Credit Misallocation During the Financial Crisis

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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 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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- As a consequence, our assessment of the effects differ substantially
- We do find evidence that week banks more lend 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

- 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 limited liabilities companies
  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
			Panel B: Crisis			
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: Δ 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:

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

- 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*Z*crisis	1.906**	1.745**	1.957***	2.042***	1.982***	1.893***
	(0.790)	(0.703)	(0.694)	(0.704)	(0.680)	(0.671)
LowCap*Z	-1.150	-0.845	-0.857	-0.993*	-0.864	-0.830*
	(0.745)	(0.614)	(0.593)	(0.581)	(0.580)	(0.492)
LowCap*crisis	2.156	2.790	2.658	2.281	0.514	
	(1.911)	(1.715)	(2.007)	(1.672)	(1.866)	
LowCap	-1.766	-2.189	-2.300	-1.597	-0.817	
	(1.790)	(1.598)	(1.664)	(1.606)	(1.960)	
Z*crisis	-4.578***					
	(0.637)					
Z	-3.088***					
	(0.468)					
Firm-bank cntrs	N	N	Y	Y	Y	Y
Bank Controls	N	N	N	Y	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	N	Y	N
Bank*year FE	Y	N	N	N	N	Y
Obs	3,656,203	3,656,203	3,656,203	3,654,795	3,654,794	3,656,184
Rsq	0.112	0.358	0.377	0.379	0.382	0.390

Main results

- Growth rate of credit to Zombies was 2% higher for banks with CR below the median- compared to an average growth of -8%
- Capital ratio does not matter before the crisis: evidence of zombie lending only during the crisis
  - Consistent with the view that capital ratio requirements binding only during the crisis
- During the crisis, no negative effect for healthy firms – important to notice

Robustness and Extensions

- Robust to different definitions of zombie firms
- Robust to different definitions of weak banks
  - 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.
- Other policies: weak banks less likely to:
  - severe a relationship with a zombies
  - classify a loan to a zombie as bad

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:

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

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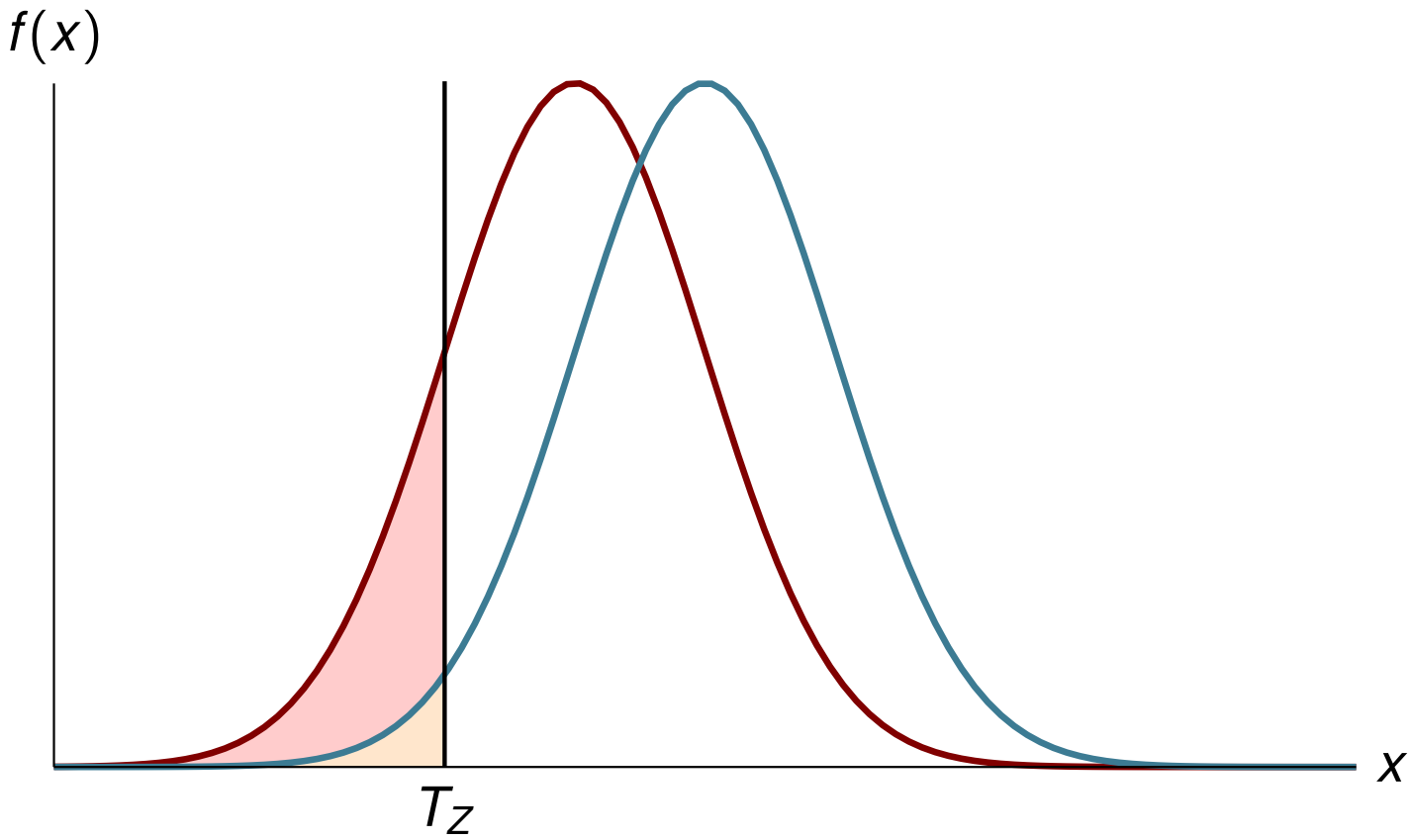
- A test of negative effects of Z on non Z is $\beta_2 < 0$.
- Identification challenge: *pt* shocks affect both ShZ_{pt} and firm performance
- Proposed solution: a full set of dummies at the *pt* level (β_1 drops out)

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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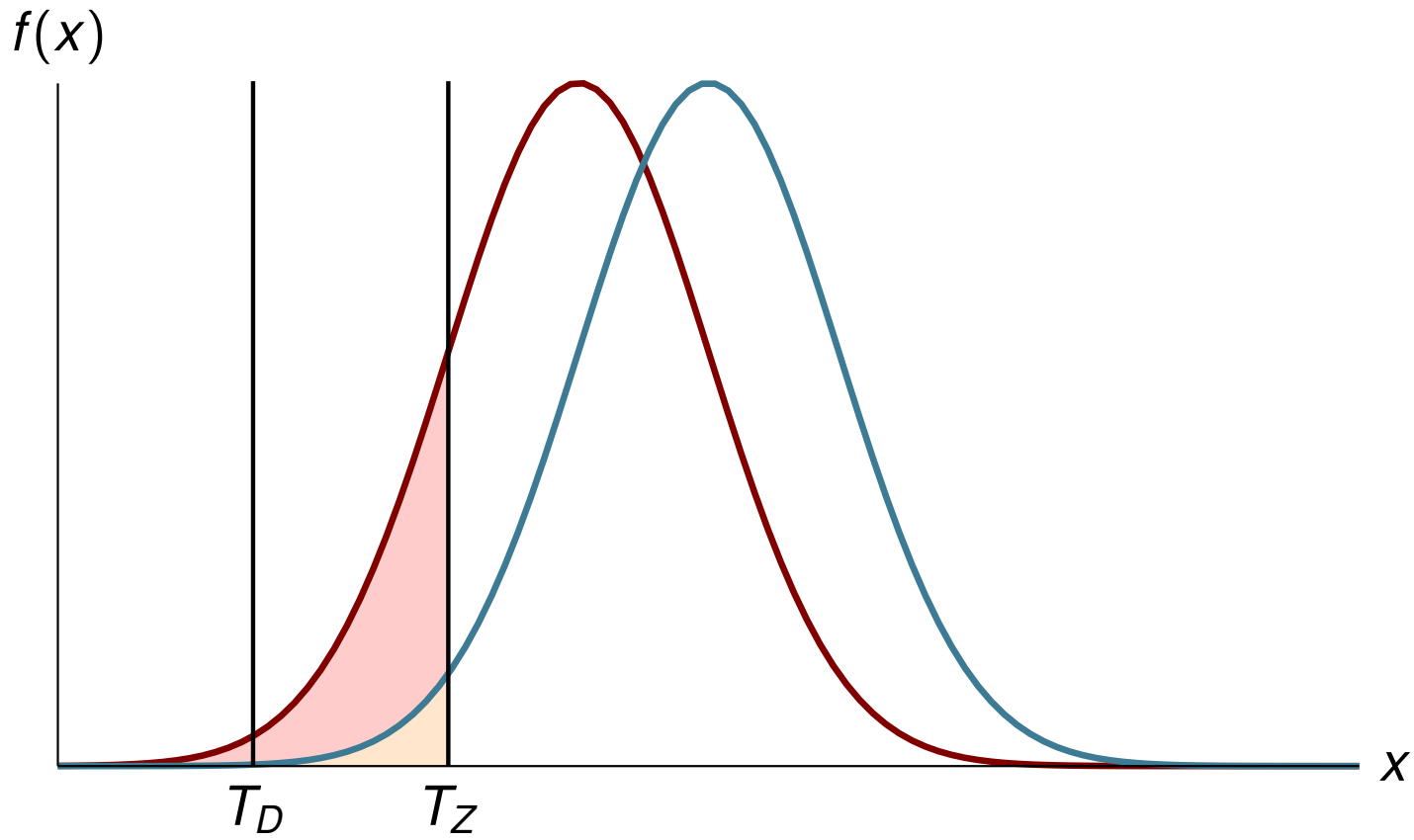
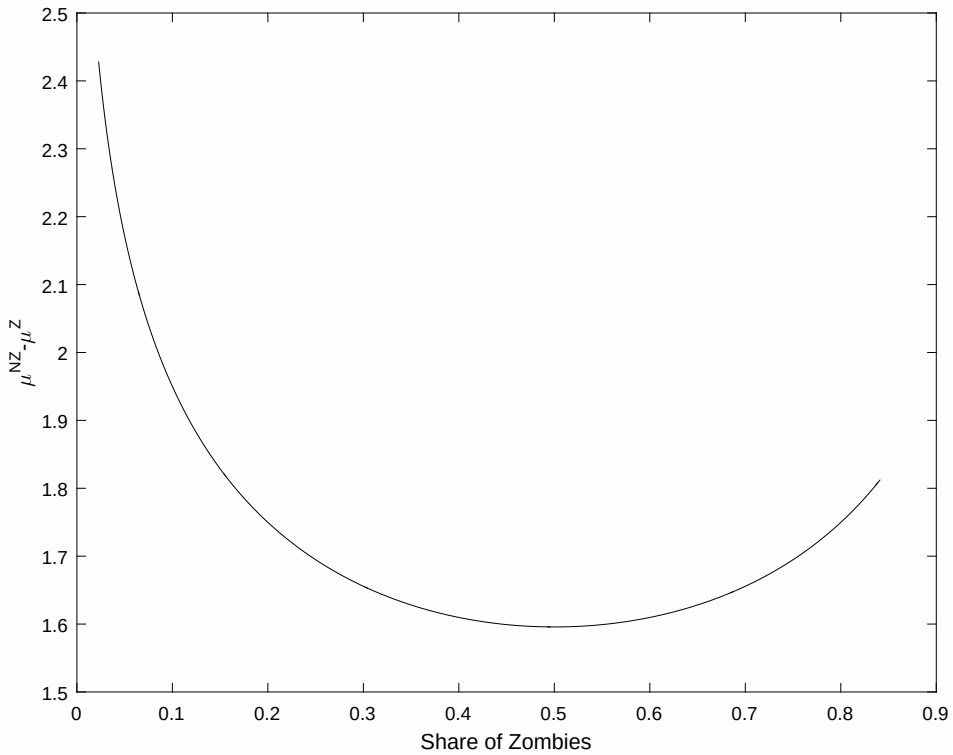


The figure plots two normal distributions with unit variance and mean $\mu_L = 4$ and $\mu_H = 5$, respectively. T_Z the zombie threshold and T_D is the exit threshold.

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

Banks capital and firms performance

	(1)	(2)	(3)	(4)	(5)	(6)
	ΔLabour		ΔCapital		ΔSales	
$\overline{\text{LowCap}}$	0.027***		0.011		0.026***	
	(0.007)		(0.007)		(0.010)	
$\overline{\text{LowCap}}$*(1-Z)	-0.028***	-0.028***	-0.007	-0.001	-0.013**	-0.016***
	(0.004)	(0.004)	(0.006)	(0.006)	(0.005)	(0.005)
Z	-0.060***	-0.060***	-0.015***	-0.012***	-0.053***	-0.055***
	(0.002)	(0.002)	(0.003)	(0.003)	(0.003)	(0.003)
$\beta_1 + \beta_2$	-0.001		0.004		0.013	
H_0: $\beta_1 + \beta_2 = 0$ (p-value)	0.878		0.4154		0.162	
Observations	966,968	966,968	916,559	916,559	965,755	965,755
R-squared	0.036	0.058	0.019	0.029	0.083	0.122
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

Real Consequences - Evidence

- Labor: We do find a negative relative effect of $\overline{\text{LowCap}}$ on growth of healthy firms
- However, the absolute effect is zero
  - The negative relative effect comes from the fact that low capital banks help zombies, but do not hurt healthy firms
- Similar with capital and sales, and robust to modifications of the regression framework

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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

Evaluating the aggregate consequences of low capitalized banks

- Policy experiment: increase the capital ratio so that all banks are above the median so that $\overline{LowCap}_{pt}$ goes from an average of 0.45 to zero. 4 billions required.
- We set up a simple sche me based on the estimates to evaluate effects on GDP growth
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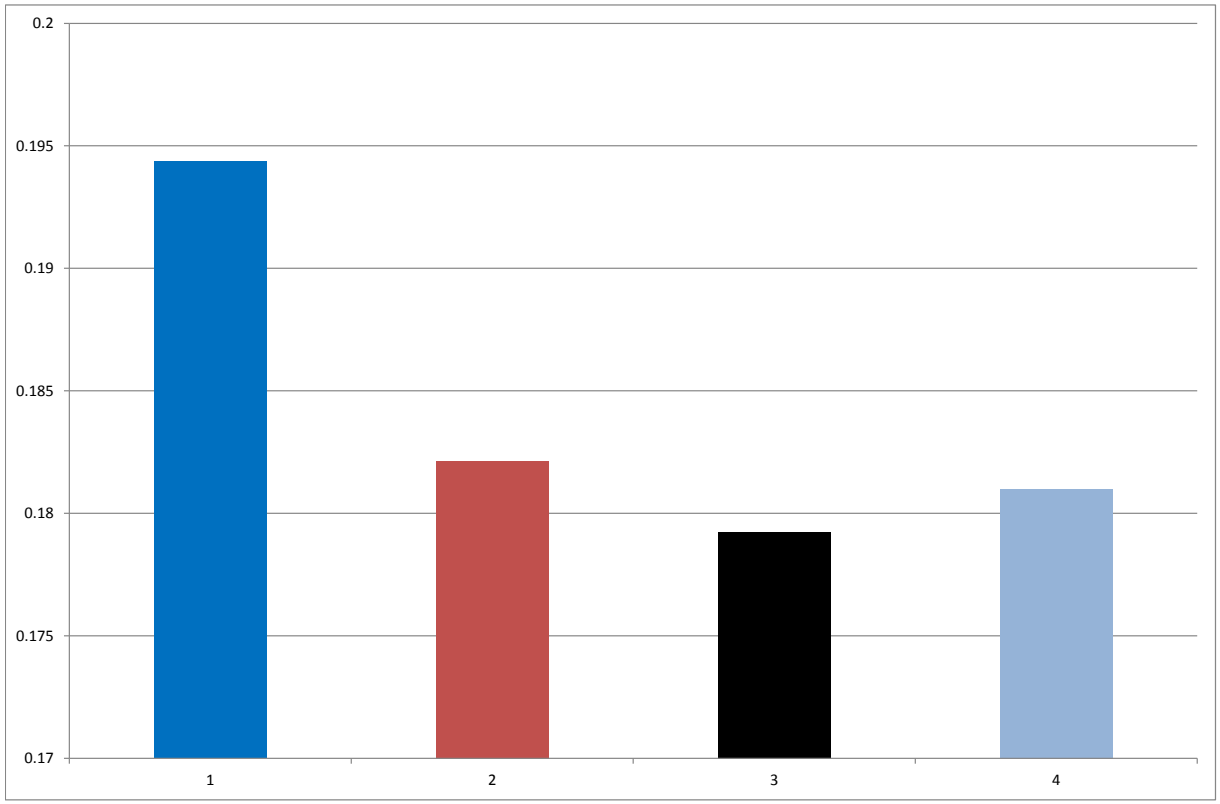
- Contrary to previous results, it suggests that contribution of zombie lending to GDP contraction (avergae -3.7%) has been at best modest

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? 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

	(1)	(2)	(3)	(4)	(5)	(6)
	Definition of zombie firm					
	Zombie 2		PC 1		PC 2	
LowCap*Z*crisis	1.746***	1.855***	1.437***	1.527***	1.567***	1.648***
	(0.564)	(0.601)	(0.394)	(0.413)	(0.387)	(0.412)
LowCap*Z	-0.112	-0.239*	-0.574*	-0.652***	-0.741**	-0.819***
	(0.348)	(0.127)	(0.330)	(0.106)	(0.325)	(0.068)
LowCap*crisis	0.690		0.787		0.669	
	(1.953)		(1.936)		(1.919)	
LowCap	-0.965		-0.947		-0.871	
	(2.044)		(2.031)		(2.019)	
Bank FE	Y	N	Y	N	Y	N
Bank*year FE	N	Y	N	Y	N	Y
Obs	3,569,638	3,570,983	3,654,794	3,656,184	3,569,638	3,570,983
Rsq	0.379	0.388	0.382	0.390	0.3780	0.388

Back

Alternative definitions of weak banks

	(1)	(2)	(3)	(4)	(5)
	Bank's strength definition				
	CapRat<9	CapRat	Tier1Rat	Tier1Rat<5	Tier1Rat<med
BankCap*Z*crisis	2.452***	-0.398**	-0.098	3.366***	0.215
	(0.807)	(0.169)	(0.108)	(0.827)	(0.488)
BankCap*Z	0.160	0.123	0.100	-0.877	0.204
	(0.630)	(0.138)	(0.114)	(0.822)	(0.571)
BankCap*Crisis	-1.368	0.796**	0.764***	5.835***	-2.657**
	(1.254)	(0.380)	(0.246)	(2.163)	(1.165)
BankCap	0.691	-0.440	-0.464	-8.326***	2.403
	(1.344)	(0.494)	(0.505)	(2.791)	(1.466)
Obs	3,654,794	3,654,794	3,654,794	3,654,794	3,654,794
Rsq	0.382	0.382	0.382	0.382	0.382

Back

Extensive Margin Regressions

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

	(1)	(1)	(3)	(4)	(5)
LowCap*Z*crisis	-0.831**	-0.661*	-0.703*	-0.726*	-0.760*
	(0.414)	(0.390)	(0.401)	(0.393)	(0.391)
LowCap*Z	-0.073	-0.134	-0.076	-0.107	-0.094
	(0.169)	(0.175)	(0.177)	(0.163)	(0.163)
LowCap*Crisis	-1.041**	-1.056***	-1.351***	-1.213***	
	(0.428)	(0.371)	(0.385)	(0.315)	
LowCap	0.611*	0.713**	0.475	1.051***	
	(0.319)	(0.302)	(0.329)	(0.289)	
Bank FE	N	N	N	Y	N
Bank*year FE	N	N	N	N	Y
Obs	4,331,355	4,331,355	4,329,493	4,329,493	4,331,341
Rsq	0.465	0.481	0.483	0.492	0.495

Back

Banks' decision to classify a loan as non-performing

	(1) Bad Loan	(2) Sub-Standard	(3) Past due
LowCap*Z*crisis	-0.538**	-0.597***	0.535***
	(0.255)	(0.171)	(0.188)
LowCap*Z	-0.009	0.201**	-0.140
	(0.056)	(0.081)	(0.111)
LowCap*Crisis	0.139**	-0.218**	-0.085
	(0.067)	(0.108)	(0.151)
LowCap	-0.076	0.031	0.116
	(0.048)	(0.067)	(0.194)
Obs	4,099,406	4,099,406	4,099,406
Rsq	0.747	0.561	0.374

Back

Firm growth and Share of Zombie Firms

Dependent variable: ΔLabour

	(1)	(2)
ShZ	-0.042**	
	(0.018)	
ShZ*(1-Z)	-0.067***	-0.058***
	(0.013)	(0.013)
$\beta_1 + \beta_2$	-0.109	
Test $\beta_1 + \beta_2 = 0$ (p-val)	0.000	
Observations	966,968	966,968
R-squared	0.036	0.058
Province-Sector FE	YES	NO
Year FE	YES	NO
Prov-sect-year FE	NO	YES

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
$\overline{\text{LowCap}}$	-0.877***		-0.620***
	(0.376)		(0.233)
$\overline{\text{LowCap}}$*(1-Z)	1.682***	1.732***	1.413***
	(0.374)	(0.383)	(0.210)
Z	6.079***	6.010***	4.686***
	(0.256)	(0.260)	(0.131)
$\gamma_1 + \gamma_2 = 0$	0.805***		0.792***
	(0.194)		(0.203)
Year FE	Y	N	Y
Prov*sect FE	Y	N	Y
Prov*sect*year FE	N	Y	N
Obs	1,150,661	1,150,661	1,150,661
Rsq	0.016	0.020	0.038

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

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

	(1)	(2)	(3)	(4)
$\overline{\text{LowCap}}$	-0.001	-0.001	-0.037***	-0.029***
	(0.008)	(0.006)	(0.010)	(0.008)
ShZ			-0.037	0.013
			(0.025)	(0.022)
$\overline{\text{LowCap}}$*ShZ			0.154***	0.139***
			(0.039)	(0.031)
Tfp growth	-0.054***	-0.076***	-0.053***	-0.073***
	(0.013)	(0.008)	(0.013)	(0.008)
Observations	9,191	10,868	9,191	10,868
R-squared	0.824	0.871	0.826	0.872

Back