Credit Misallocation During the Financial Crisis

Fabiano Schivardi[1] Enrico Sette[2] Guido Tabellini[3]

[1]LUISS and EIEF [2]Banca d'Italia [3]Bocconi

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The analysis and conclusions expressed in this paper are those of the authors and should not be interpreted as those of the Bank of Italy

Motivation

- Legacy of financial crisis is a weakened banking sector
- Undercapitalized banks can prolong stagnation by reallocating credit to weak firms, to avoid further losses in their balance sheets
- Slow recovery explained by a misallocation of credit?
- Italy ideal testing ground: no injection of public capital (at least up to our sample period) or bad bank
- Bad loans and low capitalization still plaguing banks today

Credit and GDP growth in Italy during the great recession

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  2. What is the cost of zombie lending, in terms performance of heathy firms and misallocation of real resources?
- We improve on the previous literature both in terms of data quality and methodologically
- As a consequence, our assessment of the effects differ substantially
- We do find evidence that week banks lend relatively more to zombies, but this hardly hurts healthy firms

Related literature

- Seminal paper by Caballero, Hoshi, Kashyap (2008) for Japan. Main message: zombie lending hurts non zombies. Confirmed by Acharia, Eisert, Eufinger, Hirchs (2016) for Europe during the crisis. The OECD also has paper on this (Adams et al. 2017).

- Other work on Japan in the 90s, Kwon et al (2014), Giannetti and Simonov (2013).

- Evidence on the 2007-2008 financial crisis (Albertazzi and Marchetti 2010, Barnett et al. 2014).

- Growing literature on credit frictions and misallocation (Hsieh and Klenow 2009, Midrigan and Xu 2014 etc.) and more generally on misallocation and TFP (Olley and Pakes 1996, Bartelsmann et al 2013).

Plan of the talk

1. What is a zombie firm? How can we identify it empirically?
2. Do weak banks lend more to zombie firms?
3. Aggregate consequences of zombie lending: impact on non zombies and productivity dispersion

Data sources

- We match 3 data sources:
  1. Firm data: balance sheets from CERVED – all incorporated businesses
  2. Bank data: Supervisory report (balance sheets)
  3. Loans data: Credit registry. All firm-bank relationships above 30,000 euros. Amount granted and drawn – we look at granted, better measure of credit supply

Definition of Zombie Firms

- Main idea: a zombie is a firm with expected marginal return on capital below the risk adjusted market cost of capital
- Economic interpretation: returns on capital allocated to zombies would be higher elsewhere – misallocation
- A combination of low ROA and high leverage
  - Preferred Definition: zombie=1 if 3-years moving average of Ebitda/Assets $<$ prime rate and Leverage $>$ 40% – median Leverage in the year 2005 for low returns firms that exited the market between 2006-2007

Firms Characteristics

	Mean	Median	25pct	75pct	S.D.	N
Non-Zombie Firms						
Leverage	23.92	23.05	6.71	36.36	19.09	582,406
ROA	5.54	5.26	1.77	9.46	8.50	582,406
EBITDA/Int Exp	6.10	2.71	0.11	0.67	12.28	569,568
Cash Hold / Assets	6.96	2.71	0.62	8.85	10.27	551,970
Liquidity / Assets	13.18	6.07	2.33	14.14	62.10	582,265
Assets (000 Euros)	9,414	1,999	896	5,049	119,134	582,406
Zombie Firms						
Leverage	56.84	52.89	45.88	63.58	15.06	119,488
ROA	-1.34	1.09	-3.35	3.35	7.98	119,488
EBITDA/Int Exp	-0.45	0.48	-1.36	1.44	4.16	118,875
Cash Hold / Assets	3.18	0.94	0.23	3.30	6.15	109,909
Liquidity / Assets	9.11	3.20	1.05	8.62	65.19	119,463
Assets (000 Euros)	12,896	3,156	1,245	8,653	79,031	119,488

Bank Variables

- Bank strength: Regulatory Capital Ratio (CR): ratio of total capital (Tier 1 and Tier 2) to risk-weighted assets – Minimum level: 8%.
- We construct **LowCap** as a dummy=1 if below the median (11%) to capture non linearities
- Credit growth: Delta log of total credit granted (credit lines, term loans, loans backed by receivables)
- Other bank controls: share of total credit to firm accounted by bank, share of credit granted through credit lines, liquidity ratio (cash and government bonds to total assets), interbank funding (interbank deposits and repos with commercial banks and total assets), ROA, log of assets.

Identification of Credit Supply effects

- Test if low capital ratio conducive to zombie lending during the crisis
  - Weak banks particularly loss averse: hard to reconstruct the capital ratio
- Estimating equation:

$$\text{Delta log credit}_{ijt} = \beta_0 + \beta_1(Z_{it} * \text{LowCap}_{jt}) + +\beta_2 \mathbf{X_{ijt}} + \textit{Dummies} + \eta_{ijt}$$

- Challenge: distinguish demand from supply of credit
  - Zombies may have a different demand for credit
  - Zombies may disproportionately borrow from weak banks - non random matching

Use Khwaja-Mian (2008) identification approach

- Fist, consider growth of *granted* credit
- Second, use Firm*year FE to capture all firm specific time-varying unobservables
- Identification relies on multiple bank relations: compare credit growth of the same firm by banks with different capital levels
- Additional concern: capital ratio and lending related to unobserved bank characteristics – include bank controls, and bank*time FE.
- Std errors double clustered at the bank and firm level

Results: Baseline specifications

	(1)	(2)	(3)	(4)	(5)	(6)
LowCap	-0.7029	-1.6530**	-1.6590**	-1.3749*	-1.326	-1.469**
	(0.6486)	(0.7228)	(0.7080)	(0.6997)	(1.024)	(0.673)
LowCap*Z	1.5228***	1.2530***	1.4010***	1.4121***	0.423	1.641***
	(0.5625)	(0.4559)	(0.4778)	(0.4811)	(0.744)	(0.556)
Z	-5.5827***					
	(0.2064)					
Share bank			-0.2226***	-0.2225***	-0.0403***	-0.304***
			(0.0130)	(0.0130)	(0.00716)	(0.0132)
Share credit line			0.1411***	0.1410***	0.0877***	0.146***
			(0.0065)	(0.0065)	(0.00733)	(0.00851)
H_0 : LowCap + LowCap*Z=0						
p-value	0.395	0.641	0.761	0.965	0.505	0.830
Bank Controls	N	N	N	Y	Y	Y
Collateralized					Y	N
Firm FE	Y	N	N	N	N	N
Time FE	Y	N	N	N	N	N
Firm*year FE	N	Y	Y	Y	Y	Y
Bank FE	N	N	N	Y	Y	Y
Observations	2,788,833	2,287,690	2,287,690	2,286,282	144,789	1,878,353
R^2	0.149	0.360	0.376	0.376	0.470	0.389

Main results

- Weak banks cut lending to healthy firms when compare to strong banks: growth rate smaller by approximately 1.5% (overall credit contraction -8%)
- Instead, they do not cut credit to Zombies: We never reject that $\beta_1 + \beta_2 = 0$
  - Note: always in comparison to healthy firms, as credit to zombies does drop substantially – by 5.5%
- So weak banks do lend relatively more to weak firms, but do so by contracting credit to healthy firms
- Role of collateral: no differences for collateralized loans, largest for non collateralized, on which loss provisions are substantially higher

Other predictions

- Weak banks are less likely to:
  - severe a relationship with zombies
  - classify a loan to a zombie as bad
- Instead, they do not charge higher rates – no evidence of gambling for resurrection
- Debt rollover uniformly more likely by all banks when they account for a large share of the firm's credit

Robustness

- Robust to different definitions of zombie firms
- Robust to different definitions of banks strength
  - Only regulatory ratios matter: not leverage, ROA, share of bad loans.

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  - Only regulatory ratios matter: not leverage, ROA, share of bad loans.
- Nothing going on before the crisis

Credit growth: effects at the firm level

	(1)	(2)	(3)	(4)
LowCap	-0.9699***	-1.2161***	-1.0261***	-1.5498***
	(0.2335)	(0.2286)	(0.2308)	(0.1729)
LowCap*Z	3.0060***	3.3340***	3.3057***	3.9108***
	(0.4102)	(0.4078)	(0.4077)	(0.3414)
Z	-8.9887***	-8.6526***	-8.6451***	-10.3704***
	(0.2071)	(0.2042)	(0.2041)	(0.1927)
H_0 : LowCap + LowCap*Z=0				
p-value	0	0	0	0
Banks controls	Y	Y	Y	Y
Firm Fe	Y	Y	Y	Y
Year Fe	Y	Y	Y	Y
Observations	662187	662187	662187	1223793
R^2	0.318	0.349	0.349	0.368

Sum up of credit results

- Low capitalized banks deleverage by cutting credit to healthy firms more than high capital banks, but not to zombie
  - They do so to prevent losses from showing up on their balance sheets
- More credit to zombies at the extensive margin, while not at the intensive margin - but in total, zombies benefit
- No differences in terms of interest rates or evergreening

Effects of zombie lending during the crisis

- Zombie lending can hurt healthy firms through two channels:
  1. Crowding out of bank credit
  2. Implicit subsidy and distorted competition for inputs and output
- Relevant market: sector-province-year *pt*

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- Caballero et al. 2008, Acharia et al. 2006:

$$\text{Delta}y_{ipt} = \beta_0 + \beta_1 ShZ_{pt} + \beta_2(1 - Z_{ipt}) * ShZ_{pt} + \beta_3 Z_{ipt} + Dummies_{ipt} + \eta_{ipt}$$

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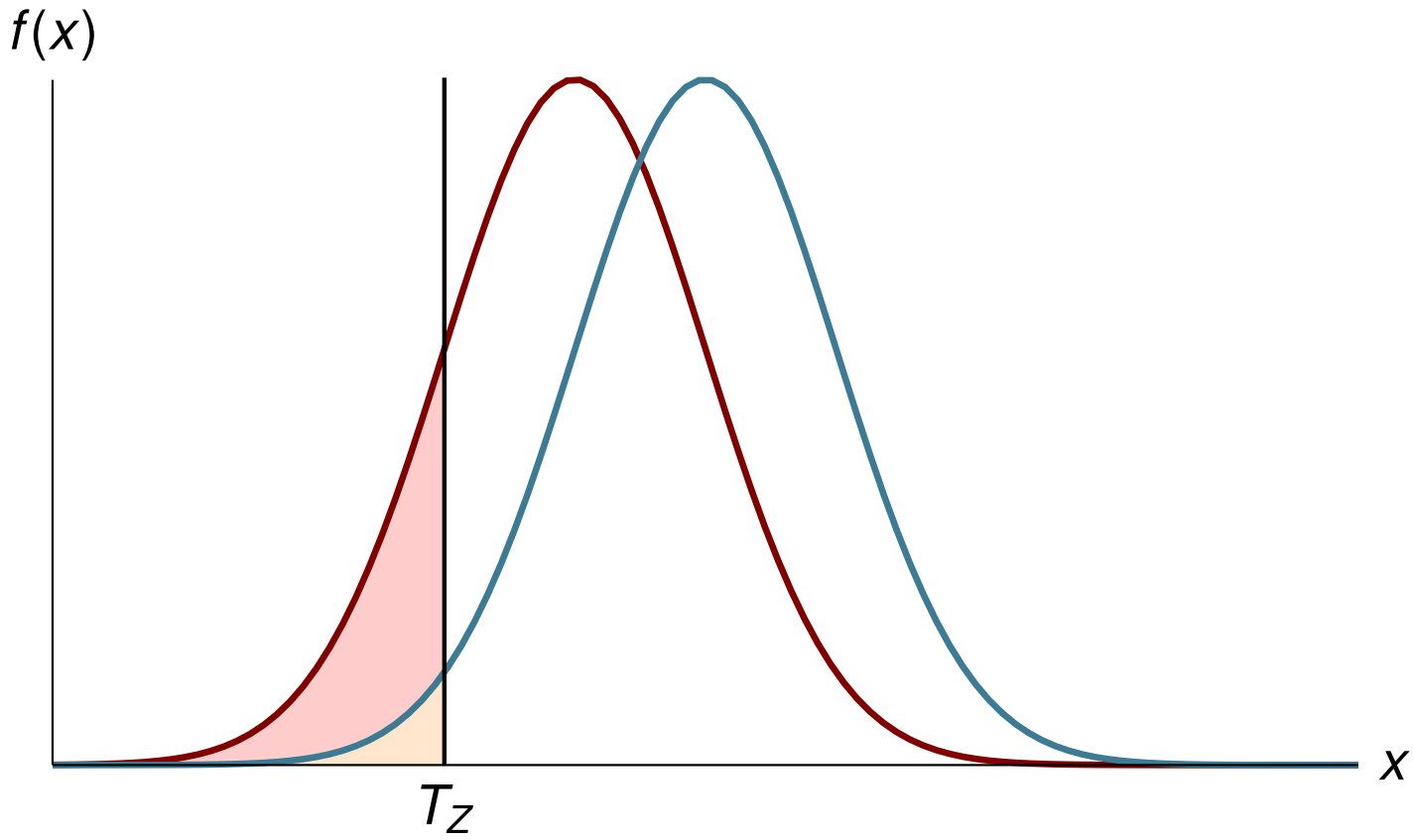
- A test of negative effects of Z on non Z is $\beta_2 < 0$.
- Identification challenge: *pt* shocks affect both ShZ_{pt} and firm performance
- Proposed solution: a full set of dummies at the *pt* level (β_1 drops out)

Problems in interpreting these regressions

- First, they can only identify the relative effects on non zombies
- Second, while they account for aggregate shocks, they face a more subtle identification issue
  - Define μ^Z as the mean performance of Z, and μ^{NZ} of non Z.
  - (Implicity) Identifying assumption: a shock at *pt* has the same effect on μ^{NZ} and μ^Z, absent negative spillovers
  - Necessary to attribute any relative change to spillovers
  - Unfortunately, this does not hold in general

The effect of a common shock on zombies and non zombies



The figure plots two normal distributions with unit variance and mean $\mu_L = 4$ and $\mu_H = 5$, respectively. T_Z the zombie threshold.

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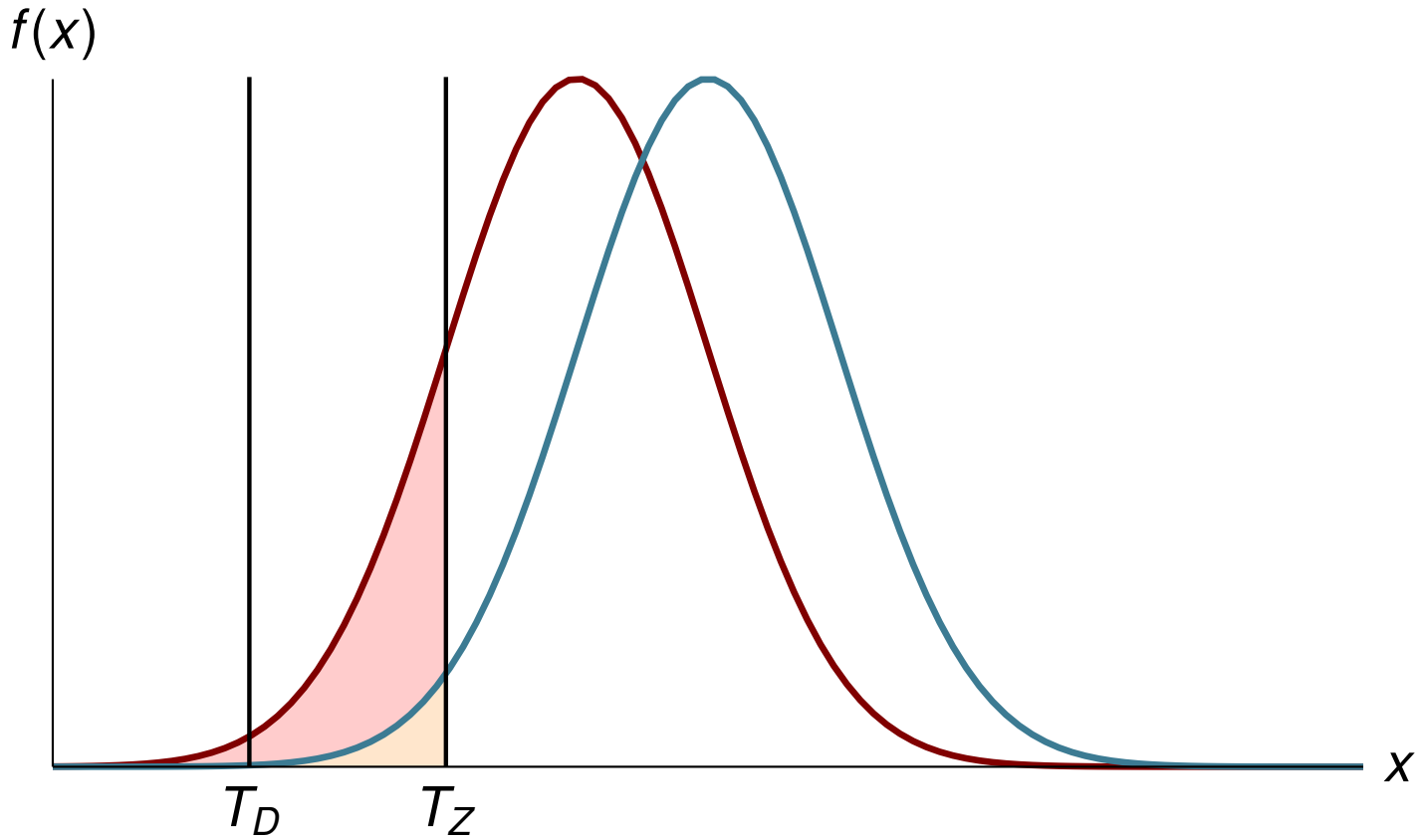
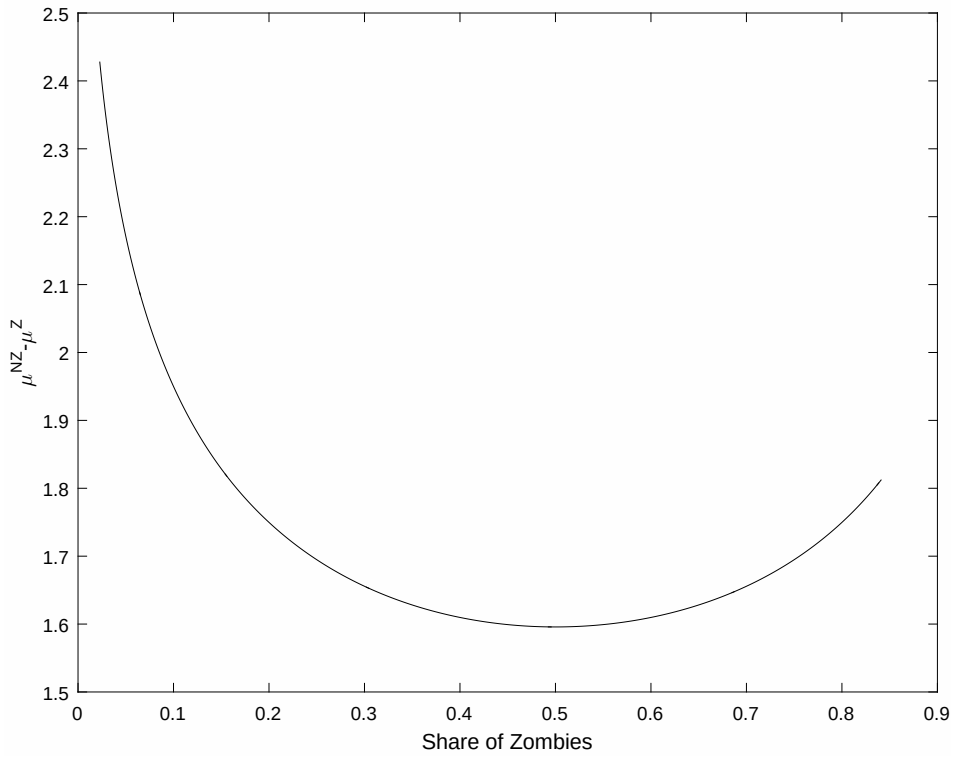


The figure plots two normal distributions with unit variance and mean $\mu_L = 4$ and $\mu_H = 5$, respectively. T_Z the zombie threshold and T_D is the exit threshold.

Figure: Difference in non zombies vs. zombies average performance



The graphs report the difference in the conditional mean of zombies and non zombies, $\mu^{NZ} - \mu^{Z}$ against the share of zombies

- Negative correlation emerges just from firms heterogeneity, absent any spillovers!
- We find this correlation in the data, like the previous literature

Alternative identification scheme

- We propose a variable that moves the shares of zombies in a province-sector-year but that is orthogonal to local-sectoral shocks.

$$\overline{LowCap}_{pt} = \frac{\sum_j LowCap_{jt} * Credit_{jpt}}{\sum_j Credit_{jpt}}$$

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- It captures the average degree of capitalization of banks lending in *pt*
- Likely to be exogenous with respect to local conditions prevailing in *pt*
  - Share of loans of each bank in a *pt* is on average 0.38%, median 0.03%
  - We have experimented excluding province-sectors that account for more than 5% of any bank loans, finding similar results
- Similar results when we use pre-crisis share of credit

Firms' growth and banks capital ratio

	(1)	(2)	(3)	(4)	(5)	(6)
	Delta Labour		Delta Capital		Delta Sales	
$\overline{\text{LowCap}}$	0.001		-0.009		-0.000	
	(0.007)		(0.006)		(0.008)	
$\overline{\text{LowCap}} * Z$	0.038***	0.037***	0.007	-0.002	0.018***	0.021***
	(0.004)	(0.004)	(0.007)	(0.006)	(0.005)	(0.005)
Z	-0.058***	-0.058***	-0.014***	-0.011***	-0.053***	-0.053***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
H_0 : LowCap + LowCap*Z=0						
p-value	0		0.795		0.044	
Province-Sector FE	YES	NO	YES	NO	YES	NO
Year FE	YES	NO	YES	NO	YES	NO
Prov-sect-year FE	NO	YES	NO	YES	NO	YES
Observations	966,963	966,691	916,553	916,301	965,751	965,471
R-squared	0.036	0.058	0.019	0.029	0.083	0.122

Real Consequences - Evidence

- Labor and sales: No effects on healthy firms, while zombies contract employment less the weaker banks lending locally
- No effects on investment: zombie firms use credit to pay for working capital, not for investment

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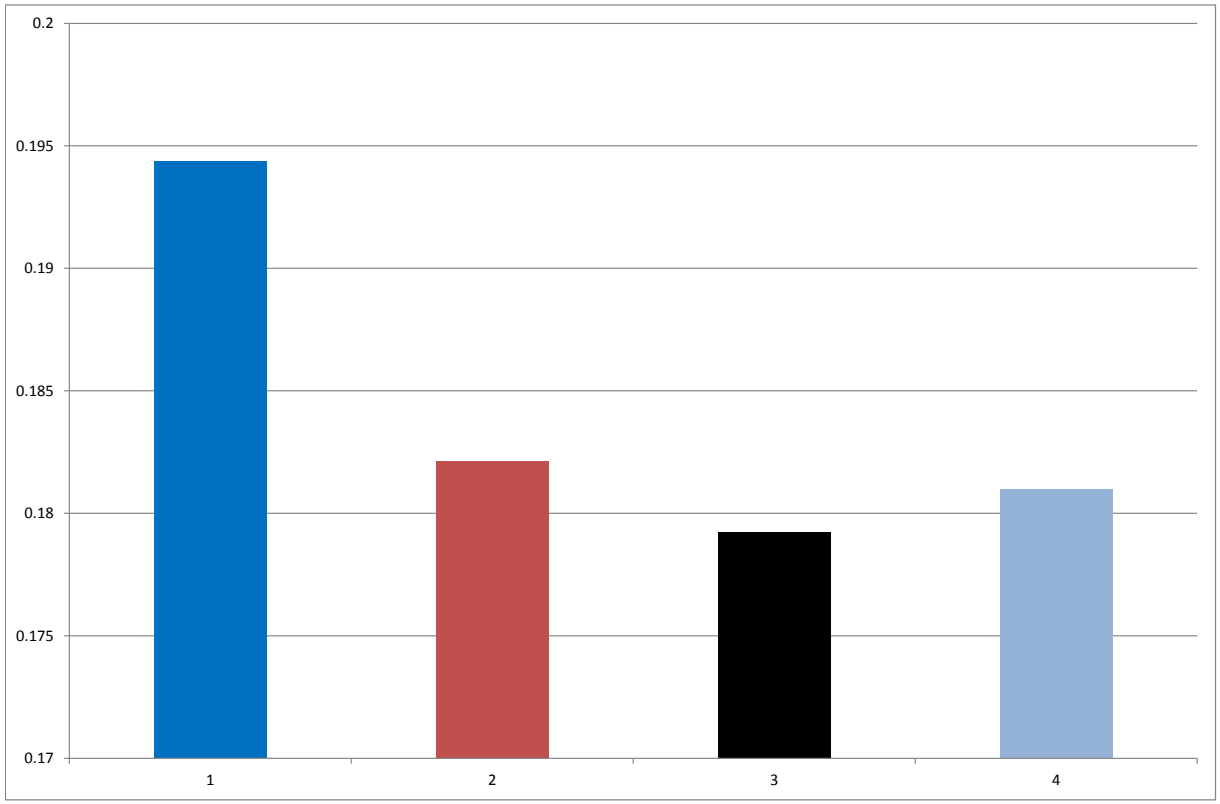
- Something emerges when looking at the failure margin: low capitalization decreases failure of zombies and increase that of non zombies, even in absolute terms
- We also perform an analysis of TFP dispersion as a measure of misallocation (Hisieh-Klenow 2009). Some (weak) evidence that lower bank capitalization increases misallocation at the province-sector level

Conclusion

- We study the extent to which credit misallocation affects resources misallocation and, in this way, economic performance.
- Weak banks (low capital banks) are relatively more likely to lend to weak firms during the crisis.
- Real effects at are however small: it looks like low capitalized banks sustain zombies but do not hurt healthy firms. Why?
  1. During the recession, Zombies need credit to survive, healthy firms can cover working capital and do not demand credit for investments
  2. We look at credit granted, but credit used might not decrease for healthy firms – multibanking helps
  3. Local demand externalities, low competition for inputs, prevents disruptions of supply chains
- Things might be different during the recovery phase

Share of credit to zombies by quartile of the capital ratio



Back

Alternative definitions of zombie firms

Back

	(1) Zombie 2	(2) Zombie3	(3) PC 1	(4) PC 2
LowCap	-1.3003*	-1.3918*	-1.1833*	-1.2145*
	(0.7224)	(0.7073)	(0.7020)	(0.7038)
LowCap*Z	2.1315***	1.8413***	1.1200***	1.0315***
	(0.4872)	(0.4809)	(0.2585)	(0.2412)
Share bank	-0.2217***	-0.2225***	-0.2226***	-0.2219***
	(0.0134)	(0.0130)	(0.0130)	(0.0134)
Share credit line	0.1418***	0.1409***	0.1409***	0.1417***
	(0.0065)	(0.0065)	(0.0065)	(0.0065)
H_0 : LowCap + LowCap*Z=0				
p-value	0.273	0.590	0.934	0.809
Firm*Year FE	Y	Y	Y	Y
Bank FE	Y	Y	Y	Y
Bank Controls	Y	Y	Y	Y
Observations	2,223,379	2,286,282	2286,282	2,223,379
R^2	0.373	0.376	0.376	0.373

Alternative definitions of banks strength

Back

	(1)	(2)	(3)	(4)	(5)	(6)
LowCap	-1.9289**					
	(0.7816)					
LowCap*Z	1.4369***					
	(0.4576)					
Capital ratio		0.6601**				
		(0.2720)				
Capital ratio*Z		-0.2735*				
		(0.1551)				
LowCap9			-0.6040			
			(0.6577)			
LowCap9*Z			2.7006***			
			(0.6417)			
LowROA				1.3582**		
				(0.5390)		
LowROA*Z				0.0722		
				(0.6793)		
HighLeverage					-0.3250	
					(0.8599)	
HighLeverage*Z					-0.3478	
					(0.6030)	
HighBadLoan						-0.0672
						(0.6323)
HighBadLoan*Z						1.7288***
						(0.5925)
H_0 : LowCap + LowCap*Z=0						
p-value	0.608		0.0391	0.106	0.500	0.0435
Observations	2,286,282	2,286,282	2,286,282	2,286,282	2,286,282	2,285,554
r^2						

Extensive Margin Regressions

Back

Dependent variable: dummy=1 if the credit relationship is severed

	(1)	(2)	(3)	(4)
LowCap	0.1704	0.0811	0.1123	-0.1685
	(0.5073)	(0.1930)	(0.1968)	(0.3330)
LowCap*Z	-1.4301***	-0.9781***	-0.7978***	-0.8124***
	(0.4095)	(0.3080)	(0.2803)	(0.2830)
Z	2.2598***			
	(0.2323)			
H_0 : LowCap + LowCap*Z=0				
p-value	0.106	0.00291	0.0163	0.00992
Banks controls	Y	Y	Y	Y
Firm FE	Y	N	N	N
Time FE	Y	N	N	N
Firm*year FE	N	Y	Y	Y
Bank FE	N	N	N	Y
Observations	3144915	2638666	2638666	2636764
R^2	0.214	0.436	0.457	0.457

Additional tests

Back

	(1) Bad Loan	(2) Sub-Standard	(3) Past due	(4) Int. rates	(5) Evergreening	(6) Evergreening
LowCap	0.1103*	-0.1222	0.0243	0.0612	-1.3504	-1.1545
	(0.0606)	(0.0836)	(0.0800)	(0.1094)	(0.8172)	(0.8311)
LowCap*Z	-0.5523**	-0.6017***	0.5413***	0.0106	1.6490**	1.6780**
	(0.2220)	(0.1917)	(0.1824)	(0.0453)	(0.6983)	(0.6852)
Sharetot*Z					0.1329***	0.1328***
					(0.0099)	(0.0098)
Sharetot*LowCap*Z					-0.0156	-0.0158
					(0.0151)	(0.0147)
H_0 : LowCap + LowCap*Z=0						
p-value	0.0281	0.000718	0.00122	0.525	0.753	0.603
Firm*time FE	Y	Y	Y	Y	Y	Y
Bank FE	Y	Y	Y	Y	Y	Y
Observations	2698744	2698744	2698744	966838	2287690	2286282
R^2	0.735	0.570	0.391	0.654	0.376	0.376

Pre-crisis period

Back

	(1)	(2)	(3)	(4)
LowCap	0.7997	-0.6807	-0.4763	0.7384
	(1.4099)	(1.6467)	(1.6100)	(1.6043)
LowCap*Z	-1.6304**	-0.4380	-0.2341	-0.1331
	(0.7185)	(0.5104)	(0.5420)	(0.5031)
Z	-4.7284***			
	(0.3785)			
Share bank			-0.4664***	-0.4652***
			(0.0239)	(0.0240)
Share credit line			0.1011***	0.1009***
			(0.0147)	(0.0143)
H_0 : LowCap + LowCap*Z=0				
p-value	0.552	0.569	0.717	0.750
Banks controls	N	N	N	Y
Observations	1622863	1368511	1368511	1368511
R^2	0.149	0.336	0.364	0.364

Firms' growth and Share of Zombie Firms

	(1)	(2)	(3)	(4)	(5)	(6)
	Delta Labour		Delta Capital		Delta Sales	
ShZ	-0.110***		-0.039***		-0.112***	
	(0.014)		(0.013)		(0.017)	
ShZ*Zombie	0.067***	0.057***	0.041***	0.043***	0.079***	0.072***
	(0.013)	(0.013)	(0.013)	(0.014)	(0.013)	(0.013)
Zombie	-0.062***	-0.060***	-0.021***	-0.021***	-0.065***	-0.063***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
$\beta_1 + \beta_2$	-0.043**		0.002		-0.033	
Test $\beta_1 + \beta_2 = 0$ (p-val)	0.018		0.880		0.110	
Province-Sector FE	YES	NO	YES	NO	YES	NO
Year FE	YES	NO	YES	NO	YES	NO
Prov-sect-year FE	NO	YES	NO	YES	NO	YES
Observations	966,950	966,678	916,548	916,296	965,750	965,470
R-squared	0.036	0.058	0.019	0.029	0.083	0.122

Back

Firm failure and banks capital ratio

$$F_{ipt} = \gamma_0 + \gamma_1 \overline{LowCap}_{pt} + \gamma_2 (1 - Z_{ipt}) * \overline{LowCap}_{pt} + \gamma_3 Z_{ipt} + Dummies_{ipt} + \nu_{ipt}$$

	(1)	(2)	(3)
	Linear probability		Probit
$\overline{\text{LowCap}}$	0.444**		0.501**
	(0.208)		(0.220)
$\overline{\text{LowCap}}$*Z	-1.407***	-1.448***	-1.136***
	(0.346)	(0.355)	(0.195)
Z	5.659***	5.669***	4.318***
	(0.191)	(0.193)	(0.100)
H_0 : LowCap + LowCap*Z=0			
p-value	0.008		0.008
Province-sector FE	Y	N	Y
Year FE	Y	N	Y
Prov-sect-year FE FE	N	Y	N
Observations	1,150,659	1,150,623	1,150,661
R-squared	0.016	0.020	0.0381

Back

Real Consequences - Productivity dispersion

- Further implication of credit misallocation: the dispersion of (revenue) productivity across firms should increase with zombie lending.
- Regression of the standard deviation of TFPR at the sector-province-year level on *LowCapitalRatio*
- Weak banks may misallocate credit only if a market is populated by zombies, hence also important to interact with the share of zombie firms.

Back

TFP dispersion and credit to zombies

$$SD(TFP)_{pt} = \lambda_0 + \lambda_1 \overline{LowCap}_{pt} + \lambda_2 \blacksquare TFP_{pt} + \lambda_3 \overline{LowCap}_{pt} * ShZ_{pt} + \\ + \lambda_4 ShZ_{pt} + Dummies_{pt} + \eta_{pt}$$

	(1)	(2)	(3)	(4)	(5)	(6)
ShZ	0.040**	0.082***			-0.008	0.045**
	(0.018)	(0.014)			(0.020)	(0.018)
$\overline{\text{LowCap}}$			-0.002	-0.001	-0.038***	-0.027***
			(0.008)	(0.006)	(0.011)	(0.008)
$\overline{\text{LowCap}}$*ShZ					0.152***	0.121***
					(0.038)	(0.029)
Tfp growth	-0.055***	-0.075***	-0.054***	-0.076***	-0.054***	-0.074***
	(0.013)	(0.008)	(0.013)	(0.008)	(0.013)	(0.008)
Observations	9,194	10,885	9,194	10,885	9,194	10,885
R-squared	0.825	0.872	0.824	0.871	0.826	0.872

Back