Credit Misallocation During the European Financial Crisis

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Motivation

- Legacy of financial crisis is a weakened banking sector

- We investigate the implications

  - Credit misallocation by weaker banks?

  - Deeper recession due to a misallocation of credit?

- Italy 2008-2013 ideal testing ground: deep financial crisis, no injection of public capital or bad bank

- Bad loans and low bank capital still plaguing banks today

Two main questions and three findings

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1. Do weaker banks lend to zombie firms?

2. What are the real effects of credit misallocation?

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Findings:

1. Robust evidence of zombie lending by low-capital banks

2. However, negligible effects on healthy firms, which are able to use alternative sources of funding – cash and equity, and very small –if any – aggregate consequences

3. Previous literature likely to overestimate the effects of zombie lending due to an overlooked methodological problem

Outline

1. What is a zombie firm? How can we identify it empirically?

2. Do weak banks misallocate credit?

3. What are the real effects of credit misallocation?

4. Why do our results on the real effects differ from the "received wisdom"?

Data sources

- Estimation sample: 2008-2013

- We match 3 data sources:

  1. Firm data: balance sheets from CERVED – all incorporated businesses

  2. Bank data: Supervisory report (bank balance sheets)

  3. Loans data: Credit registry. All firm-bank relationships above 30,000 euros. Detail information (quantities, prices, collateral...)

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 (low return & high risk)

    - Preferred Definition: zombie=1 if: (i) 3-years moving average of ROA = Ebit/Assets < prime rate; (ii) Leverage > 40% (median Leverage in the year 2005 for low returns firms that exited the market for economic reasons between 2006-2007)

    - Intuition: low return plus leverage of low return firms which exited in normal times

- Several robustness checks: different thresholds, interest coverage, pc of ROA and Leverage (continuous variable), SCORE. See descriptive stats

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 2008 median (10.2%) to capture non linearities

- Other bank controls: 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.

- We exclude Mutual and Cooperative banks: very small, lend to shareholders and in the local area.

Who Lends to Zombie Firms, and why?

- If not re-financed, a zombie firm likely to default, making the loss apparent in the balance sheets

- Low-capital banks attempt to hide losses to avoid provisioning

  - Postpone raising new capital, waiting for better market conditions

- We estimate:

$$\triangle \log \text{credit}_{ijt} = \beta_0 + \beta_1 * \text{LowCap}_{jt} + \beta_2(Z_{it} * \text{LowCap}_{jt}) +$$
$$+ \beta_3 Z_{it} + \beta_4 \mathbf{X_{ijt}} + Dummies + \eta_{ijt}$$

Use Khwaja-Mian (2008) identification approach

- 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

- First, 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

- Other controls: bank*time FE, Add relationship-specific; Std errors double clustered at the bank and firm level

Results: Baseline specifications

Dependent variable: Growth of granted credit

	(1)	(2)	(3)	(4)
LowCap	-0.7029	-1.6530**	-1.6590**	-1.2085*
	(0.6486)	(0.7228)	(0.7080)	(0.6768)
LowCap*Z	1.5228***	1.2530***	1.4010***	1.3918***
	(0.5625)	(0.4559)	(0.4778)	(0.4775)
Z	-5.5827***			
	(0.2064)			
H_0 : LowCap + LowCap*Z=0				
p-value	0.395	0.641	0.761	0.823
Bank Controls	N	N	N	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	2788833	2287690	2287690	2286282
R^2	0.149	0.360	0.376	0.376

- Weak banks lend relatively more to Z than to healthy firms, but do so by contracting credit to healthy firms

Other results and robustness

- Extensive margins: Weak banks are less likely to:
  - severe a relationship with zombies or classify a loan to a zombie as bad

- Weak banks do not charge higher rates – no evidence of gambling for resurrection

- 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.

- Nothing going on before the crisis

- Firm-level regressions confirm zombie lending from weak banks during the crisis

The real effects of zombie lending

- Zombie lending can affect healthy firms through three channels:

  1. Crowding out of bank credit (–)

  2. Implicit subsidy and distorted competition for inputs and output (–)

  3. Aggregate demand externalities/IO effects (+)

- We explore three outcomes. How did credit misallocation affect:

  1. Growth rate of healthy vs zombie firms

  2. Composition of bankruptcies

  3. Dispersion of productivity across firms

Estimation strategy - Firm growth

- Relevant market: sector-province-year *pt*

$$\triangle y_{ipt} = \beta_0 + \beta_1 \overline{LowCap}_{pt} + \beta_2 Z_{ipt} * \overline{LowCap}_{pt} + \beta_3 Z_{ipt} + Dummies_{ipt} + \eta_{ipt}$$

where $\triangle y_{ipt}$ are alternative measures of firm growth, and

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

- 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)
	$\triangle$ Labour			$\triangle$ Capital			$\triangle$ Sales	
LowCap	0.001			-0.009			-0.000	
	(0.007)			(0.006)			(0.008)	
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

Internal vs. external alternative sources of funding

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	$\triangle$ Trade Debt		$\triangle$ Non-Bank Debt		$\triangle$ Cash		Dummy Equity Injection	
LowCap	-0.006		0.015		-0.032*		0.012***	
	(0.009)		(0.017)		(0.018)		(0.003)	
LowCap*Z	-0.004	-0.005	-0.007	-0.005	-0.006	0.003	-0.016***	-0.014***
	(0.008)	(0.008)	(0.017)	(0.018)	(0.020)	(0.021)	(0.005)	(0.005)
Z	-0.054***	-0.054***	0.086***	0.085***	-0.093***	-0.095***	0.057***	0.056***
	(0.003)	(0.003)	(0.006)	(0.006)	(0.006)	(0.006)	(0.002)	(0.002)
H_0 : LowCap + LowCap*Z=0								
p-value	0.328		0.672		0.118		0.458	
Prov-Sect FE	Y	N	Y	N	Y	N	Y	N
Year FE	Y	N	Y	N	Y	N	Y	N
Prov-Sect-Year FE	N	Y	N	Y	N	Y	N	Y
Observations	838,270	837,982	362,252	361,520	874,236	873,937	1,002,523	1,002,266
R-squared	0.015	0.036	0.007	0.031	0.005	0.017	0.023	0.034

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Prov-Sect FE	Y	N	Y	N	Y	N	Y	N
Year FE	Y	N	Y	N	Y	N	Y	N
Prov-Sect-Year FE	N	Y	N	Y	N	Y	N	Y
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- Given the bad cyclical conditions, healthy firms have no demand for investments and can cover lower supply from weak banks with internal sources of finance

- Zombies use additional bank finance to cover working capital, which allows to reduce the contraction of operations

- Evaluation scheme to compute the aggregate consequences of recapitalizing all banks: we find very small effects even under the most "favorable" parametrization

Why did previous literature find larger effects?

- Caballero et al. (2008) and followers estimate:

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

  where ShZ_{pt} is the share of zombies in a province-sector

- Goal: to quantify negative externalities of Z on healthy firms -

- Robust result (that we also obtain): $\beta_2 < 0$ – interpreted as evidence that zombies hurt healthy firms

- 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) firms
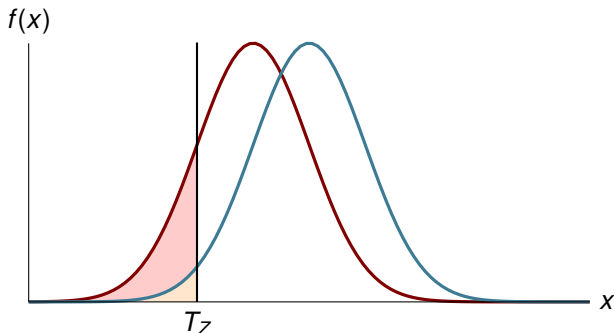
The effect of a common shock on firm performance X

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

In practice, $\beta_2 \equiv (\mu^{NZ} - \mu^Z) - (\mu^{NZ} - \mu^Z)$, where μ^Z is the conditional expectation below the threshold, and μ^{NZ} above.

Figure: Difference in non zombies vs. zombies average performance
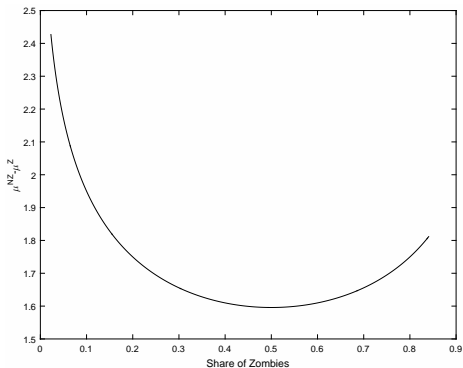
The graphs report the difference in the conditional mean of zombies and non zombies, $\mu^{NZ} - \mu^{Z}$ (vertical axis) against the share of zombies

- Negative correlation emerges just from firms heterogeneity, absent any spillovers!
- If take this approach, we also estimate much larger effect, similar in magnitude to previous literature

Conclusion

- We study the extent to which low bank capital affects credit misallocation and, through it, economic performance.

- Low-capital banks misallocate credit, cutting loans to healthy firms but not to Z.

- Real effects are small: low-capital banks sustain zombies but do not hurt the growth of healthy firms. Why?
    1. During the recession, Zombies need credit to survive, healthy firms can cover working capital with internal sources of funding and do not demand credit for investments
    2. Local demand externalities, low competition for inputs, prevents disruptions of supply chains

- Existing literature overestimated impact of zombies on healthy firms.

Share of Zombie Firms By Quartiles of Bank Capital
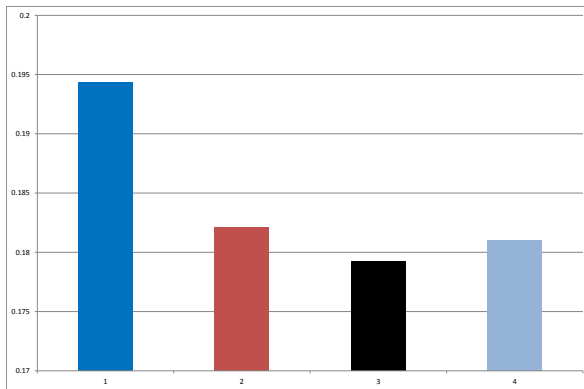
Back

Firms Characteristics   Back

	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
EBIT/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
EBIT/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

Extensive Margin - Interrupting Credit Relationships and Classifying Loans as Bad or Non-Performing

	(1) D(Cut=1)	(2) D(Cut Rev=1)	(3) D(Bad loan=1)	(4) D(Non-perf=1)
LowCap	-0.2467 (0.3383)	0.5513** (0.2463)	0.1090* (0.0592)	-0.1318 (0.0856)
LowCap*Z	-0.8033*** (0.2827)	-1.4302*** (0.3889)	-0.5527** (0.2220)	-0.5989*** (0.1912)
H_0 : LowCap + LowCap*Z=0				
p-value	0.00703	0.0556	0.0296	0.000687
Firm*year FE	Y	Y	Y	Y
Bank FE	Y	Y	Y	Y
Observations	2636764	2095046	2698744	2698744
R^2	0.457	0.469	0.735	0.570

The following variables, not shown in this table, are included as controls: *Share bank*,
Share credit line, *Liquidity ratio*, *Interbank ratio*, *Return on assets*, *Bank size*.

Additional Tests   Back

	(1) collateral	(2) no collateral	(3) interest rates	(4) evergreening
LowCap	-1.1941 (1.0122)	-1.2925** (0.6462)	0.0604 (0.1018)	-1.0413 (0.7887)
LowCap*Z	0.4052 (0.7425)	1.6195*** (0.5206)	0.0090 (0.0454)	1.6728** (0.6827)
Share bank	-0.0402*** (0.0072)	-0.3036*** (0.0131)	-0.0196*** (0.0009)	-0.2485*** (0.0129)
Share bank*LowCap				-0.0059 (0.0093)
Share bank*Z				0.1329*** (0.0098)
Share bank*LowCap*Z				-0.0162 (0.0147)
H_0 : LowCap + LowCap*Z=0				
p-value	0.556	0.672	0.516	0.519
Firm*time FE	Y	Y	Y	Y
Bank FE	Y	Y	Y	Y
Observations	144789	1878353	966838	2286282
R^2	0.470	0.389	0.654	0.376

Controls included: *Share credit line*, *Liquidity ratio*, *Interbank ratio*, *Return on assets*, *Bank size*.

Alternative definitions of zombie firms   Back

	(1) Zombie 2	(2) Zombie3	(3) PC 1	(4) PC 2	(5) Score
LowCap	-1.1356	-1.2252*	-1.0202	-1.0511	-1.1273
	(0.6981)	(0.6842)	(0.6803)	(0.6811)	(0.6960)
LowCap*Z	2.1040***	1.8121***	1.0972***	1.0188***	3.7804***
	(0.4978)	(0.4912)	(0.2688)	(0.2519)	(0.7995)
Share bank	-0.2217***	-0.2224***	-0.2225***	-0.2218***	-0.2231***
	(0.0133)	(0.0130)	(0.0130)	(0.0133)	(0.0130)
Share credit line	0.1417***	0.1408***	0.1408***	0.1416***	0.1410***
H_0 : LowCap + LowCap*Z=0					
p-value	0.202	0.476	0.918	0.965	0.004
Firm*Year FE	Y	Y	Y	Y	Y
Bank FE	Y	Y	Y	Y	Y
Observations	2,223,379	2,286,282	2,286,282	2,223,379	2,281,296
R^2	0.373	0.376	0.376	0.373	0.376

Alternative definitions of banks strength   Back

	(1)	(2)	(3)	(4)	(5)	(6)
LowCap yby	-1.8463**					
	(0.7945)					
LowCap yby*Z	1.4287***					
	(0.4564)					
Capital ratio		0.6616**				
		(0.2600)				
Capital ratio*Z		-0.2729*				
		(0.1547)				
LowCap9			-0.9295			
			(0.6407)			
LowCap9*Z			2.6762***			
			(0.6309)			
LowROA				1.1890**		
				(0.4956)		
LowROA*Z				0.0457		
				(0.6844)		
HighLeverage					-0.0713	
					(0.8397)	
HighLeverage*Z					-0.3556	
					(0.6017)	
HighBadLoan						-0.0294
						(0.6206)
HighBadLoan*Z						1.7293***
						(0.5928)
H_0 : LowCap + LowCap*Z=0						
p-value	0.664		0.0638	0.157	0.668	0.0377
Observations	2286282	2286282	2286282	2286282	2286282	2285554
R^2	0.376	0.376	0.376	0.376	0.376	0.376

Pre-crisis period   Back

	(1)	(2)	(3)	(4)
LowCap	0.7997	-0.6807	-0.4763	0.6513
	(1.4099)	(1.6467)	(1.6100)	(1.6129)
LowCap*Z	-1.6304**	-0.4380	-0.2341	-0.1435
	(0.7185)	(0.5104)	(0.5420)	(0.5025)
Z	-4.7284***			
	(0.3785)			
Share bank			-0.4664***	-0.4653***
			(0.0239)	(0.0240)
Share credit line			0.1011***	0.1008***
			(0.0147)	(0.0143)
				(3.2112)
H_0 : LowCap + LowCap*Z=0				
p-value	0.552	0.569	0.717	0.790
Bank Controls	N	N	N	Y
Observations	1,622,863	1,368,511	1,368,511	1,368,511
R^2	0.149	0.336	0.364	0.364

Credit Growth: Effects at the Firm Level Back

Dependent variable: Credit growth

	(1)	(2)	(3)	(4)
LowCap	-0.9699***	-1.2161***	-0.8833***	-1.4187***
	(0.2335)	(0.2286)	(0.2313)	(0.1734)
LowCap*Z	3.0060***	3.3340***	3.2917***	3.8852***
	(0.4102)	(0.4078)	(0.4077)	(0.3414)
Z	-8.9887***	-8.6526***	-8.6391***	-10.3609***
	(0.2071)	(0.2042)	(0.2041)	(0.1927)
H_0 : LowCap + LowCap*Z=0				
p-value	0	0	0	0
Bank Controls	N	Shares	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

Firms' growth and Share of Zombie Firms

	(1)	(2)	(3)	(4)	(5)	(6)
	$\triangle$ (Labour)		$\triangle$ (Capital)		$\triangle$ (Sales)	
ShZ	-0.110***		-0.039***		-0.112***	
	(0.014)		(0.013)		(0.017)	
ShZ*Z	0.067***	0.057***	0.041***	0.043***	0.079***	0.072***
	(0.013)	(0.013)	(0.013)	(0.014)	(0.013)	(0.013)
Z	-0.062***	-0.060***	-0.021***	-0.021***	-0.065***	-0.063***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
$H_0 : ShZ + ShZ*Z=0$						
p-value	0.018		0.880		0.110	
Prov-Sect FE	Y	N	Y	N	Y	N
Year FE	Y	N	Y	N	Y	N
Prov-Sect-Year FE	N	Y	N	Y	N	Y
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

Real Consequences - Failure margin   Back

$F_{ipt} = 1 \Leftrightarrow$ firm is bankrupt

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

	(1)	(2)	(3)
	Linear probability		Probit
$\overline{LowCap}$	0.444**		0.501**
	(0.208)		(0.220)
$\overline{LowCap}$*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

Low Cap to 0 for all banks $\implies$ failure rate of Z: +0.4%; of NZ: -0.2%

Real Consequences - Productivity dispersion
Back

- Further implication of credit misallocation: the dispersion of (revenue) productivity across firms should increase with zombie lending (Hsieh and Klenow 2009).

- Regression of the standard deviation of TFPR at the sector-province-year level on *LowCap*

- Weak banks may misallocate credit only if a market is populated by zombies, hence also interact with the share of zombie firms
  - If all firms are strong, no scope for credit misallocation

TFP dispersion and credit to zombies   Back

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

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

Columns 1 and 3 exclude province-sector-years with less than 10 firms. Columns 2 and 4 include all province-sector-years but weight them according to the number of firms. All regressions include year and province-sector fixed effects.

Real effects - Other results

- Some effect on the failure margin: higher share of credit by low capital banks associated to higher exit of healthy firms, lower exit of Z

- Hsieh-Klenow: zombie lending leads to misallocation. Some effect on TFP dispersion: higher share of credit by low capital banks associated to more TFP dispersion if share of zombies in province-sector is large enough