

Born in Hard Times: Startups and Intangible Capital during the Financial Crisis

Guzmán González-Torres ^{1 2} Francesco Manaresi ¹ Filippo Scoccianti ¹

¹Bank of Italy ²International Monetary Fund

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- Falling entry rates and rising exit rates during the financial crisis:
 - ▶ US (2007-2009): entry rates down by 25%, exit rates up by 15%;
 - ▶ In Southern European countries: drop prolonged for 6 years.
- What are the implications for growth?
 - ▶ “missing generation”: Siemer (2014) Clementi and Palazzo (2016);
 - ▶ being born in recession may be a permanent “scar” on growth (Moreira 2016);
 - ▶ but positive selection of new cohorts may mitigate these effects (Lee and Toshihiko 2006, Ates and Saffie 2016).

What are the effects of the financial crisis on startups?

- 1 We combine detailed firm balance-sheets with matched firm-bank data for the census of Italian corporations over the period 1999-2016;
- 2 While initially hit by the financial crisis, **revenues and employment of cohorts born during the crisis quickly catch-up** during the recovery; yet, they remain **persistently under-capitalized**;
- 3 They have **higher share of intangibles-to-total capital** and **higher productivity**;
- 4 **Intangible-intensity is a persistent feature of firms**, associated with higher productivity, lower K/L ratio, lower leverage at entry.
- 5 Selection on intangible-intensity during the crisis is **causally linked to tightening credit supply**;

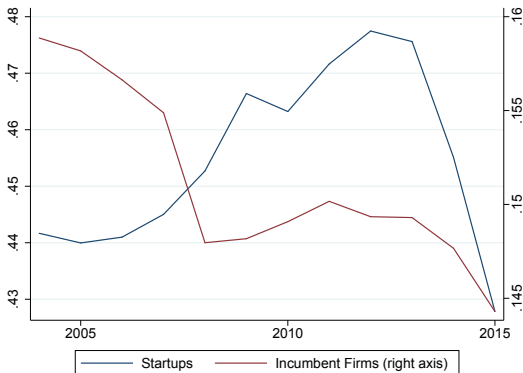
How can we interpret these results in a comprehensive framework?

- We develop a **firm dynamics model** featuring:
 - ▶ Two types of capital (material & intangibles)
 - ▶ Two technologies (high- & low-intensity of intangibles)
 - ▶ External financing costs (fixed & variable + pledgeability of material K)
- Intangible-intensive firms are more profitable and less capital intensive \implies less leveraged at entry
- **Smaller leverage makes them less vulnerable** to credit tightening
- Startups born during the crisis display higher productivity on average because of:
 - ▶ higher share of intangible-intensive firms (**between-technologies effect**)
 - ▶ stronger selection among material-intensive firms (**within-technology effect**)

The Financial Crisis→Intangibles Micro/Macro Puzzle

- **Micro-Studies:** the financial shock affected intangibility of investments among incumbents (Duval et al. 2017; Manaresi and Pierri 2018);
- **Macro Data:** during the financial crisis, aggregate accumulation of intangibles was more resilient than those of material capital.

A possible solution to this puzzle:



- **Young firms** represent 1/4 of total intangible capital, but **contribute for 64% to intangible capital formation**

Roadmap

- Data
- Stylized Facts on Intangibility and Selection
- Identifying the Financing Channel: Evidence from a Natural Experiment
- The Model
- Conclusions

- Census of Italian incorporated firms
- Sample selection
 - ▶ Manufacturing, Construction, Private Services
 - ▶ From 1999 to 2016

- Variables

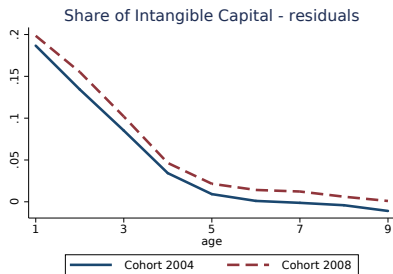
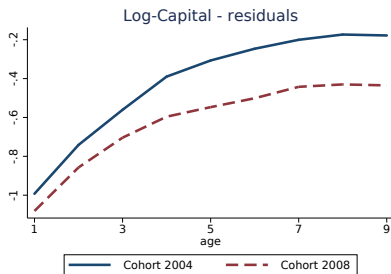
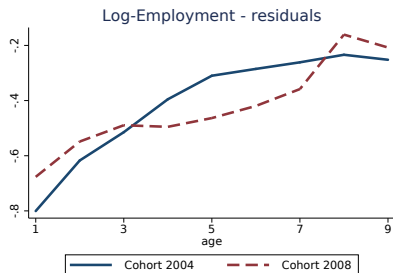
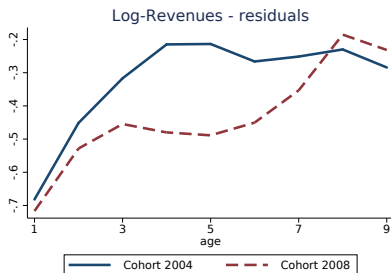
- ▶ Revenues \Rightarrow balance-sheet
- ▶ Capital \Rightarrow perpetual inventory method
- ▶ Employment \Rightarrow wagebill OR employees
- ▶ TFP \Rightarrow translog, DL-W

Variable	Mean	Median	St.Dev.
Rev.	955.7	135.7	2286.2
VA	232.0	25.3	658.8
L	136.6	10.4	319.2
K	204.5	13.3	680.4
Intang. K (%)	25	7	33

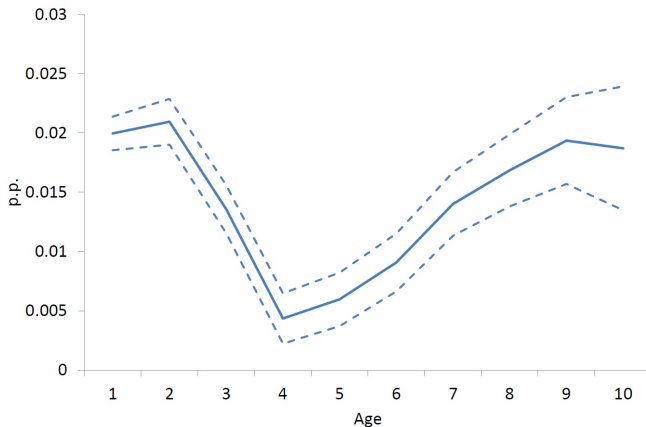
- Definition of a Firm

- ▶ Fiscal Code
- ▶ Controls for M&A

Firm Lifecycle Before and During the Crisis



Firms born during the crisis have higher share of intangibles to total capital

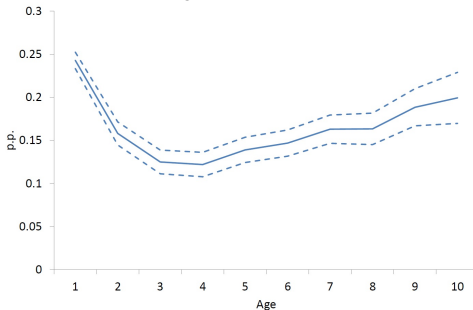


$$\frac{K^I}{(K^I + K^M)_{ipst}} = \sum_{a=1}^A \beta_a * A_{it} + \sum_{a=1}^A \gamma_a * A_{it} \times CrisisCohort_i + \lambda_t + \theta_p + \pi_s + \varepsilon_{ipst}$$

Firms born during the crisis are more productive

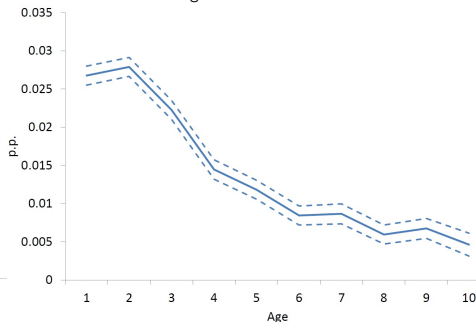
Capital Productivity

regression results



TFP

regression results



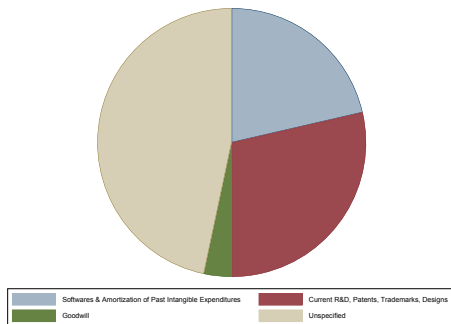
$$\log Prod_{ipst} = \sum_{a=1}^A \beta_a * A_{it} + \sum_{a=1}^A \gamma_a * A_{it} \times CrisisCohort_i + \lambda_t + \theta_p + \pi_s + \varepsilon_{ipst}$$

What is Intangible Capital?

In our data:

According to the Italian law:

- 1 R&D expenditures
- 2 Softwares
- 3 Value of patent rights, trademarks, designs (either owned or granted)
- 4 Goodwill (intangibles of a purchased company) and setting-up costs
- 5 Amortization of past intangible investments (net of goodwill and setting-up costs)



Persistency of intangibility

Cohorts born **before** the crisis

		Age 10	
		Low	High
Age 1	Low	70	30
	High	21	79

Cohorts born **during** the crisis

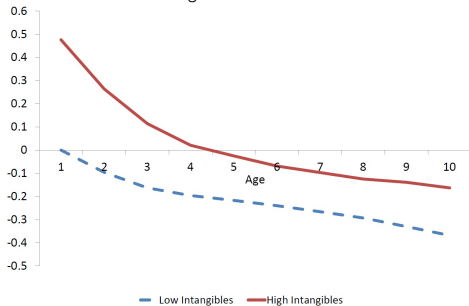
		Age 10	
		Low	High
Age 1	Low	73	27
	High	21	79

- High-Intangible firms \Rightarrow Intangibles/Total Capital= 0.48
- Low-Intangible firms \Rightarrow Intangibles/Total Capital= 0.14

High-intangibility \Rightarrow \uparrow productivity & \downarrow K/L ratio

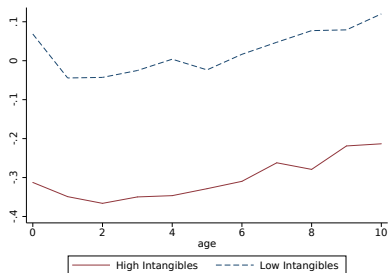
Log-K Productivity

regression results



K/L

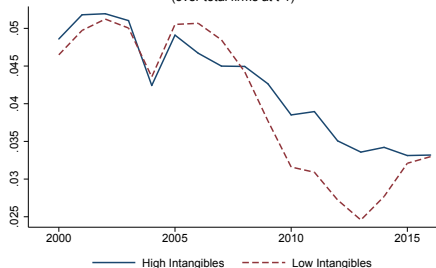
regression results



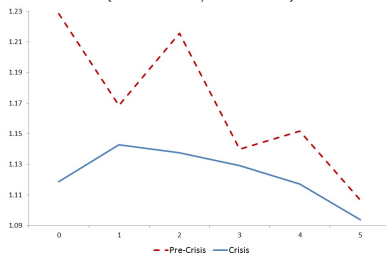
$$Y_{ipst} = \sum_{a=1}^A \beta_a * A_{it} + \sum_{a=1}^A \gamma_a * A_{it} \times HighIntang_i + \lambda_t + \theta_p + \pi_s + \varepsilon_{ipst}$$

High-Intangible Startups Suffered Less at Entry and Through Exit

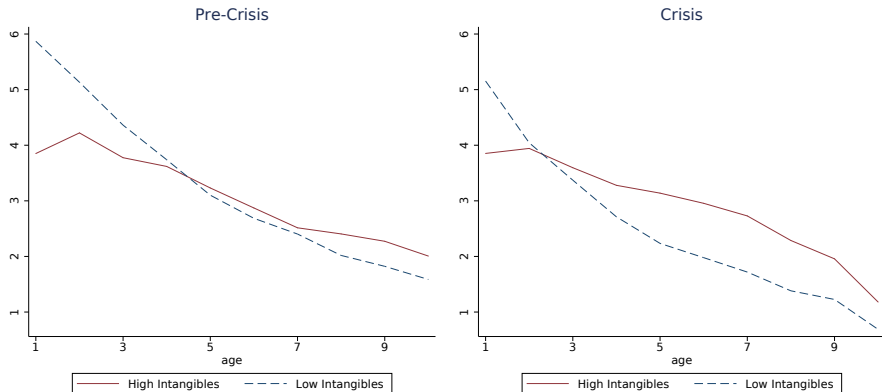
Entry Rates
(over total firms at t-1)



Odds-ratios of exit
(exit rates H / exit rates L)



High-intangibility is associated with lower leverage at entry



$$\frac{\text{Assets}}{\text{NetWorth}}_{ipst} = \sum_{a=1}^A \beta_a * A_{it} + \sum_{a=1}^A \gamma_a * A_{it} \times \text{HighIntang}_i + \lambda_t + \theta_p + \pi_s + \varepsilon_{ipst}$$

Takeaways from Empirical Facts

- ❶ Intangible-intensity is a persistent feature of firms
 - ❷ associated with higher revenue productivity...
 - ❸ ... and a lower reliance on external finance during early years of life
 - ❹ During the crisis, intangible intensity *and* capital productivity of new cohorts have increased, thanks to selection through entry and exit
- Has the financial shock (2007-8) being a driver of the selection that we observe?

Credit Tightening Driving Selection? Evidence from a Natural Experiment

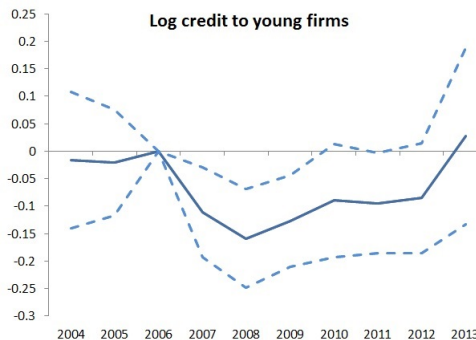
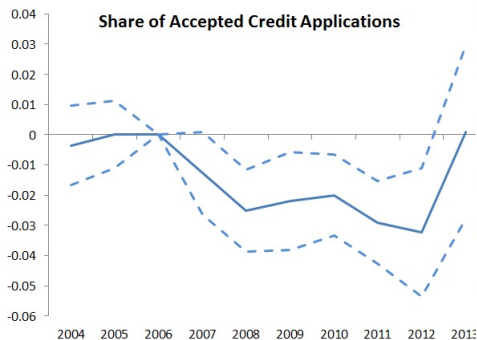
- Subprime & Lehman \implies freeze in Interbank market (ITBK) \implies credit reduction
- Local pre-crisis (2006) exposure to ITBK as an exogenous shock to credit supply
- **Credit supply shifter**: weighted average of 2006's "*interbank liabilities-to-assets ratio*" of lenders; weights equal to share of credit granted to province p and sector s

$$IT\bar{BK}_{p,s,2006} = \sum_b \frac{C_{bps,2006}}{C_{ps,2006}} ITBK_{b,2006}$$

- Empirical model (within province-sector)

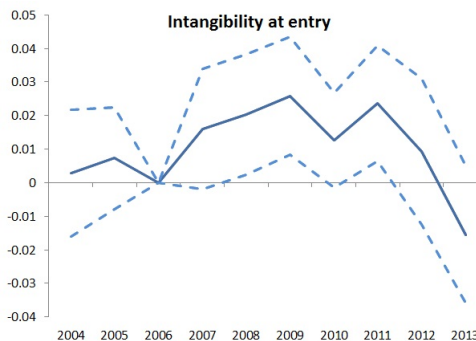
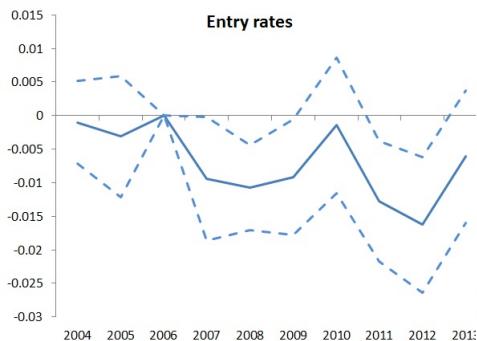
$$Y_{p,s,t} = \psi_{ps} + IT\bar{BK}_{p,s,2006} \times \lambda_t \gamma + [X_{pst} \beta] + \varepsilon_{p,s,t}$$

Interbank Shock and Credit Access of Startups



$$Y_{p,s,t} = \psi_{ps} + IT\bar{BK}_{p,s,2006} \times \lambda_t \gamma + [X_{pst}\beta] + \varepsilon_{p,s,t}$$

Interbank Shock and Firm Entry



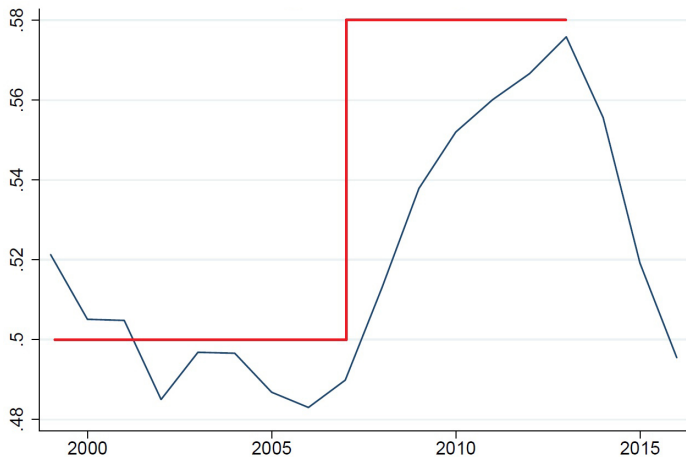
$$Y_{p,s,t} = \psi_{ps} + IT\bar{B}K_{p,s,2006} \times \lambda_t \gamma + [X_{pst}\beta] + \varepsilon_{p,s,t}$$

Main Model's Ingredients

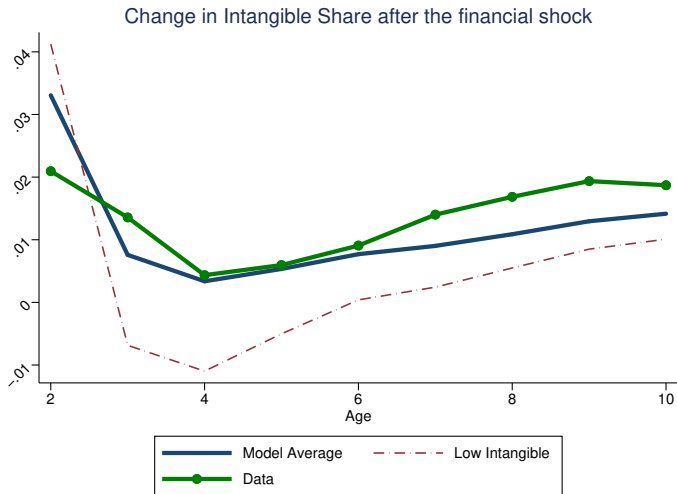
We build upon Hopenhayn's (1992) model, augmenting it with

- Two types of capital
 - ⇒ material capital m and intangible capital i
- Two technologies
 - ⇒ high- and low-intangible firms, which differ in the share of intangibles in total capital
 - ⇒ High-intangible firms enjoy higher efficiency units of capital
- External financing costs as in Gomes (2001) ⇒ firms face a cost from investing more than their current profits (fixed & variable + pledgeability premium for material capital)
- Model calibrated with micro & macro data to match:
 - 1 K-prod of intangible-intensive firms
 - 2 Intangible intensity of the two 'technologies'
 - 3 Exit rates by age (*pre-crisis*)
 - 4 Debt/assets for start-ups (*pre-crisis*)
- Steady-states' comparison: low-VS-high financing costs' economy

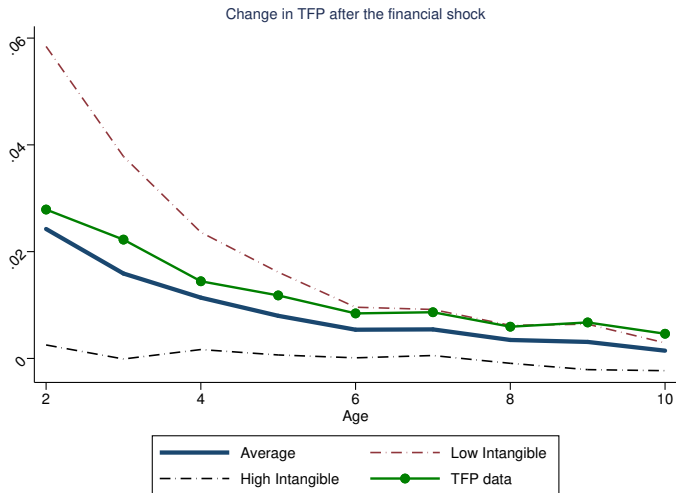
Model Replicates the Increase in Share of Intangible-intensive Firms



Increase in the Intangible Share of New Cohorts



Material-intensive Firms: Fewer but Better

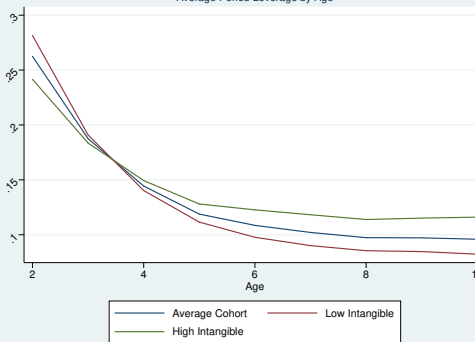


Low-intangible firms increase their TFP at entry \implies their entry rate declines

Selection of more productive low-intangible firms \Rightarrow lower leverage

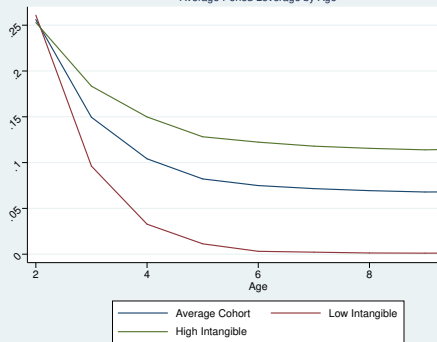
No Financial Shock

Average Period Leverage by Age



Financial Shock

Average Period Leverage by Age



Why High-Intangible Firms are Less Selected by the Crisis?

- High-intangible firms have higher efficiency units of capital \implies lower capital intensity and lower leverage!
- Increase in financing costs \implies \downarrow firm's profitability and the value of starting a business
- Entry value falls more for ventures that are more leveraged at entry: material-intensive firms

Conclusion

We find:

- Intangible-intensity is a persistent feature, correlated with higher productivity;
- Intangible-intensive startups suffered less during the crisis; while material-intensive startups were more fiercely selected;
- Intangible-intensive firms are more resilient to a financial shock thanks to the higher efficiency of their capital which implies a lower leverage at entry

Implications:

- Startups and young firms are key for capital accumulation, also intangible ones;
- Selection of new firms during financial recessions may spur technological change (Necessity Mother of Inventions);
- Policies aimed at fostering R&D and intangible accumulation may target young firms, rather than being size-dependent.

Thank you!

francesco.manaresi@bancaditalia.it