

# Online appendix to Chapter 2: Growth, tangible and intangible investment in the EU and US before and since the Great Recession<sup>1</sup>

## Measuring Intangible Investments: the INTAN-Invest database

The INTAN-Invest estimates reported in this paper (INTAN-Invest 2016) are the result of a complete revision and update of previous INTAN-Invest data. INTAN-Invest 2016 estimates are based on the same estimation strategy adopted to produce previous releases of INTAN-Invest estimates. However, new data sources have become available since estimates for previous benchmark years were produced. In order to fully exploit the new data sources, a complete revision of previous estimates was needed.

The main pillar of the INTAN-Invest estimation strategy is the adoption of the expenditure-based approach to measure the value of investment in intangible assets (i.e. expenditure data are used to develop direct measures of intangible investment). Moreover, the project has the goal of generating measures of harmonised intangible investment satisfying (as much as possible) the following criteria: exhaustiveness, reproducibility, comparability across countries and over time, and consistency with official national accounts data (since our aim is to generate measures of intangible investment consistent with other national accounts aggregates, such as output, investment in tangible assets, intermediate costs, compensation of employees and employment)

The above characteristics are assured by the adoption of official data sources that are homogeneous across countries. An implication of the adopted estimation strategy is that our estimation methods can be applied only for the years when national accounts data are available. For EU countries, the starting date of national accounts data from the Eurostat database usually ranges from 1995 (for almost all countries) to 2000 (and even more recent years for detailed data on GFCF by industry in a few countries). The relatively short time coverage for European countries is one of the main weaknesses of our database, because a longer time period would be preferred for the analysis of economic growth.

The industry and sector coverage in INTAN-Invest 2016 has changed with respect to the previous INTAN-Invest releases. New estimates cover total investment in industries from NACE sections A to M (excluding M72) and section S plus the market sector component of NACE M72, P, Q and R (while previous INTAN-Invest estimates did not cover industries P and Q and covered all industry R).

The new definition of the market sector makes INTAN-Invest 2016 fully consistent with SPINTAN estimates. SPINTAN is a project funded by the European Union's Seventh Framework Programme that aims at discovering the theoretical and empirical underpinning of public intangible policies and that has among its objectives to build a public intangible database for a wide set of EU countries and some other big non-EU countries.

The two projects, although different and independent, share the same measurement approach and refer to two non-overlapping cross-classifications of sectors and industries. INTAN-Invest and SPINTAN estimates, taken together, provide harmonised measures of investment in intangible assets for the total economy cross-classified by 21 industries (corresponding to the sections of the NACE Rev. 2 classification) and two institutional sectors (market and non-market) – see Bacchini et al. (2016) for an overview of the estimation methods adopted to produce SPINTAN estimates.

The implementation of the INTAN-Invest estimation strategy leads to the adoption of two different approaches for intangible assets not currently included in the SNA2008/ESA2010 asset boundary

<sup>1</sup> Prepared by Carol Corrado (The Conference Board), Jonathan Haskel (Imperial College, CEPR and IZA), Cecilia Jona-Lasinio (Istat and LUISS Lab), and Massimiliano Iommi (Istat and LUISS Lab).

(design, brand, training, organisational capital and new financial products) and for the assets already included (computer software and databases, research and development, mineral exploration and evaluations and entertainment, literary and artistic originals).

National accounts intangible assets are based on official national accounts estimates of gross fixed capital formation by industry. National accounts data on GFCF in intellectual property products ("IPP") by 21 industries and total GFCF (with no industry disaggregation) in computer software and databases ("Soft") and in research and development ("R&D") are available for all countries included in our analysis. Moreover, for almost all countries data on Soft and R&D by 21 industries are also available. For these countries, we estimate overall GFCF in mineral exploration and originals ("MinArt") by 21 industries as a residual. Instead, for countries where only total IPP by industry is available, we have adopted the following approach. First, we have produced preliminary estimates of the industry distribution of GFCF in Soft, R&D, and MinArt using the available indicators. Then we have rescaled preliminary estimates to make them consistent with total GFCF in IPP by industry and with aggregate GFCF in Soft, R&D and MinArt (using an iterative bi-proportional fitting procedure). The preliminary estimates have been derived from ESA95 national accounts data on GFCF by industry or from capital stocks estimates<sup>2</sup>, depending on data availability.

Once we obtained total investment in the three asset types by industry, we obtained the split between the market and the non-market component for each asset in each industry simply by deducting from total GFCF by industry the estimates for the non-market component available from the SPINTAN project. The estimates of the purchased component of brand, design and organisational capital in INTAN-Invest 2016 are based on completely different sources and methods compared to the previous release of INTAN-Invest. Old estimates for the business sector were obtained from data on turnover of the corresponding industries and, as for brand, also on private data sources (Zenith Optimedia and ESOMAR). Industry-level estimates were obtained following a top-down approach<sup>3</sup>. New estimates, instead, are obtained directly at the industry level using expenditure data by industry provided by the USE Tables, expressed according to the NACE Rev.2/CPA 2008 classifications. USE Tables consistent with ESA2010 national accounts are available for all countries included in this paper for 2010 and 2011 and for almost all countries for the year 2012, while USE Tables consistent with ESA95 national accounts are available from 2008 until 2010.

The USE Tables compiled according to NACE Rev.2/CPA 2008 report intermediate costs of each industry for the following products: advertising and market research services (CPA M73), architectural and engineering services, technical testing and analysis services (CPA M71) and legal and accounting services, services of head offices and management consulting services (CPA M69 and M70). We take the data on total intermediate costs for these products as a proxy for total expenditure, respectively, in brand, design and organisational capital.

The general approach is quite similar for all three assets. The first step is to make the initial data a better proxy of expenditure in the corresponding asset. We deem that in the case of advertising and market research services (CPA M73) and architectural and engineering services, technical testing and analysis services (CPA M71), the products identified in the USE Table are good proxies of the corresponding assets and no further adjustments are needed. In contrast, this is not the case for legal and accounting services, services of head offices and management consulting services (CPA M69 and M70). In this

<sup>2</sup> The country coverage of capital stocks data on Soft and R&D by industry is larger than the country coverage of GFCF data. Then, there are several countries for which capital stocks data by industry are available and GFCF is not. In this case, we have used capital stocks data as follows: starting from capital stock estimates (chained values) for year  $t$  and  $t-1$  ( $K_t$  and  $K_{t-1}$ ) and making an assumption on the value of the depreciation rate ( $\delta$ ) we have computed the implied value of chained investment for year  $t$  ( $I_t$ ), as  $I_t = K_t - K_{t-1} + K_{t-1} \cdot \delta$ . If net capital stocks were estimated with the geometric model and if we knew the actual depreciation rate used to compute capital stocks, the above calculation would provide the correct value for  $I_t$ . In the EU, national statistical institutes usually do not use the geometric method (with the exception of R&D), so the result of the calculation above can provide only an approximation of the real value of  $I_t$ . We use these approximated estimates as a preliminary estimate of investment by industry (i.e. as seeds for the iterative bi-proportional fitting). On the other hand, it is likely that the bias is quite similar across industries and therefore it should decrease when the initial estimates are re-scaled to make them consistent with total GFCF in IPP by industry and with aggregate GFCF in Soft, R&D and MinArt.

<sup>3</sup> Old INTAN-Invest estimates by industry were obtained as follows. We first produced a detailed benchmark estimate of intangible investment in 2008 based on the USE table and then we built a time series for the period 1995 to 2007 applying the rate of change of gross output (national accounts) by industry to the level of the estimated intangible gross fixed capital formation in 2008. Finally, since our benchmark was the INTAN-Invest market sector estimate of intangibles, we rescaled the estimated value for each industry, in each country, for every year, to the total provided by INTAN-Invest (see Corrado et al. (2014) for more details).

case, we computed the share of turnover of NACE M701 in the turnover of NACE M69 plus M70 for each country and we applied the share to intermediate consumption in CPA M69 and M70. The above correction is based on the assumption that, in each country the share of CPA M701 (consulting services) in total intermediate consumption for CPA M69 and M70 is the same across all industries.

Once expenditure for each asset is identified, the second step is to split total expenditure in each industry between the component due to the market sector and the component due to the non-market sector. This adjustment is applied only to the SPINTAN mixed industries (M72, P, Q and R90-92), while for all other industries we deem that the expenditure is entirely made up either by the non-market sector (industry O) or by the market sector (all remaining industries). The split is based on the share of non-market output over total market and non-market output in each industry.

Finally, in each industry the capitalisation factor is applied to total expenditure by market producers to obtain the value of total expenditure that we deem should be treated as GFCF rather than intermediate consumption. Capitalisation factors are asset specific but not industry specific, with the only exception of special treatment for subcontracting. In fact, it is likely that part of advertising and market research services (CPA M73) bought by the advertising and market research industry, that part of design services (CPA M71) bought by the architectural and engineering industry and that part of legal, accounting and consulting services (CPA M69 and M70) bought by the legal, accounting and consulting industry are due to subcontracting activity. For this reason, we assume that the capitalisation factors for CPA M73 in the advertising and market research, for CPA M71 in the architectural and engineering industry and for CPA M69 and M70 in the legal, accounting and consulting industry are 50% lower than in the other industries.

The approach outlined above is used to obtain estimates from 2010 until 2012 (the years in which USE Tables consistent with ESA2010 national accounts are available). The same approach has been applied to the USE Tables consistent with ESA95 available from 2008 and 2010 and the resulting estimates have been used as indicators to back-cast the level of the estimated intangible gross fixed capital formation in 2010 until 2008. The back-casting procedure has been implemented at the industry level. For the years before 2008, we produced an intangible investment time series using the rate of change of the previous release of INTAN-Invest estimates of GFCF by industry as an indicator to back-cast the level of the estimated gross fixed capital formation from 1995 to 2008.

The estimates based on data available from the USE Tables guarantee the exhaustiveness of purchased GFCF in brand (based on product CPA M73) and organisational capital (based on product CPA M6970), but not that of design (based on product CPA M71). In fact, in the CPA classification, part of design activity is also classified in the CPA M741 "Specialised design activities". The USE Tables currently available from Eurostat do not allow the identification of expenditure in CPA M741 because they only report data for the CPA M74\_75 ("Other professional, scientific and technical services and veterinary services"). Instead, Structural Business Statistics report data on turnover of NACE M741. Then we have taken the turnover of NACE M741 as a proxy of total expenditure in CPA M741, we have assumed that only the market sector purchases "Specialised design activities" and, finally, we have obtained GFCF estimates applying the same capitalisation factor as CPA M71.

As for the own account component, estimating it requires detailed employment data by type of occupation and by industry (e.g. from the Structure of Earnings Survey or the Labour Force Survey) or a special survey. Eurostat's available occupational data allow the identification of only those occupations related to organisational capital. This is why, at this stage, we measure only the own account component of organisational capital, while for design and brand we only estimate the purchased component.

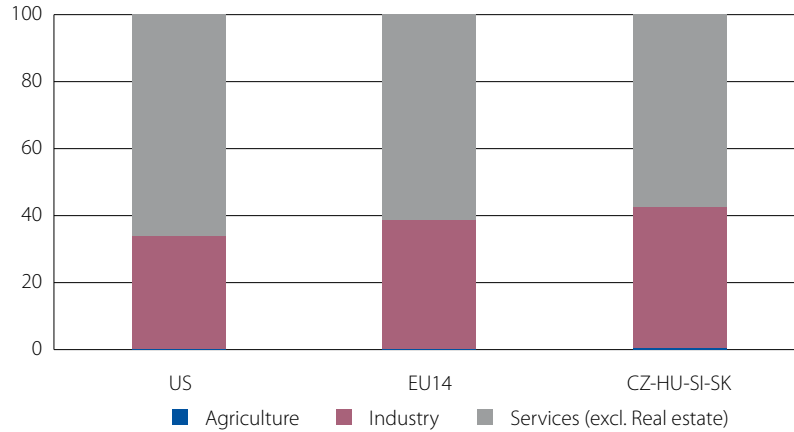
In order to estimate organisational capital produced on own account we need to estimate total compensation of managers and then apply a capitalisation factor. The estimate of total compensation of managers requires data on the number of managers and their average compensation. The main data sources for these variables are the Structure of Earnings Surveys that are currently available for 2002, 2006 and 2010. From the SES we are able to compute industry-specific shares of gross earnings of managers in total earnings of all employees for the years 2006 and 2010 and the share for the business

sector in 2002. We have produced a time series of industry-specific shares of gross earnings of managers from 1995 till 2013 as follows. For the years 2007-2009 we have (linearly) interpolated values from the SES available for 2006 and 2010. We have updated the industry-specific shares for the years from 2010 onwards applying the dynamic of the share of the number of managers in total employees from Labour Force Surveys. For the year before 2006 no data at the industry level are available, so we back-cast 2006 shares using the same indicator for all industries (namely, the change in the share of gross earnings of managers for the total business sector between 2002 and 2006 from the SES and the change in the share of the number of managers in total employees from Labour Force Surveys for the previous years). Having produced a time series of the shares of gross earnings of managers at the industry level is a big improvement compared to the previous INTAN-Invest release, which considered only the business sector with no industry detail and was based on the share obtained from SES 2002 updated using the change in the share of the number of managers in total employees from Labour Force Surveys.

We have then estimated total expenditure for management compensation consistent with national accounts data by applying the share of gross earnings of managers to national accounts measures of total compensation of employees in each industry. Finally, we have estimated the value of own account investment in organisational capital by applying the capitalisation factor to the total managers' compensation.

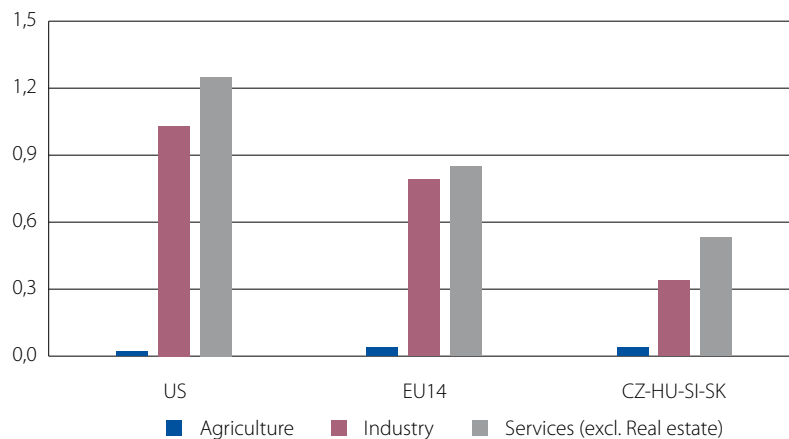
As for firm-specific human capital, our estimates for the market sector are based on data from the Continuing Vocational Training Survey (CVTS) and Labour Cost Survey, which make it possible to produce industry-level estimates of expenditure in training that include both the purchased and the own account component. For this asset the main improvement compared to the old estimates is due to the availability of the CVTS for 2010 (while the old estimates only used the 1999 and the 2005 survey). For training, we assume that all expenditures increase the value of the stock of FSHC and therefore should be considered as GFCF (i.e. we assume a capitalisation factor equal to one).

**Figure A1** Industry composition of intangible investment (average 2000-2013)



Source: INTAN-Invest

**Figure A2** Intangible to tangible investment by industry (average 2000-2013)



Source: INTAN-Invest and authors' elaborations on National Accounts

**Figure A3** Real intangible investment growth in the industry and the service sectors (chain linked volumes, compounded annual average rates of growth 2000-2013)

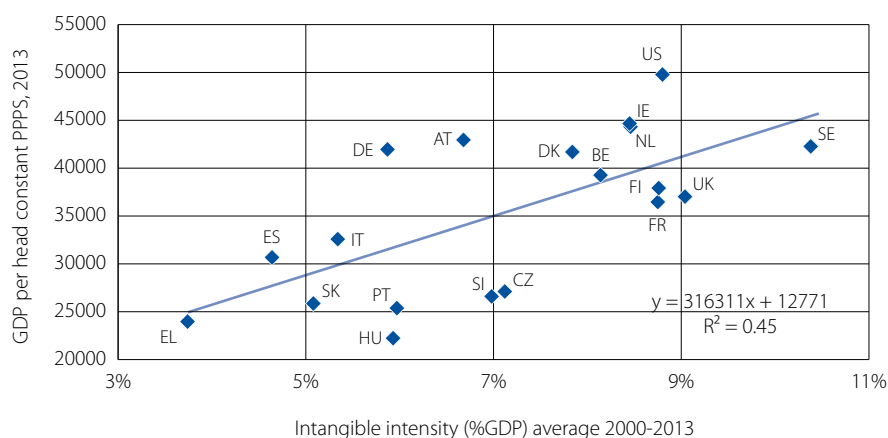


Source: INTAN-Invest and authors' elaborations on National Accounts

**Table A1 Evolution of industrial composition 2000-2013**

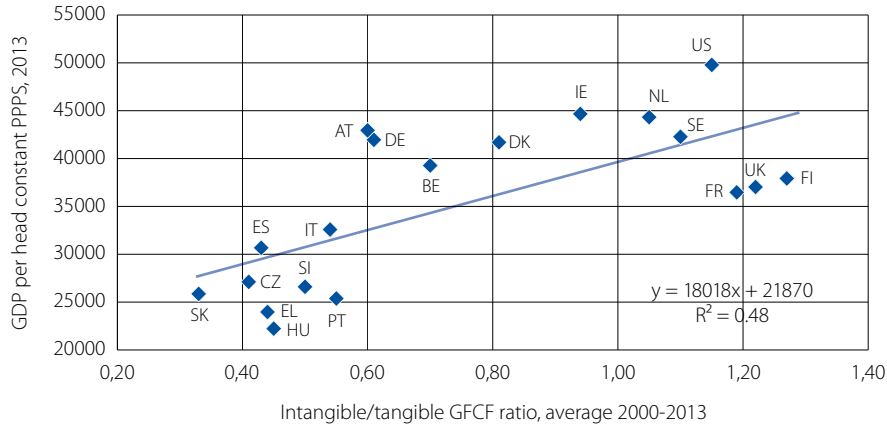
		a		b		c		c-a		b-a		c-b		
		value added share 2000-2007		2008-2009		value added share 2010-2013								
		INTANG				INTANG								
		IND	SERxL	IND	SERxL	IND	SERxL	IND	SERxL	IND	SERxL	IND	SERxL	
AT	Austria	9.6%	8.9%	11.2%	9.1%	12.2%	9.9%	AT	2.6%	1.0%	1.6%	0.2%	1.0%	0.7%
BE	Belgium	11.0%	10.8%	13.0%	12.1%	14.5%	13.6%	BE	3.6%	2.7%	2.0%	1.3%	1.5%	1.4%
CZ	Czech Republic	9.1%	10.5%	9.2%	11.6%	9.1%	11.3%	CZ	0.0%	0.8%	0.1%	1.1%	-0.1%	-0.3%
DK	Denmark	13.2%	9.5%	15.0%	10.4%	15.3%	9.7%	DK	2.1%	0.3%	1.8%	0.9%	0.4%	-0.7%
FI	Finland	15.3%	12.2%	19.5%	12.4%	20.1%	12.3%	FI	4.7%	0.1%	4.2%	0.2%	0.5%	-0.1%
FR	France	15.8%	12.4%	16.8%	13.5%	17.8%	14.2%	FR	1.9%	1.8%	0.9%	1.1%	1.0%	0.7%
DE	Germany (until 1990 former territory of the FRG)	12.3%	6.0%	12.6%	6.1%	12.0%	6.3%	DE	-0.3%	0.3%	0.3%	0.1%	-0.6%	0.2%
EL	Greece	7.4%	5.1%	9.2%	5.6%	9.1%	6.5%	EL	1.7%	1.4%	1.8%	0.5%	-0.1%	0.9%
HU	Hungary	8.6%	10.0%	9.6%	11.0%	10.0%	10.2%	HU	1.4%	0.2%	1.0%	1.0%	0.4%	-0.8%
IE	Ireland	9.7%	11.4%	14.9%	13.4%	15.7%	13.9%	IE	6.0%	2.6%	5.2%	2.0%	0.8%	0.5%
IT	Italy	8.9%	8.0%	9.5%	8.1%	9.9%	7.9%	IT	1.0%	-0.1%	0.6%	0.1%	0.4%	-0.2%
NL	Netherlands	11.0%	11.8%	11.3%	12.4%	12.6%	12.0%	NL	1.6%	0.3%	0.3%	0.7%	1.3%	-0.4%
PT	Portugal	5.8%	11.0%	7.5%	12.4%	7.7%	11.8%	PT	1.9%	0.8%	1.7%	1.3%	0.2%	-0.6%
SI	Slovenia	10.0%	10.0%	10.7%	10.4%	12.6%	11.0%	SI	2.6%	1.1%	0.7%	0.4%	1.9%	0.7%
ES	Spain	5.3%	6.9%	6.4%	7.5%	7.5%	8.1%	ES	2.2%	1.2%	1.1%	0.6%	1.1%	0.6%
SE	Sweden	21.0%	13.3%	22.2%	12.9%	22.4%	12.8%	SE	1.4%	-0.5%	1.2%	-0.3%	0.2%	-0.2%
SK	Slovakia	5.6%	7.7%	5.8%	8.5%	6.6%	9.2%	SK	1.0%	1.4%	0.2%	0.8%	0.8%	0.7%
UK	United Kingdom	11.3%	14.7%	11.2%	14.5%	11.5%	14.3%	UK	0.2%	-0.4%	0.0%	-0.2%	0.2%	-0.2%
US	United States	13.3%	12.3%	14.6%	12.5%	15.0%	12.6%	US	1.7%	0.3%	1.3%	0.2%	0.4%	0.1%
EU14	European Union (15 countries excl. LU)	11.5%	10.1%	12.2%	10.3%	12.7%	10.6%	EU14	1.3%	0.5%	0.7%	0.3%	0.5%	0.3%
CZ-HU-SI-SK	Czech Rep-Hungary-Slovenia-Slovakia	8.5%	9.9%	8.8%	10.7%	9.1%	10.6%	CZ-HU-SI-SK	0.6%	0.7%	0.3%	0.8%	0.3%	-0.1%

Source: INTAN-Invest and authors' elaborations on national accounts.

**Figure A4 Intangible to tangible investment by industry (average 2000-2013)**

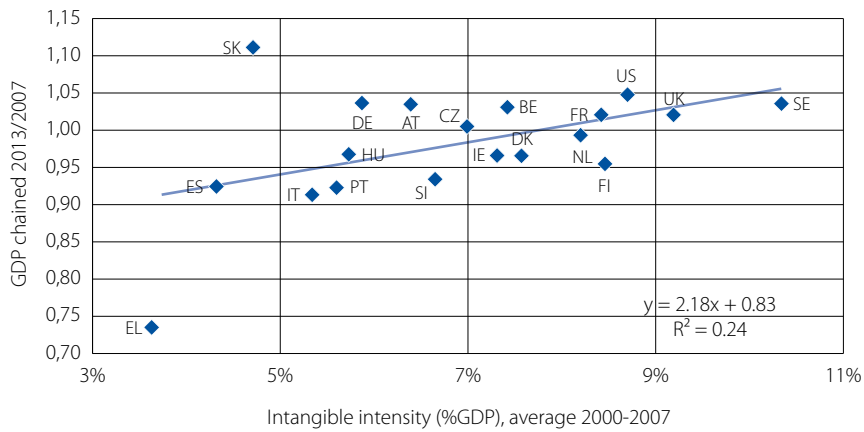
Source: INTAN-Invest and OECD

**Figure A5** Intangible over tangible investment ratio and GDP per head



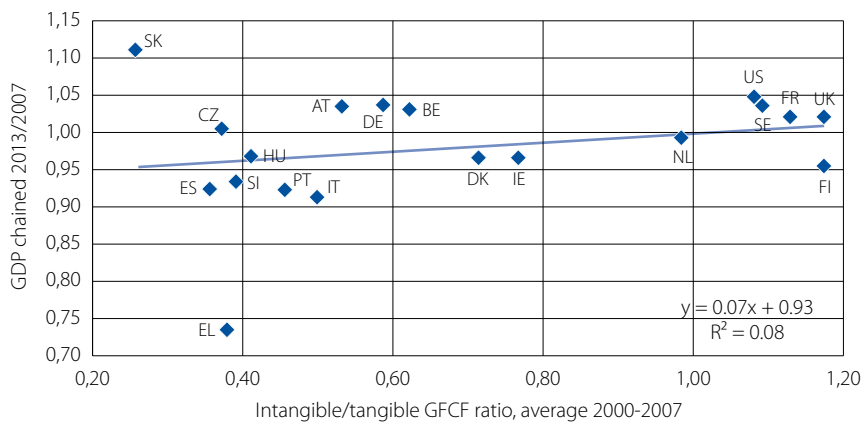
Source: INTAN-Invest and OECD

**Figure A6** Intangible intensity before the crisis and the impact of the crisis



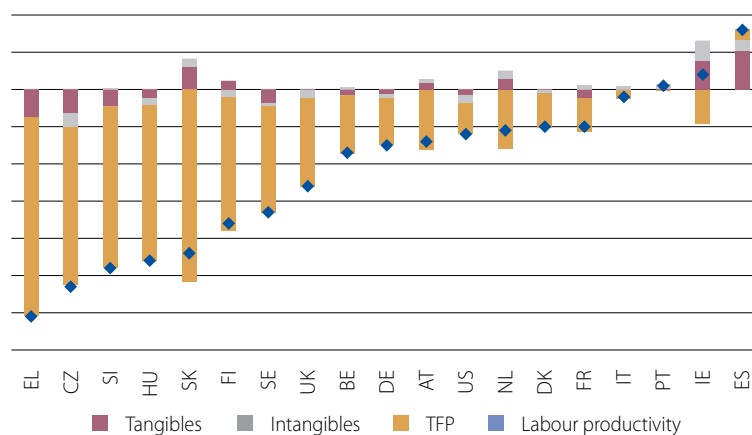
Source: INTAN-Invest and authors' elaborations on National Accounts

**Figure A7** Intangible/tangible ratio before the crisis and the impact of the crisis



Source: INTAN-Invest and authors' elaborations on National Accounts

**Figure A8** Changes in the contributions to the growth of labour productivity in 18 European countries and the United States before and since the Great Recession (averages 2007-2013 minus averages 2000-2007)



Source: INTAN-Invest and authors' elaborations on National Accounts

**Table A2** Cross-country correlation between intangible investment and firm size in EU countries

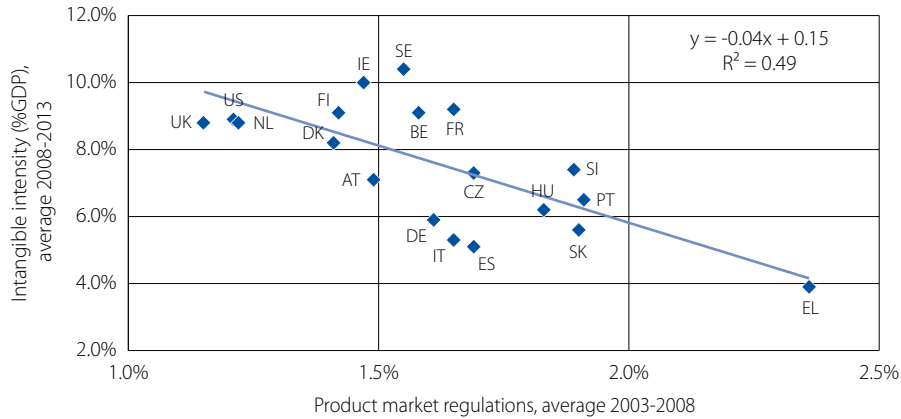
	Intangible share	intangible/tangible ratio
Mining and quarrying	0.12	0.18
Manufacturing	0.48	0.45
Electricity, gas, steam and air conditioning supply	0.09	0.19
Water supply; sewerage, waste management and remediation activities	-0.02	-0.04
Construction	0.29	0.01
Wholesale and retail trade; repair of motor vehicles and motorcycles	0.29	0.45
Transportation and storage	0.30	0.25
Accommodation and food service activities	0.44	0.47
Information and communication	0.18	0.67
Professional, scientific and technical activities	0.09	0.33
Administrative and support service activities	0.25	0.26

Source: INTAN-Invest, National Accounts and OECD

Note: average firm size is measured as the share of persons employed in firms with more than 250 persons employed



**Figure A9** Intangible intensity and product market regulation



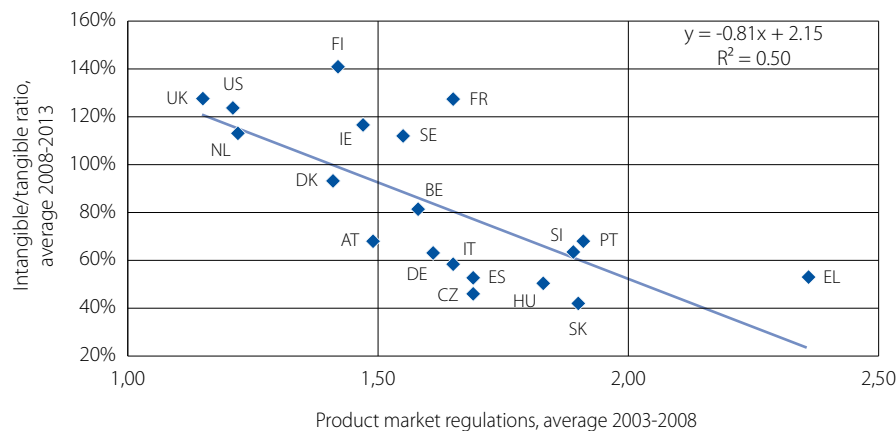
Source: INTAN-Invest and OECD

**Table A3** Cross-country correlations between intangible investment by asset type and high-level economy-wide indicators of product market regulation

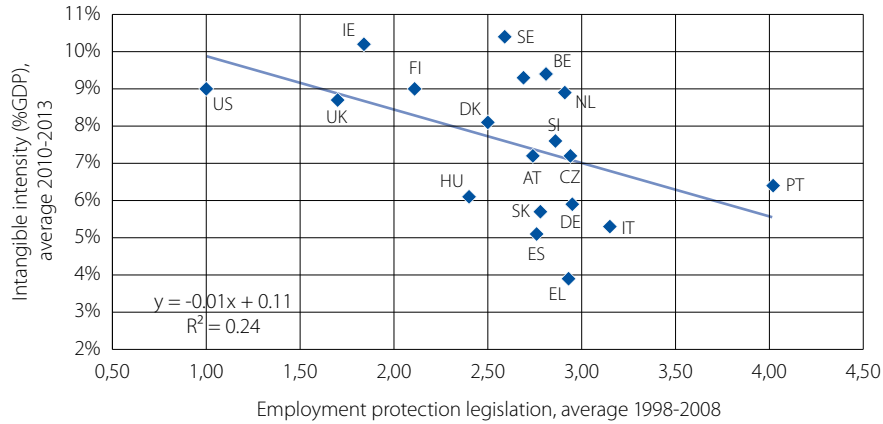
	Product Market Regulations			
	PMR	State control	Barriers to entrepreneurship	Barriers to trade and investment
Intangible Investment (%GDP)	-0.69	-0.62	-0.42	-0.53
Software and Databases	-0.48	-0.44	-0.34	-0.32
Innovative Property	-0.60	-0.58	-0.32	-0.45
Economic Competencies	-0.46	-0.36	-0.31	-0.40
Intangible over tangible Investment	-0.70	-0.54	-0.44	-0.68

Source: INTAN-Invest and OECD

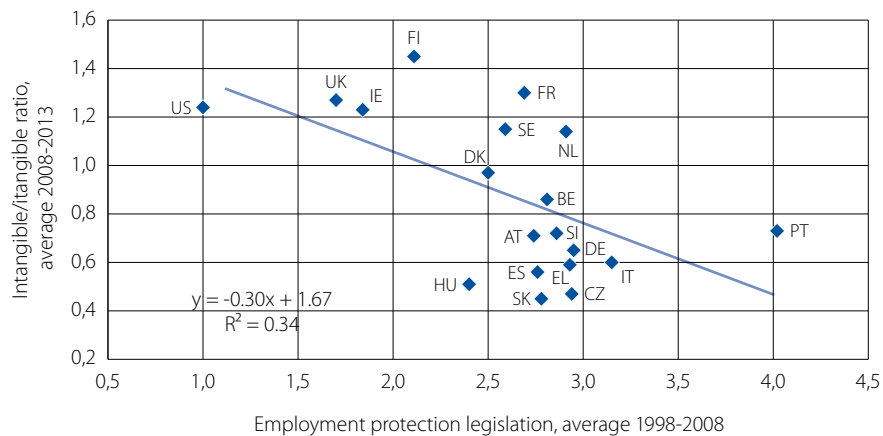
**Figure A10** Intangible/tangible ratio and product market regulation



Source: INTAN-Invest and OECD

**Figure A11** Intangible intensity (%GDP) and employment protection legislation

Source: INTAN-Invest and OECD

**Figure A12** Intangible/tangible ratio and employment protection legislation

Source: INTAN-Invest and OECD

**Table A4 Contributions of intangible assets to the growth of labour productivity in 18 European countries and the United States, 2000 to 2013**

	Intangible Capital	Software	Innov. Prop	R&D	Design	NFP	Min_Art	Econ Comp.	Brand	Org_Cap	Train
AT	0.4	0.1	0.2	0.13	0.01	0.01	0.00	0.1	0.02	0.08	0.02
BE	0.4	0.1	0.1	0.06	0.03	0.00	0.00	0.2	0.01	0.16	0.03
CZ	0.2	0.1	0.1	0.02	0.04	0.01	0.01	0.1	0.01	0.07	-0.01
DK	0.1	0.1	0.1	0.06	-0.01	0.00	0.01	0.0	0.00	0.01	-0.05
FI	0.3	0.1	0.2	0.18	0.04	0.00	0.00	-0.1	-0.04	0.04	-0.06
FR	0.4	0.1	0.2	0.08	0.05	0.01	0.02	0.1	0.02	0.06	0.01
DE	0.2	0.1	0.1	0.07	0.01	0.00	0.01	0.0	-0.03	0.05	-0.01
EL	0.1	0.1	0.1	0.07	0.03	0.01	0.01	-0.1	-0.05	-0.02	0.00
HU	0.5	0.2	0.0	0.12	-0.05	0.01	-0.05	0.3	0.06	0.15	0.05
IE	1.0	0.1	0.7	0.75	-0.07	0.03	0.03	0.2	0.12	0.12	0.01
IT	0.1	0.0	0.1	0.06	0.02	0.01	0.00	0.0	-0.03	0.01	-0.02
NL	0.3	0.1	0.1	0.02	0.02	0.01	0.00	0.1	0.00	0.12	-0.03
PT	0.4	0.1	0.2	0.11	0.02	0.01	0.01	0.2	0.02	0.11	0.04
SK	0.3	0.0	0.1	0.01	0.05	0.00	0.03	0.2	0.10	0.06	0.02
SI	0.4	0.1	0.1	0.10	0.04	0.01	0.00	0.1	0.06	0.06	0.02
ES	0.3	0.1	0.2	0.10	0.04	0.01	0.02	0.1	0.02	0.02	0.02
SE	0.3	0.1	0.2	0.10	0.04	0.01	0.01	0.0	-0.04	0.09	-0.02
UK	0.4	0.1	0.2	0.10	0.07	0.01	-0.02	0.1	0.00	0.19	-0.07
US	0.6	0.2	0.3	0.12	0.05	0.02	0.13	0.2	0.05	0.04	0.06
Memo items (value added weighted average)											
EU14	0.3	0.1	0.1	0.09	0.03	0.01	0.01	0.1	0.00	0.07	-0.01
CZ-HU-SI-SK	0.3	0.1	0.1	0.05	0.02	0.01	-0.01	0.1	0.04	0.09	0.02

Source: INTAN-Invest and authors' elaborations on national accounts

## References

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