Credit Constraints and Firms’ Productivity Growth

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Motivation

- To grow and thrive firms need reliable access to external funding;
- The supply of credit, in particular, has been found to affect input accumulation Gan (2007) Cingano et al. (2016), Acharyia et al. (2016), Chodorow-Reich (2014), Bentolilla et al. (2016)
- ... and the efficiency of its allocation among heterogeneous firms (Schivardi et al. 2017)
- Yet, there are reasons to expect also a direct effect of credit supply on firm-level TFP growth: through innovation (Amore et al. 2013), export (Paravisini et al. 2014), technology adoption, managerial practices.
TFP and Credit among Italian Firms

Notes: Data from ∼ 30K Italian firms from CADS dataset.
Estimated p.f.: Value Added Cobb-Douglas.
Does credit supply affect firm’s TFP growth?
1. **Stylized Facts from a Quasi-Experiment**: the Freeze of the Interbank Market in Italy (2007-2008)
   - unexpected and heterogeneous shock to firms’ access to credit
   - fall in VA *much* larger than fall in K and L
   - suggest that **credit crunch reduced firm-level TFP growth**

2. **A More General Framework**
   - simple model of heterogeneous credit supply and production
   - identify credit supply shocks using firm-bank connections
   - estimate production parameters and productivity allowing for an effect of credit supply on TFP
   - **main results**: \( \uparrow \text{cred supply} \Rightarrow \uparrow \text{productivity growth} \)

3. **The Channels**: evidence that credit supply shocks stimulates TFP enhancing activities
   - R&D, Export, Innovation, ICT adoption, time spent in raising finance
Why Italy?

- High quality and large dataset on
  - credit relations
  - firms’ production
- Firms extremely reliant on banks’ credit
  - more than 60% of liabilities vs one third for U.S.
  - leverage is higher: 43.8% vs 26.6%
Data

Credit Register: all credit relations in country
- report credit instruments, we use total
- focus on credit granted, yearly
- on average, per year:
  - 468,984 firms
  - 1,008 banks
  - 2.8 relationships per firm; 1,321 per bank

Balance-Sheets and Income Statement from CADS:
- large sample of small and large Italian manufacturers
- capital series reconstructed with perpetual inventory methodology
- sector-level deflators from National Accounts
  - \( \Rightarrow \) measure of productivity based on revenues, not quantity (Foster, Haltiwanger, and Syverson, 2008)
The Interbank Shock
the Interbank Shock


- Banks not able to sufficiently compensate with other sources of finance ⇒ credit to real economy significantly reduced.
  - Cingano et al. (2016) show it affected investments
  - Italian banks not directly exposed to ABS or Lehman-issued liabilities

We use bank’s pre-crisis (2006) exposure to ITBK as an exogenous shock to credit supply

- $\bar{ITBK}_{i,2006} = 2006$ weighted average “interbank liabilities-to-assets ratio” of firm’s $i$ lenders
Trends in Firm-level Credit and Investments as a Function of Pre-Crisis Exposure to Interbank Market.

$\text{ITBK/Assets} = \text{weighted average of bank interbank liabilities-to-assets ratio in 2006, with weights equal to 2006 firm-level credit shares.}$

High (Low) $= \text{above (below) median value.}$
Interbank Shock on Value Added and its Input

\[ \Delta x_{i,t} = \psi_{p,s,t} + \gamma \cdot INTBK_{i,2006} + \eta_{i,t} \]

<table>
<thead>
<tr>
<th>Dependent Variable</th>
<th>(1) $\Delta va_{i,t}$</th>
<th>(2) $\Delta k_{i,t}$</th>
<th>(3) $\Delta l_{i,t}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$INTBK_{i,2006}$</td>
<td>-0.144***</td>
<td>-0.063*</td>
<td>-0.027</td>
</tr>
<tr>
<td></td>
<td>(0.049)</td>
<td>(0.039)</td>
<td>(0.033)</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.164</td>
<td>0.102</td>
<td>0.108</td>
</tr>
</tbody>
</table>

- one observation is one firm in CADS × one year (2007-2009)
- FEs: Province × Sector × Year
- Observations ≈ 57k
Interbank Shock and Productivity

Under CD assumption:

- we find negative effect of interbank shock on productivity for ANY parameter of the production function 
  - Cobb Douglas

Robustness exercises:

- we show that firms with higher interbank exposure were NOT more sensitive to business cycle before 2007 
  - Sensitivity Analysis
- we use a large set of “standard techniques” to estimate productivity and show results hold 
  - Table
- we show effect is not driven by firm-level observable and unobservables 
  - Balancing of Covariates, Adding Controls
- we perform placebo test 
  - Table
A Simple Model of Credit Supply and Productivity
Conceptual framework

Production

\[ y_{i,t} = \omega_{i,t} + f(k_{i,t}, l_{i,t}, m_{i,t}, \beta) \]

policy functions

\[ k_{i,t} = k(k_{i,t-1}, l_{i,t-1}, \omega_{i,t}, \Lambda_{i,t}, \delta_t) \]

Productivity (\( \omega \)) and Credit Supply (\( \Lambda \)) evolve jointly

Variables (in logs) are:

- \( y \) output (value added or revenues)
- \( k \) and \( l \) capital stock and labor (wage bill)
- \( m \) flexible inputs (e.g. intermediates)
- \( \delta \) aggregate demand/technology conditions

Goals:

1. identify an empirical counterpart of \( \Lambda \);
2. estimate \( \beta \) and back-up \( \omega \);
3. study how changes in \( \Lambda \) affect \( \omega \).
Credit Supply

Each year $t$ bank $b$ changes its supply of credit according to some factor $\phi_{b,t}$

- $\phi_{b,t}$ depends on bank’s cost of funds, business strategies, etc

Decompose growth of credit granted by $b$ to $i$:

$$\Delta c_{i,b,t} = \phi_{b,t} + \chi_{i,t} + \xi_{i,b,t}$$

- $\phi_{b,t}$ identified from firms with multiple relations (approx. 57%)
- similar to Amiti and Weinstein (forthcoming)
A Valid Decomposition?

Assumptions:

1. Firms-banks pre-existing connections are valuable, costly to establish, and partially sticky (relationship matters):
   - each firm is connected to a sub-set of banks \( \{ B_i \} \)
   - connection intensity \( \{ w_{b \rightarrow i, t} \} \)
2. firm demand is not bank-specific (no assortative matching)
3. firms are sufficiently small not to impact idiosyncratically on supply (no granularity in credit demand)
From bank supply to firm credit supply shock

The empirical counterpart of \( w_{b \rightarrow i, t} \) is

\[
w_{b \rightarrow i, t} = \frac{\exp(c_{i,b,t-1})}{\sum_{b'} \exp(c_{i,b',t-1})}
\]

Firm-level credit supply shock:

\[
\lambda_{i,t} = \sum_b w_{b \rightarrow i, t-1} \phi_{b,t}
\]

In the empirical specification we identify within-province \( \times \) sector variability:

\[
\Lambda_{i,t} = \lambda_{p,s,t} + \lambda_{i,t}
\]
Credit supply and input and output growth

\[
\Delta x_{i,t} = \psi_i + \psi_{p,s,t} + \gamma \lambda_{i,t} + \eta_{i,t}
\]

<table>
<thead>
<tr>
<th>VARIABLES</th>
<th>(1) $\Delta v_a$</th>
<th>(2) $\Delta y$</th>
<th>(3) $\Delta k$</th>
<th>(4) $\Delta l$</th>
<th>(5) $\Delta n$</th>
<th>(6) $\Delta m$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\lambda_{i,t}$</td>
<td>0.148*** (0.0219)</td>
<td>0.0736*** (0.0176)</td>
<td>0.0656*** (0.0191)</td>
<td>-0.0109 (0.0186)</td>
<td>0.00471 (0.0135)</td>
<td>0.0352** (0.0174)</td>
</tr>
<tr>
<td>Observations</td>
<td>322k</td>
<td>333k</td>
<td>302k</td>
<td>333k</td>
<td>333k</td>
<td>332k</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.241</td>
<td>0.316</td>
<td>0.258</td>
<td>0.260</td>
<td>0.315</td>
<td>0.312</td>
</tr>
</tbody>
</table>
Production Function Estimation with heter. credit frictions

\[ y_{i,t} = \omega_{i,t} + f(k_{i,t}, l_{i,t}, m_{i,t}, \beta) + \xi_{i,t} \]

- \( \omega_{i,t} \) is hicks-neutral productivity and \( \xi_{i,t} \) is untrasmitted error (noise)

we observe

- one flexible input with demand

\[ m_{i,t} = m(\omega_{i,t}, k_{i,t}, l_{i,t}, \lambda_{i,t}, z_{i,t}) \]

if demand is monotonic in \( \omega_{i,t} \Rightarrow \)

\[ \omega_{i,t} = m^{-1}(m_{i,t}, k_{i,t}, l_{i,t}, z_{i,t}, \lambda_{i,t}) \Rightarrow \]

\[ y_{i,t} = m^{-1}(m_{i,t}, k_{i,t}, l_{i,t}, z_{i,t}, \lambda_{i,t}) + f(k_{i,t}, l_{i,t}, m_{i,t}, \beta) + \xi_{i,t} \Rightarrow \]

\[ y_{i,t} = \Psi(m_{i,t}, k_{i,t}, l_{i,t}, z_{i,t}, \lambda_{i,t}) + \xi_{i,t} \]

in a first stage we estimate \( \Psi(\cdot) \), given \( \xi_{i,t} \) is independent of input choice
Productivity’s law of motion

\[ E [\omega_{i,t} | \mathcal{I}_{t-1}] = E_t [\omega_{i,t} | \omega_{t-1}, \lambda_{i,t-1}] = g_t (\omega_{t-1}, \lambda_{i,t-1}) \]

approximate \( g \) with a polynomial

\[ \zeta_{i,t} := \omega_{i,t} - E [\omega_{i,t} | \mathcal{I}_{t-1}] = \omega_{i,t} - g (\omega_{t-1}, \lambda_{i,t-1}, G_t) \]

\[ \Rightarrow E [\zeta_{i,t} | \mathcal{I}_{t-1}] = 0 \]

what does it mean?

1. \( \not\exists \) persistent, firm-specific unobservable affecting input choices and productivity
   - violated if we did not observe \( \lambda_{i,t} \)

2. shocks to \( \omega \) are orthogonal to lagged variables
   - violated if e.g. company invested more in the past anticipating higher prod growth
Estimating moments

\[ E [\zeta_{i,t} + \xi_{i,t}|I_{t-1}] = 0 \Rightarrow \]

\[ E \left[ y_{i,t} - f(k_{i,t}, l_{i,t}, m_{i,t}, \beta) - g(\psi_{i,t-1} - f(k_{i,t-1}, l_{i,t-1}, m_{i,t}, \beta), \lambda_{i,t-1}, G_t) \right] \]

\[ \Rightarrow \text{estimate, for each industry, both } \beta \text{ and the ancillary coefficients } G_t \]

- so far, only Cobb Douglas
- value added: average \( \beta_k \approx 0.35 \) and \( \beta_l \approx 0.64 \)
- net revenues: average \( \beta_k \approx 0.03 \), \( \beta_l \approx 0.10 \) and \( \beta_m \approx 0.87 \)
Now we can run:

\[ \Delta \omega_{i,t} = \psi_i + \psi_{p,s,t} + \gamma \lambda_{i,t} + \eta_{i,t} \]

<table>
<thead>
<tr>
<th>VARIABLES</th>
<th>(1) $\Delta \omega$</th>
<th>(2) $\Delta \omega$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\lambda_{i,t}$</td>
<td>0.149*** (0.0241)</td>
<td>0.0423*** (0.00820)</td>
</tr>
<tr>
<td>Output measure</td>
<td>va</td>
<td>y</td>
</tr>
<tr>
<td>Functional Form</td>
<td>CD</td>
<td>CD</td>
</tr>
<tr>
<td>Observations</td>
<td>278k</td>
<td>286k</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.198</td>
<td>0.159</td>
</tr>
</tbody>
</table>
On the effect of credit supply on productivity

- Results show that the effect is significant and positive: a 1 p.p. increase in credit supply triggers VA productivity by 0.14 p.p.
- Results less different between VA and revenues productivity, once effects are standardized.
- Effect stronger for smaller firms, and in manufacturing.
- Preliminary evidence shows effect on productivity growth is temporary, while effect on productivity levels is persistent (at least for 5 years).
Why Does Credit Availability Enhance Productivity Growth?
Additional Data: INVIND

- survey conducted from ’84 on panel of firms
- mostly >50 employees
- some waves have info on innovation and export activities
- neither questions nor respondents are fixed over time
Possible Mechanisms? ICT adoption

Number of PC used by the firm available for years 1999, 2000, 2001

- do firms become more ICT intense when credit constraints are more relax

\[
\log \left( \frac{PC}{\text{employees}} \right)_{i,t} = \gamma_i + \gamma_t + \alpha \lambda_{i,t} + \eta_{i,t}
\]

and

\[
\log \left( \frac{PC}{K} \right)_{i,t} = \gamma_i + \gamma_t + \alpha \lambda_{i,t} + \eta_{i,t}
\]
No statistically significant evidence of positive effect

<table>
<thead>
<tr>
<th>VARIABLES</th>
<th>( \log\left(\frac{PCs}{employees}\right) )</th>
<th>( \log\left(\frac{PCs}{employees}\right) )</th>
<th>( \log\left(\frac{PCs}{K}\right) )</th>
<th>( \log\left(\frac{PCs}{K}\right) )</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \lambda_{i,t} )</td>
<td>0.117 (0.149)</td>
<td>0.302 (0.282)</td>
<td>0.257 (0.220)</td>
<td>0.513 (0.379)</td>
</tr>
<tr>
<td>Obs</td>
<td>6541</td>
<td>1969</td>
<td>6232</td>
<td>2193</td>
</tr>
<tr>
<td>Sample</td>
<td>All</td>
<td>Exclude top 25%</td>
<td>All</td>
<td>Exclude top 25%</td>
</tr>
<tr>
<td>( R^2 )</td>
<td>0.935</td>
<td>0.932</td>
<td>0.939</td>
<td>0.921</td>
</tr>
</tbody>
</table>

Clustered standard errors in parentheses
Firm and year FE are included
*** p<0.01, ** p<0.05, * p<0.1
Possible Mechanisms? - R&D and Export

High quality information on size of R&D investment from INVIND
  ▶ we consider dicotomic variables
    ▶ exporter vs non-exporter (dummy $Expt_{i,t}$)
    ▶ positive versus zero R&D investment
  ▶ we have two measures of R&D
    ▶ $R&D_{i,t}$
    ▶ $RD&Etal_{i,t}$

LPM with firm fixed effect:

$$Pr(d_{i,t} = 1) = \gamma_i + \gamma_t + \alpha \lambda_{i,t} + \eta_{i,t}$$

where $d_{i,t}$ is any of the dummies described above
Companies are more likely to start (less to stop) exporting or doing R&D (only one of our measures) when credit availability increases.

<table>
<thead>
<tr>
<th>VARIABLES</th>
<th>(1) $Expt_{i,t}$</th>
<th>(2) $R&amp;D_{i,t}$</th>
<th>(3) $RD&amp;Etal_{i,t}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\lambda_{i,t}$</td>
<td>0.152* (0.085)</td>
<td>0.238* (0.128)</td>
<td>-0.064 (0.105)</td>
</tr>
</tbody>
</table>

Obs 13,249 5,991 15,177

Clustered standard errors in parentheses
Firm and year FE are included

*** p<0.01, ** p<0.05, * p<0.1
Innovative effort is much broader than just formal R&D or ITC adoption

- 2011 survey wave investigate which were the main constraints to innovative effort for previous year
- one question ask how important were difficulties to collect external funds in limiting innovation on a four-items scale
- $FinCon_{i,2010}$ equal to one iff difficulties to get external funds is thought to be “somehow important” or “very important” as an obstacle to innovation
Result - Financial constraints to innovation

Linear Probability Model, using cross section

\[ Pr(\text{FinCon}_{i,2010} = 1) = \gamma_{s,p} + \alpha \lambda_{i,2010} + \eta_{i,t} \]

Estimates

- \( \hat{\alpha} = -1.111^* \)
- \( tstat = -1.75 \)
- N=628
- caveats: only regression with \( \lambda_{i,t} \) without firm FE (we include province \times sector)

\( \Rightarrow \) Innovation efforts are less likely to be constraints by lack of external funds when firms just received a positive credit shock
This paper

1. measures firm-specific credit supply
   - first, uses natural experiment
   - next, general measure

2. estimates production with credit frictions

3. shows that credit availability stimulates productivity growth

4. investigates mechanisms
   - R&D, Export, ICT adoption, Innovation

future work

- interaction with leverage decisions
- investments policy functions
- horse race: productivity growth vs allocation (and aggregate effects)
Appendix
Lehman Brothers
BNP freezes redemptions for
Estimate of total loss in mortgage mkts
Term Auction
Bearn

Spread between Euribor and Eurepo
(basis points)
Balancing of Observables

<table>
<thead>
<tr>
<th></th>
<th>Below Median</th>
<th>Above Median</th>
<th>St.Dev.</th>
<th>Normalized Diff.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inv. rate by industry</td>
<td>3.999</td>
<td>4.021</td>
<td>1.296</td>
<td>-0.012</td>
</tr>
<tr>
<td>Inv. rate by province</td>
<td>4.044</td>
<td>3.977</td>
<td>0.661</td>
<td>0.072</td>
</tr>
<tr>
<td>Inv. rate 2006</td>
<td>4.073</td>
<td>3.948</td>
<td>8.277</td>
<td>0.011</td>
</tr>
<tr>
<td>Firm Size (million euros)</td>
<td>18.538</td>
<td>43.899</td>
<td>672.673</td>
<td>-0.027</td>
</tr>
<tr>
<td>Cash Holdings / Assets</td>
<td>0.065</td>
<td>0.067</td>
<td>0.091</td>
<td>-0.016</td>
</tr>
<tr>
<td>Sales / Assets</td>
<td>1.605</td>
<td>1.509</td>
<td>0.957</td>
<td>0.071</td>
</tr>
<tr>
<td>Roa</td>
<td>6.098</td>
<td>6.443</td>
<td>7.276</td>
<td>-0.034</td>
</tr>
<tr>
<td>Operating income / VA</td>
<td>0.378</td>
<td>0.383</td>
<td>0.403</td>
<td>-0.009</td>
</tr>
<tr>
<td>Leverage (Assets/Equity)</td>
<td>10.624</td>
<td>8.675</td>
<td>14.611</td>
<td>0.095</td>
</tr>
<tr>
<td>Short-Term Debt</td>
<td>0.226</td>
<td>0.213</td>
<td>0.159</td>
<td>0.058</td>
</tr>
<tr>
<td>Z-Score</td>
<td>4.626</td>
<td>4.439</td>
<td>1.796</td>
<td>0.074</td>
</tr>
<tr>
<td>Drawn /Granted Credit</td>
<td>48.568</td>
<td>47.865</td>
<td>27.036</td>
<td>0.018</td>
</tr>
<tr>
<td>Share of collat. debt</td>
<td>8.025</td>
<td>7.08</td>
<td>14.568</td>
<td>0.046</td>
</tr>
<tr>
<td>Tier 1 Capital Ratio</td>
<td>0.076</td>
<td>0.073</td>
<td>0.02</td>
<td>0.105</td>
</tr>
<tr>
<td>Log Bank Size</td>
<td>12.183</td>
<td>12.774</td>
<td>0.878</td>
<td>-0.505</td>
</tr>
<tr>
<td>Bank ROA</td>
<td>0.916</td>
<td>1.013</td>
<td>0.198</td>
<td>-0.358</td>
</tr>
<tr>
<td>Loan Charge-Offs</td>
<td>0.566</td>
<td>0.582</td>
<td>0.14</td>
<td>-0.081</td>
</tr>
</tbody>
</table>
Simplest production function is Value Added Cobb-Douglas:

\[ va_{i,t} = \omega_{i,t} + \rho \left[ (1 - \beta_k) \cdot l_{i,t} + \beta_k \cdot k_{i,t} \right] \]

we let \( \rho \) vary from 0.3 to 2 and \( \beta_k \) from 0.01 to .9

▶ then, for each \((\rho, \beta_k)\) calculate

\[ \Delta \omega_{i,t} = \Delta va_{i,t} - \rho \left[ (1 - \beta_k) \cdot \Delta l_{i,t} + \beta_k \cdot \Delta k_{i,t} \right] \]

▶ finally, run

\[ \Delta \omega_{i,t} = \psi_{p,s,t} + \gamma \cdot INTBK_{i,2006} + \eta_{i,t}^{prod} \]
coefficient for $INTBK_{i,2006}$ as function of $(\rho, \beta_k)$

- coefficient is negative for any value of the parameter space
  - banks more exposed to interbank shock experience lower productivity growth
z-stats for $INTBK_{i,2006}$ as function of $(\rho, \beta_k)$ (change sign)

- the z-stat is above 2 in almost all the parameter space
  - banks more exposed to interbank shock experience significantly lower productivity growth
Interbank Exposure and firms sensitivity to business cycle

For each firm $i$ and year $t < 2007$ we run

$$outcome_{i,t} = c_i + \alpha_i \cdot r_t + \epsilon_{i,t}$$

where

- $r_t$ is growth rate of Italian GDP
- $\hat{\alpha}_i$ proxies for firm sensitivity to business cycle fluctuation

Then, we run $\hat{\alpha}_i$ on $INTBK_{i,2006}$

- results: firms more exposed to interbank have equal or lower $\alpha_i$, therefore they were NOT more sensitive to downturns
\( \alpha_i \) is calculated from regression

\[
\text{outcome}_{i,t} = c_i + \alpha_i \cdot r_t + \epsilon_{i,t}
\]

<table>
<thead>
<tr>
<th>VARIABLES</th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
<th>(6)</th>
</tr>
</thead>
<tbody>
<tr>
<td>( IT\bar{B}K_{i,2006} )</td>
<td>-0.717***</td>
<td>-0.0597**</td>
<td>-0.417***</td>
<td>-0.242</td>
<td>-0.0202</td>
<td>-0.0789</td>
</tr>
<tr>
<td></td>
<td>(0.249)</td>
<td>(0.0263)</td>
<td>(0.160)</td>
<td>(0.201)</td>
<td>(0.0431)</td>
<td>(0.260)</td>
</tr>
<tr>
<td>Constant</td>
<td>0.0608*</td>
<td>-0.0218***</td>
<td>0.0619***</td>
<td>0.0342</td>
<td>0.00172</td>
<td>0.0121</td>
</tr>
<tr>
<td></td>
<td>(0.0319)</td>
<td>(0.00337)</td>
<td>(0.0204)</td>
<td>(0.0257)</td>
<td>(0.00552)</td>
<td>(0.0333)</td>
</tr>
<tr>
<td>Observations</td>
<td>45,433</td>
<td>45,433</td>
<td>41,304</td>
<td>40,781</td>
<td>40,781</td>
<td>38,301</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.024</td>
<td>0.116</td>
<td>0.100</td>
<td>0.059</td>
<td>0.062</td>
<td>0.060</td>
</tr>
</tbody>
</table>

\[ \text{Outcome} \]

\( y_{i,t} \), \( va_{i,t} \), \( \omega_{i,t} \), \( \Delta y_{i,t} \), \( \Delta va_{i,t} \), \( \Delta \omega_{i,t} \)

\( \text{Province} \times \text{Sector} \times \text{Year} \) FEs are included
Interbank Exposure and Value Added Productivity

Dependent Variable is $\Delta \omega_{i,t}$

<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
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<td>-0.0895*</td>
<td>-0.0771*</td>
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</table>

- one observation is one firm in CADS × one year (2007-2009)
- Province × Sector × Year FEs are included
- production function parameters are estimated at industry level
Interbank Exposure and Value Added Productivity + Controls

Dependent Variable is $\Delta \omega_{i,t}$

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<tr>
<td>$\Delta \omega_{i,t}$</td>
<td>$-0.104^{**}$</td>
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<td>0.168</td>
<td>0.143</td>
<td>0.126</td>
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</tbody>
</table>

- one observation is one firm in CADS × one year (2007-2009)
- Province×Sector×Year FEs are included
- clustered (firm) standard errors in parenthesis
- controls are firm-level characteristics in 2005
  - polynomial of capital, liquidity, cash flow
  - $\alpha_i$ is a measure of firms’ sensitivity to business cycle
Interbank Exposure and Value Added Productivity - Placebo

- dependent Variable is $\Delta \omega_{i,t}$
- placebo: look at years pre-Interbank shock

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<td>$IN\bar{BK}_{i,2006}$</td>
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<td>0.094</td>
<td>0.094</td>
<td>0.089</td>
<td>0.086</td>
<td>0.087</td>
</tr>
</tbody>
</table>

- one observation is one firm in CADS $\times$ one year (2004-2006)
- Province$\times$Sector$\times$Year FEs are included
- clustered (firm) standard errors in parenthesis
Reflection Problem
We estimate $\lambda_{i,t}$ from a network of firms-banks connection. Endogeneity concern?

1. correlated unobservables?
   ▶ demand shocks might be correlated with credit supply because of geographical or industry concentration
   ▶ export heterogeneity (next slide)
   ▶ demand and FE (in two slides)

2. reverse causality?
   ▶ productivity shocks of some borrowers might impact banks’ ability/willingness to supply credit
   ▶ we show “granular firms” don’t drive the results

3. assortative matching?
   ▶ matching on level (e.g. more productive firms matching with better banks) not a problem
   ▶ knowledge of future productivity shocks? harmful - but one needs to assumed it away to estimate productivity
Direct Effect on Demand

Bank might directly affect borrowers demand because of correlation between lenders of suppliers and lenders of clients (e.g. local effect). Then we run

$$\Delta \omega_{i,t} = \psi_t + \psi_i + \gamma_0 \lambda_{i,t} + \gamma_1 \frac{\text{export}_{i,t-2}}{y_{i,t-2}} + \gamma_2 \lambda_{i,t} \cdot \frac{\text{export}_{i,t-2}}{y_{i,t-2}} + \eta_{i,t}$$

$\gamma_2$ capture the differential effect of the shock on exporters

- less likely foreign buyers land from same back $\Rightarrow \gamma_2 < 0$
- results: not statistically different from zero
- $\Rightarrow$ effects does not come from direct effect on mark up
<table>
<thead>
<tr>
<th>VARIABLES</th>
<th>(1) $\Delta \omega_{i,t}$</th>
<th>(2) $\Delta \omega_{i,t}$</th>
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<tr>
<td>$\lambda_{i,t}$</td>
<td>0.110***</td>
<td>0.0230***</td>
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<tr>
<td>$\frac{\text{export}<em>{i,t-2}}{y</em>{i,t-2}}$</td>
<td>(-0.0193***)</td>
<td>(-0.00107)</td>
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<tr>
<td>$\lambda_{i,t} \cdot \frac{\text{export}<em>{i,t-2}}{y</em>{i,t-2}}$</td>
<td>-0.0190</td>
<td>-0.00741</td>
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<tr>
<td>R-squared</td>
<td>0.113</td>
<td>0.101</td>
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</table>
Correlated Unobservables?

Main problem: what if demand shocks are correlated with bank shocks?

- local demand or industry exposition

Let's compare

\[
\Delta y_{i,t} = \psi_i + \psi_{p,s,t} + \gamma \lambda_{i,t} + \eta_{i,t}
\]

with

\[
\Delta y_{i,t} = \psi_i + \psi_t + \gamma \lambda_{i,t} + \eta_{i,t}
\]

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<td>(\lambda_{i,t})</td>
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<td>0.0832***</td>
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<td>(0.0176)</td>
<td>(0.0166)</td>
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<tr>
<td>R-squared</td>
<td>0.316</td>
<td>0.239</td>
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The coefficients are very similar in magnitude (despite FEs absorb 10% of variance)

- not compatible with a story of effects driven by correlated shocks
Reverse Causality

Let’s focus on “granular firms”

- firms that have credits for at least 1% of banks loans at any point in time

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<td>R-squared</td>
<td>0.122</td>
<td>0.093</td>
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Effects extremely similar excluding “granular firms”

- unlikely that bank shocks are driven by firm-specific productivity dynamics
Relevance of Substitution Patterns

We regress:

$$\Delta \omega_{i,t} = \psi_i + \psi_{p,s,t} + \gamma_0 \lambda_{i,t} + \gamma_1 \mathcal{N}r_{i,t-1} + \gamma_2 \lambda_{i,t} \cdot \mathcal{N}r_{i,t-1} + \eta_{i,t}$$

where \( \mathcal{N}r_{i,t-1} \) is the number of bank relations firm \( i \) has in previous period (capped at 10)

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<td>( \lambda_{i,t} )</td>
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Observations 236k 243k
R-squared 0.203 0.162
### Whole Economy

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Outline

1. **Stylized Facts from a Quasi-Experiment**: the Freeze of the Interbank Market in Italy (2007-2008)
   - unexpected and heterogeneous shock to firms’ access to credit
   - fall in VA *much* larger than fall in K and L
   - suggest that credit crunch reduced firm-level TFP growth

2. **A More General Framework**
   - simple model of heterogeneous credit supply and production
   - identify credit supply shocks using firm-bank connections
   - estimate production parameters and productivity allowing for an effect of credit supply on TFP
   - **main results**: ↑ cred supply ⇒ ↑ productivity growth
     - effect stronger on younger and smaller firms
     - short-term effect on TFP growth, long-term effect on TFP levels.

3. **The Channels**: evidence that credit supply shocks stimulates TFP enhancing activities
   - R&D, Export, Innovation, ICT adoption