Bank Credit and Productivity Growth

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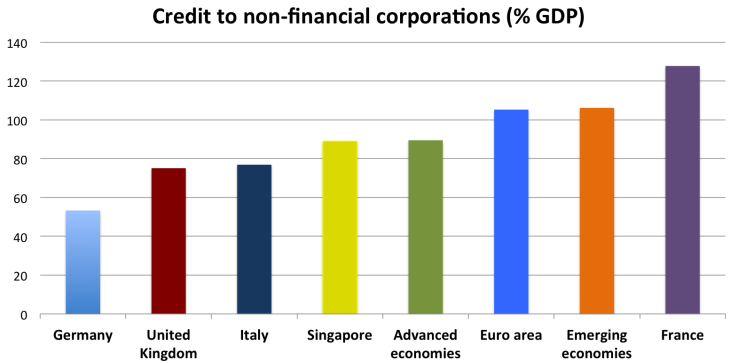
Credit to non-financial corporations is a large share of GDP



A traditional issue in Economics

Political economists say that capital sets towards the most profitable trades, and that it rapidly leaves the less profitable non-paying trades.

But in ordinary countries this is a slow process [...]

In England, however, capital runs as surely and instantly where it is most wanted, and where there is most to be made of it, as water runs to find its level.

Bagehot (1873)

How do we measure the efficiency of credit allocation?

- Standard benchmark comes from q-theory of investments.
- It's more efficient to finance firms with a market value below the book value.
- Data limitations make Q-theory measures of efficiency hard to compute for a large set of industries and countries.
- The literature typically uses the elasticity of investment (proxy for credit) to value added (proxy for investment opportunities).

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- We test the model using firm-level information on finance and productivity across a set of eurozone countries.
- We reach alternative conclusions about the efficiency of credit allocation relative to the traditional approach.

Related literature

- Effects of finance on economic growth: Beck et al. (2008); Ciccone and Papaioannou (2006); Levine (2005); Guiso et al. (2004); Rajan and Zingales (1998); Levine (1997); King and Levine (1993).
- Real effects of bank credit: Cecchetti and Kharroubi (2015) Jimenez et al. (2014), Chodorow-Reich (2014), Schnabl (2012), Amiti and Weistein (2011) and Khawaja and Mian (2008).
- Literature on resource misallocation in Europe: Calligaris et al. (2016), Gopinath et al. (2015), Benigno and Fornaro (2014).
- **Role of financial sector in allocating capital efficiently**: Wurgler(2000), Hartmann et al. (2007), and Lee et al. (2016).

Model

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- There is a borrowing constraint that limit the amount of money she can borrow to face the liquidity shock, so she has to rely on the cash-flow from short term projects.
- We derive the relation between bank credit and both short- and long-run productivity shocks.

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- Higher productivity for **long-term** projects:
  - *Opportunity cost effect:* long-term projects are more profitable; the demand of credit goes *up*
  - *Prediction:* positive relation between long-term productivity growth and credit growth.

Model

- An entrepreneur lives for three-periods: $t-1$(accumulates human capital); t (short-run); and $t+1$ (long-run).
- She maximizes a linear intertemporal utility function:

$$U_{t-1} = \sum_{s \in \{t-1, t, t+1\}} \beta^{s-t+1} \Pi_s, \tag{1}$$

- In each period s she employs her own labor L_s and a capital good K_s to supply units of the final good Y_s:

$$Y_s = A_s K_s^{\alpha} L_s^{1-\alpha}, \ \alpha \in (0,1), \tag{2}$$

- We assume that productivity follows a deterministic trajectory and A_{t-1}, A_t, A_{t+1} are known to the entrepreneur in $t-1$.

Model (II)

- The entrepreneur is endowed with:
  - L units of labor in each period
  - H units of human capital accumulated in $t-1$, normalized to 1
  - K units of physical capital in $t-1$.
- The technology for transforming human capital in physical capital is linear and available in period t: $K_t + K_{t+1} = H$.
- K_{t+1} needs additional tooling at cost ηK_{t+1} to be paid in t through:
  - D_{t-1} cash saved from period $t-1$
  - F_t credit at a risk-free interest rate R_s.

The liquidity shock

- At the beginning of $t+1$, she is hit by a liquidity shock before production takes place.
- The shock S_{t+1} is randomly drawn from a uniform distribution with c.d.f. $\Phi(S_{t+1}) = S_{t+1}/S_{\max}$, $S_{t+1} \in [0, S_{\max}]$
- She can meet the liquidity shocks with the cash flow set aside from previous periods' sales Y_{t-1}, Y_t, or by raising additional funding B_{t+1} at the risk-free rate.
- If she meets S_{t+1}, she will recover the payment at the end of period $t+1$ (pure liquidity shock and no strategic default).
- If she does not meet the shock, she will be able to repay F_t with interests upon liquidation (secondary market for K_{t+1}).

Budget constraints and financial markets setting

- When financial markets are *complete*, she can raise as much as external funding as needed to meet the liquidity shock, which becomes immaterial for allocating human capital between K_t and K_{t+1}.

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- Period $t-1$

$$\Pi_{t-1} + D_{t-1} = Y_{t-1} \tag{3}$$

- Period t

$$\Pi_t + \eta K_{t+1} = Y_t + (1 + R_{t-1})D_{t-1} + F_t. \tag{4}$$

- Period $t+1$

$$\Pi_{t+1} + (1 + R_t)F_t + B_{t+1} = Y_{t+1} + S_{t+1}. \tag{5}$$

Budget constraints and financial markets setting (II)

- When capital markets are *incomplete* there is a binding borrowing constraints:
- K_{t+1} pledged as a collateral to secure a loan $F_t > 0$ for the tooling cost.
- No collateral left for borrowing to meet the liquidity shock, so $B_{t+1} = 0$.
- She can meet the liquidity shock only with her own cash flow Y_t and lending repayment $(1 + R_{t-1})D_{t-1}$

Maximization

- By substituting the various constraints into (1), the maximization problem boils down to:

$$\max_{K_t, K_{t+1}}$$

$$A_{t-1}K^{\alpha} + \beta\left(A_t K_t^{\alpha} - \eta K_{t+1}\right) + \beta^2 S_{\max}^{-\phi}\left(A_t K_t^{\alpha} + \beta^{-1}A_{t-1}K^{\alpha}\right)^{\phi} A_{t+1}K_{t+1}^{\alpha}$$

- When financial markets are complete (incomplete) $\phi = 0$ ($\phi = 1$)
- $S_{\max}^{-\phi}\left(A_t K_t^{\alpha} + \beta^{-1}A_{t-1}K^{\alpha}\right)^{\phi}$ is the probability of surviving the liquidity shock.
- $F_t = \eta K_{t+1} - \beta^{-1}A_{t-1}K^{\alpha}$, is the amount of credit in period t to cover the tooling cost (we assume $\eta > \beta^{-1}A_{t-1}K^{\alpha}$)

Credit and productivity

- Baseline scenario: $A_{t-1} = A_t = A_{t+1} = A$
- Scenario 1: productivity growth between $t-1$ and t, $A_t > A_{t-1} = A_{t+1} = A$
- Scenario 2: productivity growth between t and $t+1$, $A_{t+1} > A_t = A_{t-1} = A$

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  - Under complete markets, a positive increase of A_t raises the marginal product of K_t without affecting the marginal product of K_{t+1}.
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- FOC implies:
  - Under complete markets, a positive increase of A_t raises the marginal product of K_t without affecting the marginal product of K_{t+1}.
  - Larger A_t reduces borrowing for covering the tooling cost.
  - Under incomplete markets, larger A_t increases the cash flow in t, raising the probability of surviving the liquidity shock, thus increasing the expected marginal product of K_{t+1}.
  - Larger A_t increases borrowing for covering the tooling cost.

Model's prediction

Proposition 1:

(a) With *complete* financial markets, the elasticity of credit to *contemporaneous* productivity is negative due to the opportunity cost effect.

(b) With *incomplete* financial markets, it can be positive as there is also an opposing liquidity effect.

(c) The elasticity of credit to *future* productivity is always positive no matter whether financial markets are complete or incomplete as only the opportunity cost effect is at work.

Empirics

Data set

- Novel firm-level data set based on the CompNet database.
- Variables' definition and data are carefully homogenised across countries.
- Countries: France, Germany, and Italy (data are not pooled)
- Period: late 1990s (exact year varies by country) until 2012
- Financial variables: bank credit, leverage, return on assets
- Productivity variables: total factor productivity, marginal product of capital, labor productivity, and real value added.

Econometric specification

- The traditional approach since Wurgler (2000):
  - Dependent variable: growth rate of investments, as a proxy for credit (industry level).
  - Main explanatory variable: growth rate of value added, as a proxy of investment opportunity (industry level).
  - Elasticity of investment with respect to real value added was consistent with a q-theory of investment as it captures whether credit get reallocated more quickly to the most promising firms.

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  - Elasticity of investment with respect to real value added was consistent with a q-theory of investment as it captures whether credit get reallocated more quickly to the most promising firms.
- Our framework is close, but we bring it forward by:
  - looking directly at bank credit and take a firm-level dimension.
  - focusing explicitly on productivity.
  - disentangling the relation of bank credit with current and future productivity.

Baseline regression

- Recovering the elasticity between credit and *current* productivity growth

$$Credit\ Growth_{it} = \beta_0 + \beta_1 Productivity\ Growth_{it} +$$
$$\beta_2 Demand\ Proxy_{it} + \beta_3 Leverage_{it-1} + \delta_t + \psi_i + \epsilon_{it} (6)$$

- Recovering the elasticity between credit and *future* productivity growth

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Empirical strategy

- We look at β_1 and α_1 through the lenses of the model
  - A negative β_1 signals efficiency (the more so, the larger it is).
  - A positive β_1 signals inefficiency.
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- We run a cross-country comparison and the different composition of firms across samples can affect the results. We do robustness by firm size.
- We do not draw a distinction between unobserved future productivity and its realization; equivalent under perfect foresight, mismeasurement leads to attenuation bias.

Baseline results

Table

Elasticity of credit to:	**France**		**Germany**		**Italy**	
	t	t+1	t	t+1	t	t+1
TFPR	-0.27***	0.15***	-0.08***	0.06***	0.02***	0.02***
	(0.01)	(0.01)	(0.007)	(0.008)	(0.001)	(0.001)
RVA	0.17***	0.23***	-0.001	0.09***	0.11***	0.001
	(0.008)	(0.01)	(0.006)	(0.007)	(0.003)	(0.005)

Baseline results at t

Table

Elasticity of credit to:	France		Germany		Italy	
	t	t+1	t	t+1	t	t+1
TFPR	−27%**	14.4%***	−8%**	6.1%***	0.8%**	2.4%***
	(0.01)	(0.01)	(0.007)	(0.008)	(0.001)	(0.001)
RVA	0.17***	0.23***	-0.001	0.09***	0.11***	0.001
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	(0.01)	(0.01)	(0.007)	(0.008)	(0.001)	(0.001)
RVA	17%**	22.5%***	−0.1%	8.8%***	12%**	1.2%
	(0.008)	(0.01)	(0.006)	(0.007)	(0.003)	(0.005)

Baseline results at $t + 1$

Table

Elasticity of credit to:	**France**		**Germany**		**Italy**	
	t	t+1	t	t+1	t	t+1
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Results with alternative productivity measures

Table

Elasticity of credit to:	France		Germany		Italy	
	t	t+1	t	t+1	t	t+1
MRPK	-0.51***	0.08***	-0.24***	0.05***	-0.003***	0.002***
	(0.007)	(0.007)	(0.006)	(0.005)	(0.000)	(0.000)
LProd	-0.17***	0.10***	-0.07***	0.06***	0.05***	0.04***
	(0.008)	(0.01)	(0.006)	(0.007)	(0.001)	(0.001)

Baseline results by firm size

Table

Elasticity of credit to		France		Germany		Italy	
		t	t+1	t	t+1	t	t+1
TFPR	Small	-0.29***	0.18***	-0.09***	0.08***	0.02***	0.03***
		(0.01)	(0.01)	(0.02)	(0.01)	(0.001)	(0.001)
	Large	-0.22***	0.09***	-0.08***	0.05***	-0.002	0.00
		(0.02)	(0.02)	(0.01)	(0.008)	(0.009)	(0.008)
RVA	Small	0.15***	0.20***	-0.003	0.10***	0.12***	0.01
		(0.01)	(0.01)	(0.01)	(0.02)	(0.002)	(0.007)
	Large	0.22***	0.12***	0.00	0.08***	0.05***	0.003
		(0.01)	(0.02)	(0.009)	(0.008)	(0.01)	(0.002)

Baseline results pre- vs. post-crisis

Table

Elasticity of credit to		France		Germany		Italy	
		t	t+1	t	t+1	t	t+1
TFPR	Pre-crisis	-0.32***	0.16***	-0.07***	0.06***	0.01***	0.02***
		(0.01)	(0.01)	(0.01)	(0.01)	(0.002)	(0.001)
	Post-crisis	-0.23***	0.12***	-0.11***	0.09***	0.02***	0.03***
		(0.02)	(0.02)	(0.02)	(0.01)	(0.001)	(0.001)
RVA	Pre-crisis	0.14***	0.26***	0.003	0.09***	0.10***	0.02
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		(0.01)	(0.02)	(0.02)	(0.01)	(0.003)	(0.02)

Conclusion

Conclusion

- We contribute to the literature on the measurement of efficient capital allocation by credit markets.
- We propose a model that takes productivity as the main focus.
- The model provides guidance to make normative statements on credit allocation by disentangling the relation between credit and current, as well as future, productivity.
- We test the prediction of the model using comprehensive firm-level data for the main Eurozone countries.
- We reach conclusions about the efficiency of credit allocation that traditional approaches would have misinterpreted.