a public institution owned by the 28 Member States of the EU, it lends these funds to finance investment projects that address systemic market failures or financial frictions, targeting priority objectives such as European cohesion, competitiveness and climate action via support for innovation and skills, SMEs, the environment, and strategic infrastructure.

**The Bank's raison d'être as a long-term investor remains to achieve structural impacts** by addressing market failures and frictions, to enhance productivity and competitiveness in line with its four priorities. We play a leading role in Europe in developing financial instruments to crowd-in the private sector and multiply the impact of public funds, helping to support the much-needed re-prioritisation of public support for investments in innovation and infrastructure. Within the EIB Group, the European Fund for Strategic Investments (EFSI) exemplifies this approach and is proving its efficacy.

**In July 2018, the European Commission and EIB jointly announced the finalisation of the first phase of EFSI.** The Fund is expected to mobilise EUR 335 billion of investments across the EU Member States, supporting innovation, access to finance and providing risk-financing opportunities. As the first pillar of the Investment Plan for Europe undertaken by the European Commission and the EIB, EFSI forms an integral part of the EIB Group's activities, further enhancing the Group's capacity to address market failures in risk-taking that hold back investment.

**The EIB Group is responding to the need to boost innovation through support for investment in different kinds of intangibles, including skills.** In 2017, the Group signed operations worth EUR 13.8 billion to support education and skills development, digital infrastructure and the financing of innovative firms. These investments will contribute to improving educational facilities for some 1.1 million students and are expected to help install or upgrade 7.44 million high-speed digital connections. The Bank is a major financier of research and development in Europe, but we also recognise that innovation-related investments go beyond R&D to include a wide range of investment in both tangible and intangible assets. Such diverse investments require a range of financing types, and the Group – particularly through the EIF – is active in fostering the use of instruments such as guarantees, SME loan securitisation and venture capital. Indeed, the EIF is a cornerstone investor in funds in the EU venture capital market, helping this market to develop and expand its geographical reach. The EIB Group is committed to addressing issues of access to finance for SMEs as long as market failures and frictions exist. The Group's support for SMEs, which accounts for some EUR 29.6 billion of EIB Group operations, helps to address financing gaps to foster innovation and make European firms more competitive to sustain and create jobs.

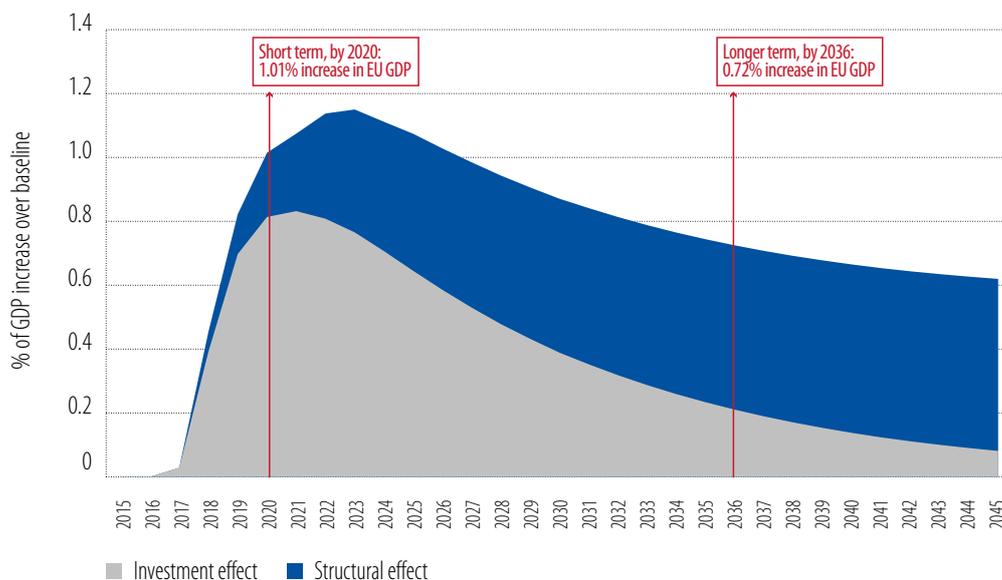
**The EIB is the world's largest multilateral lender for climate action,** with EUR 19.4 billion (28.2% of total financing) provided for climate action projects in 2017. In addition to our commitment of 25% of lending for climate action inside the EU, we have set the ambitious target for climate finance to reach 35% of our lending in developing countries by 2020, while we are also working to mainstream climate action into all our operations. The EIB is also at the forefront of innovation in climate investment instruments to mobilise resources from private investors, such as the highly successful Global Energy Efficiency and Renewable Energy Fund (GEREEF) and the development of green bond markets.

**The recovery of investment requires careful guidance in project planning, preparation and prioritisation between alternatives, at national, regional and municipality levels.** The Bank's advisory activities and

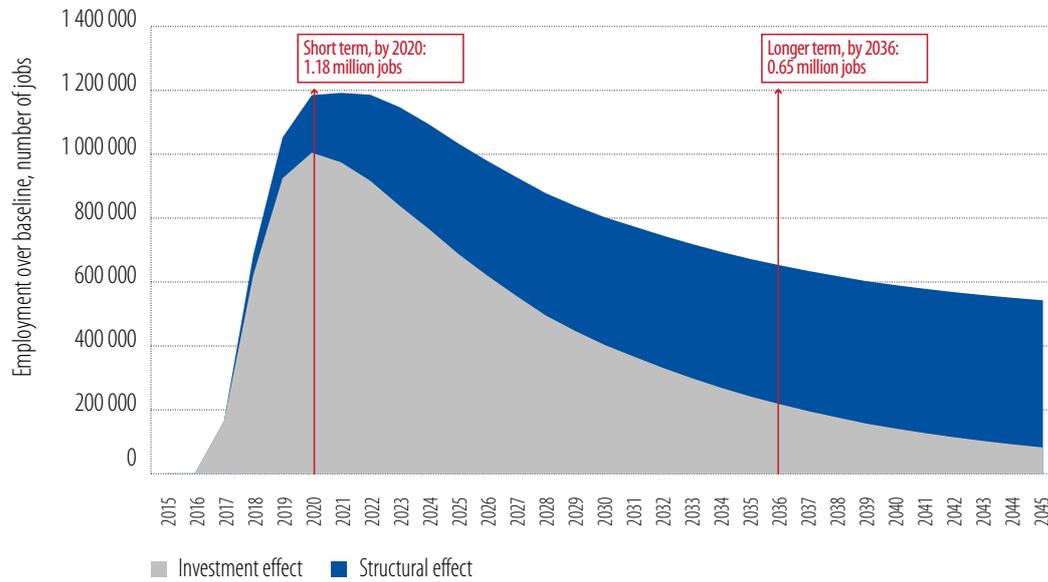
technical assistance can help projects to get off the ground and maximise the impact and value-for-money of investments. The European Investment Advisory Hub (EIAH), implemented as the second pillar of the Investment Plan for Europe, expands the Bank's ability to provide comprehensive technical assistance in the sourcing, preparation and development of investment projects. We also actively work with the European Commission to drive forward the third pillar of the Plan, which focuses on support for reforms to remove bottlenecks and regulatory barriers to ensure an investment-friendly environment, and to facilitate greater EU-level coordination to fully realise the benefits of the single market in areas such as transport and energy. In this context, the Bank's research work – including this report – and the lessons we are able to draw from our project assessment and advisory activities, constitute an important part of the Bank's contribution to EU policy efforts.

**The investments supported by the EIB Group have a strong and lasting impact on the EU economy.** The EIB's economists, together with the European Commission's Joint Research Centre in Seville, Spain, applied the RHOMOLO-EIB model to estimate the overall macroeconomic impact of EIB-supported operations in terms of jobs and growth in the EU. Being a continuation of the last year's exercise, which included 2015 and 2016 operations, the current assessment comprises the EIB Group operations signed in 2017 only. The results, presented in Figures 1 and 2, suggest that EIB-supported investments provide both a short-term boost to the economy (the "investment effect"), which fades over time, and a longer-lasting structural impact on productivity and competitiveness. Hence, by 2020, the investments supported by the EIB Group in 2017 are expected to have raised the level of EU GDP by 1% and to have added nearly 1.2 million jobs. In the long term, this investment effect will wear out, with loans being repaid and capital goods starting to depreciate, but the structural impact of the investments on growth and jobs will remain. By 2036, the expected impact is still estimated at around 0.7% of EU GDP above the baseline scenario and some 650 000 extra jobs.

**Figure 1**  
Expected impact on EU GDP from EIB Group-supported investments signed in 2017



**Figure 2**  
**Expected impact on EU employment from EIB Group-supported investments signed in 2017**



**RHOMOLO-EIB has also been used to assess the impact of EFSI-mobilised investments, from the Fund’s launch until July 2018.** EFSI is estimated to increase EU GDP by 1.3% and to create 1.4 million jobs by 2020. By 2036 the EU GDP increase converges to 0.9%, and there will be around 800 000 more jobs than without the plan.



## Data annex

The availability and quality of the data on investment are critical to supporting effective policymaking. In addition to national accounts, economists need to rely on other sources of macroeconomic data to analyse important aspects of investment, including infrastructure investment and intangible investment, and they increasingly make use of firm-level data.

The EIB has taken important steps towards bridging some of the data gaps by developing an internally consistent methodology to estimate infrastructure investment and PPP finance; by running a survey on corporate investment and investment finance; and by participating in the financing of the production of a database on investment in intangible assets and stocks of intangible capital. This annex outlines these datasets and provides references to detailed methodological notes.

### Estimating infrastructure investment in the European Union

Data on infrastructure investment, let alone its financing sources, are not available in any ready-to-use form. Over the years, the EIB has developed a new methodology to estimate infrastructure investment.

The basic idea is to use Eurostat's national accounts data on gross fixed capital formation (GFCF) in the sectors commonly considered to be "infrastructure sectors" (i.e. education, health, transport and utilities) to construct estimates of total and government infrastructure investment.<sup>1</sup> Private investment is then derived as the difference between the two.

In a next step, the private infrastructure aggregate is broken down with the help of Projectware data. This allows us to distinguish between corporate (non-project) infrastructure investment and investments made through Special Purpose Vehicles (SPVs, i.e. projects). The latter can be further divided into Public-Private Partnership projects and non-PPP projects, using data described in (Kappeler and Nemoz, 2010).<sup>2</sup>

Finally, Revoltella et al. (2016) use newly available Eurostat data on GFCF for a more precise proxy for infrastructure investment, which is GFCF in other buildings and structures.

The new data has the advantage that it excludes many non-infrastructure investments, such as investments in trucks or in other machinery and equipment (that are included in total fixed assets), and therefore reduces the risk of overestimating infrastructure investments. The new Eurostat data also allow us to differentiate between GFCF in the transport sector and in the ICT sector (which were previously lumped together). This gives us a more granular view of individual investment trends across different sectors.

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1 For details see Wagenvoort, R., de Nicola, C., and Kappeler, A. (2010). "Infrastructure Finance in Europe: Composition, Evolution, and Crisis Impact". *EIB Papers*. 15 (1), pp. 16–39. Luxembourg: EIB.

2 Kappeler, A., and Nemoz, M. (2010). *Public-Private Partnerships in Europe – before and during the recent financial crisis*. Luxembourg: European Investment Bank.

Although the new data captures infrastructure investment better, a few caveats remain. The most important one being the fact that the new data do not allow us to distinguish between GFCF in total fixed assets and in other buildings and structures for the government sector – which means that we have to approximate government investment in other buildings and structures. To do so, we use the following formula:

$$GGFCF(obs) = GGFCF(tfa) * \left( \frac{\text{government net capital stock}(obs)}{\text{government net capital stock}(tfa)} - \text{implied depreciation} \right),$$

where GGFCF(obs) and GGFCF(tfa) are government GFCF in other buildings and structures and in total fixed assets respectively and

$$\text{implied depreciation} = \left( \frac{\text{total economy net capital stock}(obs)}{\text{total economy net capital stock}(tfa)} - \frac{GFCF(obs)}{GFCF(tfa)} \right).$$

That is, we use the share of other buildings and structures in the government capital stock as a proxy for the share of government gross fixed capital formation in other buildings and structures (adjusted for differences in depreciation rates). In other words, we assume that the share of government gross fixed capital formation in other buildings and structures is equal to its historical share.

It should be noted that applying this formula requires us to make two minor data adjustments. First, when data on the net capital stock of a country are missing, we replace the missing value with the average net capital stock of the region in which the country is located (i.e. Northern Europe, Southern Europe or Central and Eastern Europe). Second, to deal with outliers, we set negative implied depreciation differentials equal to zero.

## Corporate infrastructure database

To analyse corporate infrastructure investment activities in more detail, we assembled a novel micro-dataset of infrastructure firms. All firms were selected from the Bureau van Dijk ORBIS database, a commercial database of firm balance sheet and profit and loss data.

We identified the firms to be included in the data using a two-stage approach. First, we searched the internet for the main infrastructure firms in Europe by country/sector. This was to be sure that we had included the most important infrastructure firms in the dataset. In a second step, we complemented the list of firms with all those firms that fall into one of the detailed six-digit NAICS codes related to infrastructure activities.<sup>3</sup> Among all firms identified in this way, we kept only those that (i) were listed as active in the ORBIS database; (ii) reported financials in at least one of the last two years (2016–18); and (iii) had a minimum of 49 employees.

This search strategy left us with around 10 000 infrastructure companies overall, which are relatively well distributed across the six main sectors: power, water, transport, ICT, education and health as described in Table 1 below. The sector with the fewest observations is education. This is why, for some of the data-intensive analyses, we do not report separate results for this sector.

<sup>3</sup> Hydroelectric Power Generation, Fossil Fuel Electric Power Generation, Nuclear Electric Power Generation, Solar Electric Power Generation, Wind Electric Power Generation, Geothermal Electric Power Generation, Biomass Electric Power Generation, Other Electric Power Generation, Electric Bulk Power Transmission and Control, Electric Power Distribution, Natural Gas Distribution, Water Supply and Irrigation Systems, Water and Sewer Line and Related Structures Construction, Oil and Gas Pipeline and Related Structures Construction, Power and Communication Line and Related Structures Construction, Rail Transportation, Line-Haul Railroads, Short Line Railroads, Pipeline Transportation of Crude Oil, Pipeline Transportation of Natural Gas, Pipeline Transportation of Refined Petroleum Products, All Other Pipeline Transportation, Air Traffic Control, Other Airport Operations, Other Support Activities for Air Transportation, Support Activities for Rail Transportation, Port and Harbour Operations, Marine Cargo Handling, Navigational Services to Shipping, Wired Telecommunications Carriers, Wireless Telecommunications Carriers (except Satellite), Satellite Telecommunications, All Other Telecommunications, Colleges, Universities, and Professional Schools, General Medical and Surgical Hospitals, Psychiatric and Substance Abuse Hospitals, Specialty (except Psychiatric and Substance Abuse) Hospitals.

**Table 1**  
Distribution of firms in the final sample

Sector	Number of Firms	Share of Firms (%)
Power	1 941	19.04
Water	1 222	11.99
Transport	2 030	19.92
ICT	1 199	11.76
Education	258	2.53
Health	3 542	34.75
Total	10 192	100.00

About 60% of infrastructure firms in our sample are located in the group of “other EU” countries, 25% in the “periphery region” and 15% in the “cohesion countries”. The median size of firms is around 150 employees, with very little variation across sectors. Total fixed assets for the typical infrastructure firm amount to between EUR 3 million in the education sector and EUR 44 million in the power sector (Table 2).

**Table 2**  
Descriptive statistics

	Employees		Total fixed assets (EUR)		Share from		
	mean	median	mean	median	Cohesion	Periphery	Other EU
All Sample	835	150	470m	7.3m	19%	24%	57%
Power	949	147	1.1bn	44m	19%	18%	63%
Water	539	117	260m	6.1m	39%	25%	36%
Transport	948	125	340m	2m	14%	44%	42%
ICT	1 643	134	1.2bn	9m	15%	16%	69%
Education	943	132	87m	3.5m	5%	31%	64%
Health	550	196	33m	6.2m	16%	20%	64%

## EIB Investment Survey

### General Module

The EIB carries out an annual survey of firms in the EU (EIBIS “General Module”) with the aim of monitoring investment and investment finance activities and capturing potential barriers to investment. The survey entails 12 500 completed interviews every year. It is administered by telephone (in the local language) and takes an average of 20 minutes to complete. The first wave of the survey took place in 2016.

Using a stratified sampling methodology, the EIBIS General Module is representative across all 28 Member States of the EU and applies to four firm size classes (micro, small, medium and large) and four sector groupings (manufacturing, services, construction and infrastructure) within countries. Firms have to have a minimum of five employees in order to be interviewed, with full-time and part-time employees counted as one and employees working less than 12 hours per week being excluded. Eligible respondents are senior people with responsibilities for investment decisions.

The survey is designed to build a panel of observations over time, and is set up in such a way that survey data can be linked to firms’ reported balance sheet and profit and loss data (see EIBIS ORBIS matched dataset below). Approximately 40% of the companies interviewed in each wave are companies that have already taken part in the survey in the previous wave. The third wave of the survey took place between April and August 2018.

The EIBIS General Module is intended to complement already available information on investment activities in the EU. It adds a firm-level dimension to available macroeconomic data and thus allows for more fine-grained analysis of firm investment patterns. It also adds to existing firm-level surveys at the national level by providing full comparability of results across countries. The survey complements the EC investment survey by asking a much wider set of both qualitative and quantitative questions on firm investment activities and the ECB/EC SAFE survey by focusing on the link between firm investment and investment finance decisions.

All aggregated data using the EIBIS General Module in this report are weighted by value added to better reflect the contribution of different firms to economic output. The aggregate survey data, questionnaire and a detailed account of the survey methodology are available on [www.eib.org/eibis](http://www.eib.org/eibis).

### EIBIS skills and digitalisation activities

In addition to the “General Module”, every year the EIB carries out a smaller survey (the “Add-on Module”). While the focus and questions of the General Module remain unchanged from one year to the next, the target group and topic of the Add-on Module can vary.

In 2018, the Add-on Module surveyed 1 700 firms on their demand for skills and digitalisation activities in the EU and the US. Eligible respondents were, as for the General Module of the survey, senior people with responsibility for investment decisions. The survey comprised both manufacturing and services sector firms, which were surveyed on, among other things, their awareness of adoption activities with respect to certain digital technologies, barriers to adoption and their views on the impact of digital technologies on labour markets, competition, and investment needs.

The survey was administered by telephone (in the local language) and took an average of 20 minutes to complete. The fieldwork started in April 2018 and continued until August 2018. The vast majority of interviews were conducted between June and August 2018. The sample was stratified by industry group (manufacturing and services sector), size class and region. The four regions were: Cohesion, Periphery, Other EU and the US (with four census regions within the US). Firms had to have a minimum of five employees in order to be interviewed as part of the survey.

In the EU, 888 firms were interviewed, while 800 firms were interviewed in the US. Table 3 gives a detailed overview of how the interviews were distributed.

**Table 3**  
**Survey sampling**

	Manufacturing	Services
<b>Region</b>		
US	411	389
EU	456	432
Cohesion	146	145
Periphery	122	95
Other EU	198	192
<b>Size</b>		
Micro (5-9)	143	172
Small (10-49)	291	333
Medium (50-249)	287	223
Large (250+)	146	93

Survey answers from the Add-on Module in this report are aggregated using employee weights based on Eurostat and Census information, respectively.

To complement the survey and to gain more detailed insights, the EIB's Economics Department consulted 20 firms that had already digitalised to learn more about their experience and views on the implications for investment, employment, competition and firm strategy. With the additional objective of understanding how start-ups deal with digitalisation, several of these interviews were conducted with "born digitals", i.e. companies that had organised their business around digital technologies from the start.

### EIBIS Municipality Survey

In 2017, the EIBIS "Add-on Module" surveyed 555 municipalities in Europe on their infrastructure investment activities and associated barriers.

The survey was administered by telephone (in the local language) and targeted at mayors, treasurers and/or municipalities' chief civil engineers. It took on average (median) 20 minutes to complete. Fieldwork took place between April and August 2017. As part of the survey, 555 municipalities were interviewed in all 28 Member States, split across the following countries and country groupings (regions).

**Table 4**  
**Number of interviews per country/country grouping**

France: 36	Other Northern Europe (Austria, Denmark, Finland, Ireland, Sweden): 92
Germany: 30	Other Southern Europe (Cyprus, Greece, Malta, Portugal): 58
Italy: 30	Other Central Europe (Czech Republic, Hungary, Slovakia, Slovenia): 67
Spain: 30	South East Europe (Bulgaria, Croatia, Romania): 56
Poland: 30	Baltics (Estonia, Latvia, Lithuania): 45
	Benelux (Belgium, Netherlands, Luxembourg): 46
UK: 35	

The sample frame from which municipalities were randomly selected was a comprehensive list of European cities. All larger municipalities were eligible to be included in the exercise. The exact size cut-off was decided country by country to ensure a minimum number of interviews per country, which was between 10 and 35 (depending on the size of the country).<sup>4</sup> The survey results can thus be interpreted as reflecting the views of larger municipalities in each country.

Sector-specific answers were aggregated into an infrastructure aggregate using country-specific sector weights based on public investment shares by sector. Regional and EU-wide figures are weighted using country weights based on the urban population in each country, thus taking into account size differences across countries. Within countries, answers are unweighted, giving each municipality the same weight.

More information about the design of the Municipality Survey can be found in the 2017 EIBIS technical report. Detailed results of the survey are published in a separate publication entitled "EIBIS 2017: Municipality Infrastructure Investment Activities". Both publications are available at [www.eib.org/eibis](http://www.eib.org/eibis).

<sup>4</sup> The sample was generally provided at a ratio of 5:1 (for each completed interview).

### EIBIS Representativeness

The EIB Investment Survey is designed to be representative for the EU, at the country level and for most countries at the country-industry-group and country-size-class level.

In a forthcoming EIB working paper, we assessed the data quality of EIBIS. We did this in two steps: first we benchmarked the sampling frame from which all survey respondents are drawn, the Bureau van Dijk ORBIS database, against two other databases to see how well it captures the (relevant) business population.

In a second step, we then compared the final EIBIS sample against random draws of firms from the same sampling frame. We did this on the basis of the financial information included in the sampling frame. The purpose of this exercise was to assess whether and to what extent firms' (un-)willingness to participate in the survey may have led to a selection bias.

Overall, the results are very positive. The comparison of the Bureau van Dijk ORBIS dataset against the Eurostat Structural Business Statistics (SBS) for the relevant sector/size classes showed coverage ratios (i.e. number of firms in ORBIS/number of firms in the SBS database) between 75% and 100% for the majority of countries. In a few countries, it is between 50% and 75% and in only three countries, CY, GR and LU, the coverage ratios falls below 50%.<sup>5</sup>

A comparison of the ORBIS database against the CompNet database also suggests a good coverage of ORBIS. The CompNet data is based on a "distributed micro-data approach"; relevant data is extracted from often confidential firm-level datasets available within National Central Banks or National Statistical Institutes and aggregated so that the confidentiality of firm data is preserved. The final outcome is a wide range of indicators at the country-sector-size-class level.

To assess the coverage of the EIBIS sampling frame, we reproduced the same country-sector-size-class level indicators using the ORBIS database (where possible) and compared them against those in the CompNet dataset. What we found is a very close match between the two datasets, with the evolution of financial variables in ORBIS and the CompNet database resembling each other closely.

Having a sampling frame that covers a high percentage of the population of interest is a necessary condition for the EIBIS survey results to closely reflect what is happening in the non-financial corporate sector in the EU. It is not a sufficient one, however, insofar as, like any other survey, EIBIS runs the risk of selection bias if there are systematic differences between firms that are willing to participate in the survey and firms that are not.

To test whether, and if so, to what extent the EIBIS sample is subject to such selection issues, we compared the distribution of a set of financial ratios in the final EIBIS sample against those of five randomly drawn samples from the same sampling frame. The financial ratios were calculated using information in ORBIS. The idea was that if the distributions between the EIBIS sample and the random samples are statistically identical, this provides evidence that selection bias does not pose a major issue for representativeness and vice versa.

Using a Kolmogorov-Smirnov approach to compare the two samples, we find that for almost all countries, the percentage of variables for which the null hypothesis of equal distribution in the EIBIS and random samples is rejected is very low, suggesting a high degree of resemblance between EIBIS and the random sample.<sup>6</sup> In other words, comparing the final EIBIS sample with a series of random samples from the same sampling frame, we find little evidence of sampling bias in our data.

<sup>5</sup> An important driver of the positive coverage ratio is that EIBIS samples firms with five or more employees. Coverage ratios tend to be higher for larger firms. So, excluding the smallest firms from sampling significantly boosts coverage.

<sup>6</sup> The Kolmogorov-Smirnov (KS) test is a nonparametric statistical test for the equality of probability distribution between two samples. Differently from a t-test, KS does not just compare the means of a variable, but tests the null hypothesis that two samples are drawn from the same distribution by quantifying the distance between the empirical distribution functions of two samples. That is, it compares the shapes of the two distributions and evaluates whether the vertical differences between them are statistically significant.

More information on both the EIBIS General Module and the Add-on Module can be provided upon request: [eibis@eib.org](mailto:eibis@eib.org)

## EIBIS-Orbis matched dataset

This report includes analysis based on a dataset that combines firm-level information from Bureau van Dijk's Orbis with the first survey round of EIBIS – the EIBIS-Orbis matched dataset. The matching was carried out by the current survey provider IPSOS to preserve firms' anonymity. Orbis is a proprietary dataset that contains firm-level accounting information and ownership data, gathered and standardised to the so-called "global format" that makes accounting data comparable across jurisdictions. Items from the balance sheet and profit-and-loss accounts have been used to construct standard financial ratios for firms that reflect financing activity and financial health. All data were reviewed following standard cleaning procedures to eliminate outliers and inconsistencies. Negative values for fixed assets, total assets and other stock variables were removed and all ratios have been winsorised at 1% level.

The matched dataset complements the cross-sectional perspective of EIBIS with time series information starting in 2000. It makes it possible to construct custom panel datasets used in several analyses in this report.

## Patent Data

The firm-patent data used in this publication comes from the Bureau van Dijk ORBIS database. The information source for all patent-related information in ORBIS is the PATSTAT database, established and maintained by the European Patent Office (EPO). PATSTAT is a worldwide database containing bibliographical data on the majority of patents currently in force.

The match between ORBIS and PATSTAT was carried out by Bureau van Dijk under a mutual agreement with the OECD (Organisation for Economic Cooperation and Development). An in-depth study of the data quality shows a good coverage of the patenting information contained in ORBIS. For more details, see Squicciarini and Dernis (2013).

## The EU Industrial R&D Investment Scoreboard

The EU Industrial R&D Investment Scoreboard provides economic and financial data and analysis of the top global corporate R&D investors. It is based on company data extracted directly from each company's annual report. The main indicators are R&D investment, net sales, capital expenditures, operating profits and number of employees.

The Scoreboard has been conducted annually since 2004. The 2017 edition comprises the 2 500 companies investing the largest sums in R&D in the world and an additional 433 companies to provide data on the top 1 000 R&D investing companies based in the EU. In total, there are 2 933 companies incorporated in the 2017 Scoreboard. The total amount of R&D investment of companies included in the Scoreboard (EUR 741.6 billion) is equivalent to more than 90% of the total expenditure on R&D financed by the business sector worldwide.

In order to avoid double counting, only data from parent or independent companies are considered. Normally, these companies integrate into their consolidated accounts the data of their subsidiary companies. Companies' R&D rankings are based on information taken from the companies' latest published accounts. For most companies these correspond to calendar year 2016.

The data rely on the disclosure of R&D investment in companies' published annual reports and accounts, but due to different national accounting and disclosure practices, companies of some countries are less likely than others to disclose R&D investment consistently. For example, it is a legal requirement in some countries for R&D investment to be disclosed in company annual reports. For these reasons, companies

from some countries in Southern or Eastern Europe might be under-represented while others such as companies from the UK could be over-represented.

## Investment in climate change mitigation

Investment in CCM comprises renewable energy, networks, energy efficiency, transport infrastructure, agriculture land use/land use change and forestry, and research and development. It includes investments that would be economically and financially viable without placing any special value on greenhouse gas abatement, as well as those that would be unattractive if not for the climate imperative.

### Renewable energy

Data from the International Energy Agency (IEA) and Bloomberg New Energy Finance (BNEF) are the basis for the estimates of investment in renewable energy presented in this chapter.

IEA estimates are based on analysis of annual capacity additions and unit investment costs, derived in part from surveys with industry, IEA Technology Collaboration Programmes, the International Renewable Energy Agency (IRENA) and other organisations. Investment does not include operating and maintenance expenditures, financing costs, research and development spending, mergers and acquisitions or debt and equity market transactions. Investment outlays are counted in the year that an asset becomes operational. Thus, the investment for 2017 actually reflects spending carried out in previous years too.

BNEF estimates are based on disclosed deal values, or BNEF estimates based on comparable transactions. Investment outlays are counted on the date of financial close. The estimates include all biomass and waste-to-energy, wave and tidal; geothermal and wind generation > 1 MW; hydro 1–50 MW; biofuels > 1 million l/y; all solar projects (<1 MW counted as distributed capacity).

### Networks

Investment in electricity networks includes transmission, distribution and grid-scale battery storage. The data reflect three drivers: investment in new infrastructure to accommodate new demand; investment to replace ageing infrastructure; and the investment required to integrate renewables into the power system. Network investment to accommodate new demand is calculated based on the commissioning of new transmission and distribution lines and on the analysis of data provided by the 2016 NRG Expert Transmission and Distribution Database. The applied unit investment costs are based on past capital expenditures and data from industry surveys. Investment in asset replacement assumes an average lifetime of 40 years for assets already in operation. Unit replacement costs are derived from costs of new infrastructure. Investment costs of transmission and distribution networks required for renewables integration are derived from renewable integration costs based on literature reviews. The analysis of investments in the digitalisation of the electricity grid is based on analysis of NRG, BNEF and MarketsandMarkets. Investment in grid-scale electricity storage is based on the capacity deployment reflected in the US Department of Energy's Global Energy Storage Database. Investment in pumped-hydro storage, the largest component of global storage investment, is included in the hydropower data of WEI 2018.

### Energy efficiency

There are no official data on investment in energy efficiency, and estimating it presents some unique challenges. Energy efficiency is typically a component of a larger investment. For example, when a piece of machinery is replaced, the new machinery might have a number of enhancements, including lower energy consumption. Energy efficiency investments are made by many agents – both public and private – across many sectors, including households and enterprises. Dedicated financing for energy efficiency is in its infancy. This means that for the majority of investments, the source of financing does not provide a clear-cut distinction between energy efficiency and other aspects of the investment.

Two broad approaches to estimating energy efficiency investment have been taken by the IEA. The bottom-up approach calculates for a given country the additional cost of the 25% most efficient appliances over and above the average cost of appliances in a given category. For example, in the area of residential lighting, energy efficiency investment would be estimated as the number of high efficiency light bulbs purchased times the cost difference between a high-efficiency bulb and a regular bulb.

The top-down approach estimates how much would have been spent on energy if aggregate energy intensity remained fixed from one year to the next. This is the monetary value of the energy efficiency savings. Combined with an assumption about the payback period of energy efficiency investments this yields an estimate of how much would have been invested to yield the observed reduction in energy use. In comparison with the bottom-up approach, the top-down approach has the advantage of requiring less data, but it has two disadvantages. First energy intensity is not energy efficiency, and to the extent that reductions in energy use resulted from structural shifts to lower-energy activities, the top-down approach would overestimate efficiency investment. Second, there is inevitably some overlap between the top-down measure of energy efficiency and the other categories of CCM investment used in this report. For example, switching from fossil fuels to renewable energy has a large impact on aggregate energy intensity. Also, improvement in vehicle efficiency is hard to distinguish in the aggregate data from reductions in energy consumption due to investment in transport infrastructure.

Bottom-up estimates of investment in energy efficiency are not available prior to 2015. To estimate the previous years, a top-down methodology was used. Imputed energy savings are calculated on the basis of changes in aggregate energy intensity. The savings are smoothed out using a three-year moving average. Investment is assumed to be proportional to the smoothed out energy savings, and the model is calibrated to agree with the 2017 bottom-up estimate.

### Transport infrastructure

CCM investment in transport infrastructure is estimated on the basis of OECD International Transport Forum data on capital formation in rail and inland waterways. The data are available up to 2015, and 2017 is estimated holding the ratio to gross fixed capital formation constant at the 2016 level.

The statistics are based on a survey of total gross investment (defined as new construction, extensions, reconstruction, renewal and major repair). Member countries supply data in current prices. OECD reports that despite the relatively long time series, complexities with regard to data definition and coverage have rendered international comparisons difficult. The indicators such as the investment share of GDP depend on a number of varying factors, such as the quality and age of existing infrastructure, the maturity of the transport system, the geography of the country, and the transport intensity of its productive sector. OECD therefore advises caution when making comparisons of investment data between countries, and instead would encourage studying the evolution of individual countries or aggregates over time.

### Forestry

Available data on gross fixed capital formation in forestry are taken from Eurostat, Statistics Explained: Forests, forestry and logging. The data go up to 2014. Subsequent years are estimated by assuming that the ratio of forestry to gross fixed capital formation remains constant.

### Research and development

The chapter uses four sources of information on R&D.

- OECD survey data for government R&D. These data are available up to 2013 for most countries and for some countries in 2014. CCM R&D is assumed to be composed of the following top-level categories in the database: energy efficiency, renewable energy, hydrogen and fuel cells, other power storage technologies, and other cross-cutting technologies. In addition, carbon capture and storage (which is

under fossil fuel technologies in the database) is included in the analysis. These data refer to government expenditure at the national level and do not include EU programmes.

- IEA data on corporate R&D spending on clean energy up to 2017, with state-owned enterprises (partly overlapping with public R&D) up to 2016.
- BNEF estimates of public and corporate R&D.
- EIB financing of R&D in manufacturing sectors, including automotive, chemicals and other manufacturing.

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## Glossary of terms and acronyms

ABS	Asset-backed security.
Adaptation	Addresses the risks posed by climate change rather than the underlying causes.
Adopting firms	Firms that have no substantial R&D (R&D-to-sales ratio lower than 0.1%) but have introduced or developed new products, processes or services, according to the EIB Investment Survey (EIBIS).
AFME	Association for Financial Markets in Europe.
AMECO	The annual macro-economic database of the European Commission's Directorate General for Economic and Financial Affairs.
APP	Asset Purchase Programme: ECB purchase programmes under which private and public sector securities are purchased to address the risks of an excessively prolonged period of low inflation.
ATT	Average treatment effect on the treated: The average effect of a given treatment on the group of individuals that received the treatment (as opposed to, for example, the effect of the treatment averaged across all individuals in a study, regardless of whether or not they received the treatment).
B2B	Business to business: Trade conducted via the internet between businesses.
B2C	Business to consumer: Trade conducted via the internet between businesses and consumers.
Baltics	Estonia, Latvia and Lithuania.
Basic firms	Firms that have no substantial R&D (R&D-to-sales ratio lower than 0.1%) and have not introduced or developed new products, processes or services, according to the EIB Investment Survey (EIBIS).
Benelux	Belgium, the Netherlands and Luxembourg.
Beveridge curve	A graphical representation of the relationship between unemployment and the job vacancy rate, with the number of unfilled jobs expressed as a proportion of the labour force.
BFAVAR	Bayesian factor vector autoregressive model.
Big data	Extremely large data sets that may be analysed computationally to reveal patterns, trends and associations, especially relating to human behaviour and interactions.
BIS	Bank for International Settlements (Basel, Switzerland).

Blending	Tools to help investors blend financing with additional sources. Blending can include a grant element or guarantees.
BLS	Bank Lending Survey: ECB survey carried out four times a year, which provides information on bank lending conditions in the euro area.
bn	Billion (1 000 million).
BNEF	Bloomberg New Energy Finance.
Born digital	Young firms that are digital from day one, with a business model that is centred on one or more digital technologies.
Bureau van Dijk's Orbis database	Database of private and listed company information from around the world that includes, among others, companies' financial accounts, ownership structures and details of mergers and acquisitions activity.
CAGR	Compound annual growth rate.
Capex	Capital expenditures.
Capital cost	A cost deriving from, or forming part of, capital expenditure on a project.
CCI	Credit condition indicator.
CCM	Climate Change Mitigation. Mitigation addresses the underlying causes of climate change.
Cedefop	European Centre for the Development of Vocational Training.
CEO	Chief Executive Officer.
CET1 ratio	Common Equity Tier 1 Ratio: Regulatory ratio computed for banks in order to assess their capacity to withstand major shocks. Core Tier 1 capital divided by risk-weighted assets. The ratio must be above a level determined in the so-called Basel III package.
CEE	Central and Eastern Europe.
CESEE	Central, Eastern and Southeastern Europe.
CFC	Consumption of fixed capital.
CMU	Capital Markets Union: EC action plan to establish the building blocks of an integrated capital market in the EU by 2019.
COFOG	Classification of the functions of government.
Cohesion countries	Bulgaria, Croatia, the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Romania, Slovakia, and Slovenia.
CSPP	Corporate Sector Purchase Programme.

DDM	Dividend Discount Model: a method of valuing a company's stock price based on the theory that its stock is worth the sum of all of its future dividend payments, discounted back to their present value.
De-meaning	Subtracting the sample mean from each observation so that they are mean zero.
Depreciation	A reduction in the value of an asset over time, due in particular to wear and tear; a decrease in the value of a currency relative to other currencies.
DESI	The Digital Economy and Society Index: A composite index that summarises relevant indicators on Europe's digital performance and tracks the evolution of EU Member States in digital competitiveness.
Developers	Firms that have substantial R&D (R&D-to-sales ratio equal to or higher than 0.1%) but have not introduced or developed new products, processes or services, according to the EIB Investment Survey (EIBIS).
Digital	Firms that have partially or fully implemented at least one of the four digital technologies in recent years (see "digitalisation").
Digitalisation	The adoption of one of four digital technologies in the manufacturing and services sectors respectively. The technologies include "3D-printing", "advanced robotics", "Internet of Things (IoT)", and "big data" in the manufacturing sector, and "digitalisation of internal routines", "web-based applications for marketing and sales", "provision of digital products or services over the internet", and "big data" in the services sector.
Dominance analysis	A method that enables a researcher to decompose the total predicted variance of a regression model in order to investigate the relative importance of each predictor within the model.
DSM	Digital Single Market.
DWL	Deadweight Loss: a cost to society created by market inefficiencies.
EBA	European Banking Authority.
EBIT	Earnings before interest and taxes.
EBITA	Earnings before interest and taxes and amortisation.
ECB	European Central Bank.
EIBIS	European Investment Bank Investment Survey.
EIB Digital and Skills Survey 2018 (EIBIS add-on module)	In 2018, the EIB conducted a survey of 1 700 firms in manufacturing and services in the EU and the US on the back of the EIB Investment Survey (EIBIS).
EIF	European Investment Fund.

EE	Energy efficiency.
EED	Energy Efficiency Directive: a set of binding measures to help the EU reach its 20% energy efficiency target by 2020.
EFB	European Fiscal Board.
EMTF	Effective marginal tax rate.
Energy efficiency gap	The difference between the cost-minimising level of energy efficiency and the level of energy efficiency actually achieved.
Energy intensity	Energy consumption divided by activity, e.g. energy/GDP.
Energy only markets	Electricity markets that rely solely on the price signals from the day-ahead (wholesale) market.
Energy audit	An assessment of the energy needs and efficiency of a building or buildings.
EPEC	European PPP Expertise Centre.
EPBD	Energy Performance of Buildings Directive.
EQI	European Quality of Government Index.
Erasmus+	EU programme to support education, training, youth and sport in Europe.
ERP	Equity risk premium: the excess return that investing in the stock market provides over a risk-free rate.
ESD	Energy Service Directive.
ESRB	European Systemic Risk Board.
ETS	EU emissions trading system.
EU	The 28 Member States of the European Union (taken as a whole when used for data comparison with other groups).
EU Industrial R&D Investment Scoreboard	Economic and financial data and analysis of the top corporate R&D investors (top 2 500 global R&D companies and top 1 000 EU R&D companies) based on company data extracted directly from each company's annual report.
EU-LFS	EU Labour Force Survey.
EV	Electric vehicles.
External finance	In the EIB Investment Survey, this consists of: bank loans excluding subsidised bank loans, overdrafts and other credit lines; other terms of bank finance including overdrafts and other credit lines; newly issued bonds; newly issued equity (including quoted or unquoted shares); leasing or hire purchase; factoring/invoice discounting; loans from family/friends/business partner; grants (financial support or subsidies from regional or national government); and funding provided by the public sector.

FAVAR	Factor augmented vector autoregressive model.
FCI	Financing condition index. Finance constrained: In the EIB Investment Survey (EIBIS), a firm is considered finance constrained if it was (i) rejected when seeking any external financing for an investment; (ii) quantity constrained (dissatisfied with the terms and the amount received in the last request for external financing); (iii) price constrained (the firm did not apply because it thought the conditions of external financing would be too expensive); or (iv) discouraged from seeking any external financing (the firm did not apply because it thought the application would be turned down).
FDI	Foreign Direct Investment.
Fintech	Financial technology: Computer programs and other technology used to support or enable banking and financial services.
FiT: Feed-in tariffs	Guaranteed payments made to households or businesses generating electricity from renewables for a predefined period.
FUII	Financing Union for Investment and Innovation.
Fully digital	Firms that have fully implemented at least one of four digital technologies in recent years (see “digitalisation”). The technologies include “3D-printing”, “advanced robotics”, “Internet of Things (IoT)”, and “big data” in the manufacturing sector, and “digitalisation of internal routines”, “web-based applications for marketing and sales”, “provision of digital products or services over the internet”, and “big data” in the services sector.
GDP: Gross domestic product	The total value of goods produced and services provided in a country during one year.
GDPR	(European) General Data Protection Regulation.
GFCF: Gross Fixed Capital Formation	The net increase in physical assets (investment minus disposals) within the measurement period. It does not account for the consumption (depreciation) of fixed capital, and also does not include land purchases. It is a component of the expenditure approach to calculating GDP.
GHG	Greenhouse gases.
GNP: Gross national product	The total value of goods produced and services provided by a country during one year, equal to the gross domestic product plus the net income from foreign investments.
HGEs: High growth enterprises	Enterprises that have an average annual growth rate of turnover greater than 10% per year over a minimum of three years and at least ten employees at the beginning of the growth period.
HICP	Harmonised index of consumer prices

High-technology manufacturing sectors	Pharmaceutical products and preparations; computer, electronic and optical products (NACE codes 21 and 26).
High-tech knowledge-intensive services	Motion picture, video and television programme production, sound recording and music publishing; programming and broadcasting; telecommunications; computer programming, consultancy and related activities; information services; scientific research and development (NACE codes 59 to 63 and 72).
Hollowing out	The process by which the shares of total employment in high-ranked and low-ranked jobs in terms of wages have expanded relative to middle-ranked jobs over time.
Human capital	The knowledge, skills, competencies and other attributes embodied in individuals or groups of individuals acquired during their life and used to produce goods, services or ideas in market circumstances.
ICE	Internal combustion engine (usually driven by burning fossil fuels, e.g. oil or petrol).
ICT	Information and communications technology.
IEA	International Energy Agency.
IMF	International Monetary Fund.
Incremental innovators	Firms that have substantial R&D (R&D-to-sales ratio equal to or higher than 0.1%) and have introduced or developed products, processes or services that are new to the company, according to the EIB Investment Survey (EIBIS).
Information asymmetry	A situation in which one party to an economic transaction (usually the seller) possesses greater material knowledge than the other party (usually the buyer); also called asymmetric information.
Infrastructure	Infrastructure as defined for the EIB Infrastructure Database includes the following sectors for its macro-analysis: transport, utilities, health, education and communication. Infrastructure in the EIB Municipalities Survey captures urban transport, social housing, ICT, health, education and the environment.
Infrastructure governance	Governments' readiness to respond to the diverse and complex issues involved in infrastructure decision-making, according to the Hertie School of Governance infrastructure governance indicators.
Infrastructure sector	Based on the NACE classification of economic activities, firms in groups D and E (utilities), group H (transportation and storage) and group J (information and communication).
Innovative firms	Leading innovators. Firms that have substantial R&D (R&D-to-sales ratio equal to or higher than 0.1%) and have introduced or developed products, processes or services that are new to the country or to the global market.

Institutional sectors	The general government, corporations and households are the three institutional sectors in this report.
Intangible investment	In the EIB Investment Survey (EIBIS), intangible investment consists of investment in: research and development (including the acquisition of intellectual property); software, data, IT networks and website activities; training of employees; organisation and business process improvements (including restructuring and streamlining).
Internal finance	In the EIB Investment Survey (EIBIS), internal finance consists of internal funds or retained earnings (e.g. cash, profits).
Investment intensity	Investment expenditure per employee.
IoT: Internet of Things	The interconnection via the Internet of computing devices embedded in everyday objects, enabling them to send and receive data.
IPO	Initial public offering.
IPP	Intellectual property products: In the European System of Accounts, intellectual property products are defined as fixed assets that consist of the results of research and development, mineral exploration and evaluation, computer software and databases, entertainment, literary or artistic originals and other intellectual property products, as defined below, intended to be used for more than one year.
IRENA	International Renewable Energy Agency.
IRR	Internal rate of return.
ISCED	International Standard Classification of Education: A statistical framework for organising information on education.
KIS	Knowledge-intensive sectors.
KLEMS	An EU industry-level growth and productivity research project. KLEMS stands for EU level analysis of capital (K), labour (L), energy (E), materials (M) and service (S) inputs.
Knowledge-intensive market services	Water transport; air transport; legal and accounting activities; activities of head offices, management consultancy; architectural and engineering, technical testing and analysis; advertising and market research; other professional, scientific and technical activities; employment activities; security and investigation activities (NACE codes 50, 51, 69, 70, 71, 73, 74, 78, 80).
Large companies	Firms with at least 250 employees.
LCOE	Levelised Cost of Electricity: The unit cost of a generating asset over its lifetime.

Leading innovators	Firms that have substantial R&D (R&D-to-sales ratio equal to or higher than 0.1%) and have introduced or developed products, processes or services that are new to the country or to the global market, according to the EIB Investment Survey (EIBIS).
Less developed regions	EU NUTS 2 regions with GDP per capita below 75% of the EU average.
LIFE	L'Instrument Financier pour l'Environnement programme (the EU's funding instrument for the environment and climate action).
Low-carbon economy	An economy based on low-carbon power sources (i.e. not based on fossil fuels).
LPs	Limited Partners.
Low-technology manufacturing sectors	Sectors with NACE codes 1–18 and 31–32.
LULUCF	Land use, land-use change and forestry sector.
Manufacturing	Based on NACE classification of economic activities, firms in group C (manufacturing).
Mark-up	The ratio of the cost of a good or service to its selling price, expressed as a percentage of the cost.
Medium-high-technology manufacturing sectors	Chemicals; electrical equipment; machinery and equipment; motor vehicles; other transport equipment (NACE code 20 and NACE codes 27–30).
Medium-low-technology manufacturing sectors	Coke and refined petroleum products; rubber and plastic products; other non-metallic mineral products; basic metals; fabricated metal products, except machinery and equipment (NACE codes 19, 22–25 and 33).
More developed regions	EU NUTS 2 regions with GDP per capita above 90% of the EU average.
MW	Megawatt.
MWh	Megawatt hour.
NACE	"Nomenclature statistique des activités économiques dans la Communauté européenne": Statistical Classification of Economic Activities in the European Community, the industry standard classification system used in the European Union.
NAICS	North American Industry Classification System.
NAIRU	Non-accelerating inflation rate of unemployment: The specific level of unemployment that is evident in an economy that does not cause inflation to rise.
NAWRU	Non-accelerating wage rate of unemployment: The level of unemployment at which wage growth might be kept stable.

NBER	National Bureau of Economic Research.
NEET	Young person who is “Not in Education, Employment or Training”.
NFCs	Non-financial corporations.
Non-digital	Firms that have not yet implemented any of four digital technologies considered in recent years or have not heard of them (see “digitalisation”). The technologies include “3D-printing”, “advanced robotics”, “Internet of Things (IoT)”, and “big data” in the manufacturing sector, and “digitalisation of internal routines”, “web-based applications for marketing and sales”, “provision of digital products or services over the internet”, and “big data” in the services sector.
Non-PPP projects	Projects carried out by project companies (SPVs) that are not public-private partnerships.
NPLs	Non-performing loans.
NUTS	Nomenclature des unités territoriales statistiques: Nomenclature of territorial units for statistics: A hierarchical system for dividing up the economic territory of the EU.
OECD	Organisation for Economic Co-operation and Development.
Old	Firms more than ten years old.
Other EU countries (“other”)	Austria, Belgium, Denmark, Finland, France, Germany, Luxembourg, the Netherlands, Sweden, and the United Kingdom.
Other knowledge-intensive services	Publishing; veterinary activities; public administration and defence, compulsory social security; education; human health; residential care; social work; creative, arts and entertainment; libraries, archives, museums and other cultural activities; gambling and betting; sports activities and amusement and recreation (NACE codes 58, 75, 84–88, 90–93).
Output gap	The amount by which the actual output of an economy falls short of its potential output.
Partially digital	Firms that have partially implemented at least one of four digital technologies in recent years (see “digitalisation”). The technologies include “3D-printing”, “advanced robotics”, “Internet of Things (IoT)”, and “big data” in the manufacturing sector, and “digitalisation of internal routines”, “web-based applications for marketing and sales”, “provision of digital products or services over the internet”, and “big data” in the services sector.
PE	Private equity.

Perceived gap	Firms' perceived investment gap computed on their responses to the question: Looking back at your investment in the past three years, would you say that investments have been in line with your needs, above your needs or below your needs to ensure the competitiveness of your company going forward?
Percentile	Each of the 100 equal groups into which a population or other data can be divided according to the distribution of values of a particular variable.
Periphery countries	Cyprus, Greece, Ireland, Italy, Portugal and Spain.
PIM	Perpetual inventory method: Used to estimate stocks of capital using investment flows. It is based on the idea that stocks constitute cumulated flows of investment, corrected for retirement and efficiency loss; it is calculated by type of assets, thus differentiating (at least) by categories such as dwellings, buildings, infrastructure, machinery, equipment, weapons and intellectual property products.
PISA	Programme for International Student Assessment: A worldwide study to evaluate educational systems by measuring 15-year-old school pupils' scholastic performance in mathematics, science and reading.
Potential GDP	See potential output.
Potential output	Potential output refers to the highest level of real gross domestic product that can be sustained over the long term with the available resources and labour efficiency. Potential output depends on the capital stock, the potential labour force (which depends on demographic factors and on participation rates) and the level of labour efficiency.
PPP	Public-private partnership; purchasing power parity.
Procyclical	A positive correlation between the value of a good, a service or an economic indicator and the overall state of the economy, growing when the economy grows and declining when the economy declines.
Production processes	Processes related to actual production, e.g. machinery and equipment.
PSM	Propensity score matching.
R&D	Research and experimental development.
RCI	Regional competitiveness index.
RES	Renewable energy source.
S&P 500	Standard and Poor's Index of 500 of the largest stocks that trade on the New York Stock Exchange and Nasdaq.
SAFE	Survey on Access to Finance for Enterprises: A survey on the access to finance of small and medium-sized enterprises conducted by the ECB and the European Commission.

Securitisation	The conversion of an asset, especially a loan, into marketable securities, typically for the purpose of raising cash by selling it to other investors.
Services	Based on the NACE classification of economic activities, firms in group G (wholesale and retail trade) and group I (accommodation and food services activities).
Skill categories	Classification of staff based on their responses to the question: Thinking about all the staff you employ, could you estimate what proportion is mostly engaged in "routine" tasks/"manual" work?
Slack	The discrepancy between the volume of work desired by workers and the actual volume of available work. It describes the unmet demand for paid labour in the population.
Smart grids	Electricity supply networks that use digital communications technology to detect and react to local changes in usage.
SMEs	Small and Medium-sized Enterprises: Firms with fewer than 250 employees.
SMEsec	SME securitisation: Transactions backed by SME loans, leases and other products.
SPV	Special purpose vehicle: A subsidiary company with an asset/liability structure and legal status that makes its obligations secure, even if the parent company goes bankrupt.
Support processes	Processes supporting production, e.g. lighting, ventilation and compressed air production.
Tangible investment	Investment in, for example, land, business buildings and infrastructure or machinery and equipment, as defined in the EIB Investment Survey (EIBIS).
Tech sector	In the EU Industrial R&D Investment Scoreboard, the tech sector refers to electronic and electrical equipment; technology hardware and equipment; software and computer services.
TFP	Total factor productivity: The efficiency in combining production factors to create added value.
Tobin's $q$	The ratio of the market value of a company's assets (as measured by the market value of its outstanding stock and debt) to the replacement cost of the company's assets (book value).
Transition regions	EU NUTS 2 regions with GDP per capita 75%–90% of the EU average.
UNCTAD	United Nations Conference on Trade and Development.
UNESCO	United Nations Educational, Scientific, and Cultural Organization.

UNFCCC	United Nations Framework Convention on Climate Change.
VAT	Value added tax.
VC	Venture capital: A type of private equity focused on start-up companies with high growth potential.
WACC	Weighted average cost of capital.
WEF	World Economic Forum.
WEF Infrastructure Quality Score	Question from the World Economic Forum's Global Competitiveness Report: How would you assess general infrastructure (e.g. transport, telephony, and energy) in your country? 1 = extremely underdeveloped; 7 = extensive and efficient by international standards.
WGI	World Governance Indicators.
Young	Firms less than ten years old.



# INVESTMENT REPORT 2018/2019



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