The Impact of the National Bank of Hungary’s Funding for Growth Program on Firm Level Investment

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The views expressed in this presentation are those of the authors’ and do not necessarily reflect the official stance of the National Bank of Hungary.
In June 2013 the National Bank of Hungary introduced the 1st phase of the Funding for Growth Program ("NHP") to reinvigorate business lending and growth.

- HUF 700 billion = EUR 2.3 billion (approx. 2.3% of GDP) was made available to banks (financial intermediaries) at no cost.
- Banks were asked to re-lend the amount to SMEs at an interest rate of 2.5% or less.
- Nominal purpose of loan must be:
  i) Refinance existing loans
  ii) Finance working capital
  iii) Finance new long term investment

- First phase ended in December 2013, was extended a number of times.
This paper

- Fairly narrow program evaluation approach: how much new investment did the program generate by the end of 2013?
- New=investment that would not have happened otherwise
  ⇒ Must construct a credible counterfactual investment path
- Full-fledged cost-benefit analysis would be much trickier...
- First to combine micro data and a rigorous econometric methodology to evaluate a „funding for lending” type loan program: DID estimation with additional correction for likely violation of parallel trend assumption
Some literature

- Churm et al. (2012): Evaluation of Bank of England’s funding for lending scheme; focus on credit aggregates and lending costs
- Darracq-Paries, M. and De Santis, R. (2013): macro study of ECB’s 3-year LTRO
- Banerjee and Duflo (2014): Evaluation of directed loan program in India; perhaps closest to this study
Main findings

- Participating firms did invest more:
  - ≈ 30% of their total investment in 2013 can be attributed to the program
  - leading to a ≈ 6% increase in investment in the SME sector (3% in the private sector as a whole)

- Strong heterogeneity by firm size: the program effect was proportionally larger for smaller firms; virtually non-existent for medium-sized firms

- Theoretical interpretation of heterogeneity (some insight into small firm finance):
  - before the program small firms were facing a steep aggregate credit supply curve and larger firms were facing a flat one
  - and/or larger firms were rationed in the program, small firms were not
Data sources

- National Tax and Customs Office data: firm panel—balance sheets of all double entry book-keeping firms in Hungary
  - Investment is defined as change in fixed assets + depreciation
  - Caveat! positive investment at the firm level does not necessarily imply an increase in the capital stock at the macro level

- Program data reported to the National Bank of Hungary by banks

- Central Credit Registry (information on other loans taken out by firms)—originally available up to 2011
Basic facts about NHP phase 1.

<table>
<thead>
<tr>
<th>Firm size (employees)</th>
<th>Num. of firms 2013</th>
<th>Num. of partic.</th>
<th>Part. rate</th>
<th>Tot. loans (mill. EUR)</th>
<th>Av. loan size (thsd. EUR)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Micro (1-9)</td>
<td>318,574</td>
<td>2,894</td>
<td>0.9%</td>
<td>676.4</td>
<td>235.7</td>
</tr>
<tr>
<td>Small (10-49)</td>
<td>21,726</td>
<td>2,224</td>
<td>10.2%</td>
<td>660.2</td>
<td>287.0</td>
</tr>
<tr>
<td>Med. (50-249)</td>
<td>4,359</td>
<td>803</td>
<td>18.4%</td>
<td>711.1</td>
<td>885.7</td>
</tr>
</tbody>
</table>
The basic problem of program evaluation

- Average investment in 2013:

<table>
<thead>
<tr>
<th></th>
<th>non-NHP firms</th>
<th>NHP firms</th>
</tr>
</thead>
<tbody>
<tr>
<td>HUF 5.1 mill.</td>
<td>HUF 65.6 mill.</td>
<td></td>
</tr>
<tr>
<td>(EUR 15 thousand)</td>
<td>(EUR 225 thousand)</td>
<td></td>
</tr>
</tbody>
</table>

⇒ Program effect vs. selection?

- Average investment of NHP firms:

<table>
<thead>
<tr>
<th></th>
<th>2012</th>
<th>2013</th>
</tr>
</thead>
<tbody>
<tr>
<td>HUF</td>
<td>47.2 mill.</td>
<td>65.6 mill.</td>
</tr>
<tr>
<td>(EUR</td>
<td>156 thousand)</td>
<td>(EUR 225 thousand)</td>
</tr>
</tbody>
</table>

⇒ Program effect vs. selection vs. other time varying factors?

- How to construct counterfactual investment path for participants?
a) all firms

b) micro-sized firms

c) small-sized firms

d) medium-sized firms

Solid line: not NHP firms. Dashed line: NHP firms
Theoretical framework

- **Potential outcomes:**
  - $I_{13}(1)$: investment of a randomly chosen firm in 2013 if we forced it to participate exogenously
  - $I_{13}(0)$: investment if firm was excluded exogenously (or the program would not exist at all)

- **Participation dummy**
  - $P = 0$: the firm does not participate
  - $P = 1$: the firm participates

- **Investment actually observed in 2013**

\[ I_{13} = PI_{13}(1) + (1 - P)I_{13}(0) \]
The program effect and its identification

- Average treatment effect for the treated:

\[ ATT = E[l_{13}(1) - l_{13}(0) | P = 1] \]

How to identify this?

- Decomposing the average investment of NHP and non-NHP firms:

\[
E[l_{13} | P = 1] - E[l_{13} | P = 0] = ATT + \{E[l_{13}(0) | P = 1] - E[l_{13}(0) | P = 0]\}
\]

- Counterfactual expression in curly brackets: hypothetical investment difference between NHP and non-NHP firms if NHP had not been implemented.
Identification 1: Difference-in-differences

- Parallel trend assumption:

\[ E[I_{13}(0) \mid P = 1] - E[I_{13}(0) \mid P = 0] = E[I_{12} \mid P = 1] - E[I_{12} \mid P = 0] \]

- Therefore,

\[ ATT = \{ E[I_{13} \mid P = 1] - E[I_{13} \mid P = 0] \} - \{ E[I_{12} \mid P = 1] - E[I_{12} \mid P = 0] \}. \]

- This is the difference-in-differences (DID) estimator
Difference-in-differences: graphical illustration

Effect by DiD ($\delta$)
The problem with simple DID

- Relies on 'parallel trend assumption': average change in investment without the program same for participants and non-participants
- But: self-selection into the program may well depend on this quantity. For example:

\[ I_{13}(0) - I_{12} > \text{threshold} \Rightarrow \text{participate} \]
\[ I_{13}(0) - I_{12} \leq \text{threshold} \Rightarrow \text{do not participate} \]

- This would imply a violation of the parallel trend assumption
Problem with DID: graphical illustration

Program effect ($\delta - \delta^*$)

Correction ($\delta^*$)

---

- No NHP
- NHP firms
- NHP firms - assumed inv. path under DiD
- NHP firms - assumed inv. path under corrected DiD
Identification: Where does the correction come from?

- We assume that participants in the 1st phase would have borrowed some amount on the market even without the program
  - Program operates on intensive margin rather than extensive margin
- Margin is only 2.5%—banks cherry picked among existing clients (later: risk sharing). Out of 6126 participants:
  - 5332 borrowed between 2005 and 2012
  - 3329 borrowed in 2012 alone
- Percentage of firms with new loans:

<table>
<thead>
<tr>
<th></th>
<th>2012</th>
<th>2013</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Market</td>
<td>NHP</td>
</tr>
<tr>
<td>Micro</td>
<td>6.5</td>
<td>6.3</td>
</tr>
<tr>
<td>Small</td>
<td>23.1</td>
<td>17.6</td>
</tr>
<tr>
<td>Medium</td>
<td>38.7</td>
<td>23.8</td>
</tr>
</tbody>
</table>
Identification: Where does the correction come from?

- Look at investment history of firms that took out a new market loan in a pre-program year vs. those who did not. Compare:
  - average change in investment between 2010 and 2011 for firms that borrowed in 2011
  - average change in investment between 2010 and 2011 for firms that did not borrow in 2011

- Construct DID estimator for ’investment effect’ of market loan. Estimate the average effect of NHP on participants by

\[ DID^* = [\text{NHP treatment effect estimated by DID}] - [\text{market loan treatment effect estimated by DID}] \]

- Will show corroborating evidence that correction ’well calibrated’
Identification: graphical illustration of the correction term

Correction (δ*)

Avg I(t) in millions of 2013 HUF

Firms - no new loan in 2011
Firms - new loan in 2011
Firms - new loan in 2011 - assumed investment under DID

Correction (δ*)
Implementation I.

- **Starting point:** two period panel regressions with firm and year fixed effects (DID)
- **Allowing for size-related heterogeneity** in the treatment effect:
  - Pre-treatment capital stock \((K)\): polynomials of \(K\), interacted with treatment dummy
  - Pre-treatment number of employees \((L)\): polynomials of \(L\), interacted with treatment dummy
- **Additional controls** \((X)\): pre-treatment financial statistics computed from balance sheet data
  - more credible identification, increased efficiency
Pruning the group of non-participants. Use logit regression to estimate

\[ \text{Propensity score} = P(\text{participation}|K, L, X). \]

Drop firm if propensity score is very low.

Outlier control
Estimated model

**Basic DID regression model:** two period panel \((t = 2013, 2012)\) with firm and year fixed effects + size + other controls:

\[
l_{it} = \sum_{j=1}^{3} \left( \alpha_j (K_{i,t-1} - \bar{K})^j + \beta_j (K_{i,t-1} - \bar{K})^j P_i D_{13t} \right) \\
+ \sum_{j=1}^{3} \left( \kappa_j (L_{i,t-1} - \bar{L})^j + \lambda_j (L_{i,t-1} - \bar{L})^j P_i D_{13t} \right) \\
+ \delta P_i D_{13t} + X'_{i,t-1} \gamma + c_i + \theta_t + u_{it}
\]

where \(P_i = \text{program participation dummy}; \ D_{13t} = \text{year dummy}\)

**Corrective regressions:** same form, but \(t = 2011, 2010\), \(P_i = \text{new market loan in 2011, and } D_{13t} \text{ replaced with } D_{11t} \Rightarrow \delta^*\)
Benchmark matching estimator

- 1-to-1 **propensity score matching** estimator:
  - take each firm in the treated group, find the firm in the control group with the closest propensity score value
  - take the difference between the observed investment volumes in 2013 (program year)
  - compute average

- Matching estimator is consistent for ATT only if selection-on-observables condition holds:

\[(l_{13}(0), l_{13}(1)) \perp \text{participation} \mid K, L, X\]

- Set of controls is unlikely to be sufficient for this, but still useful benchmark
### Estimated average program effects for participants

<table>
<thead>
<tr>
<th>Model specification</th>
<th>Parameter estimates (thousands of EUR)</th>
<th>I/K impact (% point)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$\delta$</td>
<td>$\delta^*$</td>
</tr>
<tr>
<td>Matching</td>
<td>94.99</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>[15.83]</td>
<td></td>
</tr>
<tr>
<td>FE+$f(K,L,X)$</td>
<td>100.6</td>
<td>32.3</td>
</tr>
<tr>
<td></td>
<td>[13.53]</td>
<td>[19.10]</td>
</tr>
</tbody>
</table>

*Notes:* For the FE model, the reported estimates correspond to the 2012 mean capital stock and/or employment among participants. The 2013 HUF/EUR exchange rate was taken to be 300.
## Estimated average program effects by size category

<table>
<thead>
<tr>
<th>Size category</th>
<th>Treatment=NHP participation</th>
<th>Parameter estimates (thousands of EUR)</th>
<th>I/K impact (% point)</th>
<th>$\frac{\delta - \delta^*}{\bar{K}}$</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$\delta$</td>
<td>$\delta^*$</td>
<td>$\delta - \delta^*$</td>
<td>$\delta/\bar{K}$</td>
</tr>
<tr>
<td>Micro (1-9)</td>
<td>81.3</td>
<td>5.0</td>
<td>76.3</td>
<td>19.9%</td>
</tr>
<tr>
<td></td>
<td>[9.7]</td>
<td>[14.7]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Small (10-49)</td>
<td>95.0</td>
<td>31.0</td>
<td>64.0</td>
<td>11.1%</td>
</tr>
<tr>
<td></td>
<td>[12.7]</td>
<td>[17.3]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Medium (50-149)</td>
<td>280.0</td>
<td>134.7</td>
<td>145.3</td>
<td>11.1%</td>
</tr>
<tr>
<td></td>
<td>[37.3]</td>
<td>[56.7]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Medium (150-249)</td>
<td>310.7</td>
<td>273.3</td>
<td>37.3</td>
<td>6.0%</td>
</tr>
<tr>
<td></td>
<td>[109.3]</td>
<td>[158.7]</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Average program effect as a function of employment

![Graph showing average effect of NHP as investment rate changes. The x-axis represents investment rate categories (1-4, 5-9, etc.), and the y-axis represents the average effect of NHP (%). The graph shows a downward trend as the investment rate increases, with the effect decreasing from 25% to 0% and then fluctuating between 0% to -5%.](image-url)
Corroborating evidence: Investment by firms in a neighborhood of the 250 employee cutoff
Discontinuity regressions

<table>
<thead>
<tr>
<th>Outlier cutoff</th>
<th>HUF 1 billion</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Empl. range</td>
</tr>
<tr>
<td>≤ 250 dummy</td>
<td>-20.46</td>
</tr>
<tr>
<td></td>
<td>[35.02]</td>
</tr>
<tr>
<td>Const.</td>
<td>205.3***</td>
</tr>
<tr>
<td></td>
<td>[29.21]</td>
</tr>
<tr>
<td>Obs.</td>
<td>237</td>
</tr>
<tr>
<td>$R^2$</td>
<td>0.002</td>
</tr>
<tr>
<td>Part. rate</td>
<td>12.7%</td>
</tr>
</tbody>
</table>
Aggregate effects: decomposition of the actual investment of participating firms

<table>
<thead>
<tr>
<th>PANEL A: Treatment = All NHP</th>
<th>Investment (millions of EUR)</th>
<th>DID</th>
<th>DID*</th>
</tr>
</thead>
<tbody>
<tr>
<td>All firms</td>
<td>actual w/o NHP due to NHP w/o NHP due to NHP</td>
<td>1270.9 683.1 587.7 898.6</td>
<td>372.2</td>
</tr>
<tr>
<td>Micro (1-9)</td>
<td>276.9 88.1 188.9 101.8</td>
<td><strong>175.1</strong></td>
<td></td>
</tr>
<tr>
<td>Small (10-49)</td>
<td>505.3 290.3 215.0 367.8</td>
<td><strong>137.6</strong></td>
<td></td>
</tr>
<tr>
<td>Medium (50-149)</td>
<td>386.0 213.8 172.3 308.2</td>
<td><strong>77.8</strong></td>
<td></td>
</tr>
<tr>
<td>Medium (150-249)</td>
<td>102.5 87.9 14.6 117.8</td>
<td><strong>-15.3</strong></td>
<td></td>
</tr>
</tbody>
</table>
Aggregate effects: decomposition of the actual investment of participating firms

<table>
<thead>
<tr>
<th>Relative impact of NHP as % of all investment by:</th>
<th>participants</th>
<th>SME sector</th>
</tr>
</thead>
<tbody>
<tr>
<td>PANEL A: Treatment = All NHP</td>
<td></td>
<td></td>
</tr>
<tr>
<td>All firms</td>
<td>29.3%</td>
<td>5.6%</td>
</tr>
<tr>
<td>Micro (1-9)</td>
<td>63.2%</td>
<td>7.1%</td>
</tr>
<tr>
<td>Small (10-49)</td>
<td>27.2%</td>
<td>6.2%</td>
</tr>
<tr>
<td>Medium (50-149)</td>
<td>20.8%</td>
<td>6.4%</td>
</tr>
<tr>
<td>Medium (150-249)</td>
<td>-14.9%</td>
<td>-2.0%</td>
</tr>
</tbody>
</table>
Interpretation of results

- Use a simplified version of theoretical framework in Banerjee and Duflo (2015)
- Simple capital supply/demand graphs can explain size related heterogeneity in treatment effect if we assume that
  1. Smaller firms were more credit constrained
  2. and/or smaller firms could borrow more relative to their pre-existing capital (large firms were rationed in the program, small firms were not)
Firm originally unconstrained on the credit market
Unconstrained firm with a small subsidized loan

\[ r^* = K_{nhp} \]

capital demand

capital supply

L_{nhp} \quad K^* = K_{nhp} \quad \text{Capital}
Unconstrained firm with a large subsidized loan

The diagram illustrates the relationship between the interest rate and capital supply. The interest rate is shown on the vertical axis, while capital supply is shown on the horizontal axis. The capital demand line is represented by a red downward-sloping line, while the capital supply line is represented by a blue horizontal line.

Key variables include:
- \( r^* \) for the interest rate
- \( r_{nhp} \) for the non-subsidized interest rate
- \( K^* \) for the optimal capital supply level
- \( K_{nhp} = L_{nhp} \) for the capital supply at the non-subsidized rate
Credit constrained firm

interest rate

capital supply

capital demand

K*

Capital
Credit constrained firm with a small subsidized loan

![Graph showing capital demand and capital supply with equations]

\[ r^* \] 
\[ r_{nhp} \] 
\[ L_{nhp} \] 
\[ K^* + L_{nhp} = K_{nhp} \]
Credit constrained firm with a large subsidized loan

\[ r^* \]

\[ r_{nhp} \]

\[ K^* \]

\[ L_{nhp} = K_{nhp} \]

interest rate

Capital supply

capital demand
The general case: firm constrained on the 'intensive margin'
Subsidized loan used both for new investment and refinancing
Types of NHP loans by firm size

<table>
<thead>
<tr>
<th>Firm size</th>
<th>New investment loans to refinancing loans (%)</th>
<th>Total NHP loans to capital (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Average</td>
<td>Average</td>
</tr>
<tr>
<td>Micro (1-9)</td>
<td>128</td>
<td>2691</td>
</tr>
<tr>
<td>Small (10-49)</td>
<td>82</td>
<td>1593</td>
</tr>
<tr>
<td>Medium (50-149)</td>
<td>49</td>
<td>70</td>
</tr>
<tr>
<td>Medium (150-249)</td>
<td>41</td>
<td>56</td>
</tr>
</tbody>
</table>
Conclusion

- The first phase of NHP generated additional investment that amounts to 6% of all investment in the SME sector in 2013 (0.2% points „accounting impact” on GDP)
- The impact was heterogenous with respect to firm size:
  - while 60+% of the investment by micro firms was due to the program
  - medium sized firm would have invested just as much in the absence of the program
- The paper gives a narrow analysis omitting important issues such as:
  - the impact on potential output and long-term growth (investment quality, multiplier effects)
  - risk-taking related to financing micro firms
  - the opportunity cost of the program