Zombie Credit and (Dis-)Inflation: Evidence from Europe

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Firm Financing and Inf ation in Europe

Low inf ation and extraordinary monetary easing

- Inflation well below 2% target since end of 2012, undershooting projections
- Substantial monetary easing (negative rates, (T)LTROs, LSAPs)

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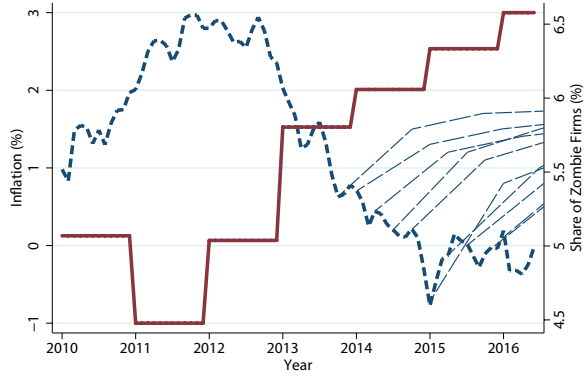
Striking resemblance to Japan's "lost decades"

- Deflationary pressure, ultra accommodative central bank policies
- Zombie lending → record low borrowing cost, even for risky firms
- Zombie lending in JP: Caballero et al. (2008), Giannetti and Simonov (2013)
- Zombie lending in EU: Acharya et al. (2019), Blattner et al. (2019)

Inflation ↓ and Zombie Firms ↑



Δshare of zombie firms in manufacturing post-2012: +22pp in ITA and +0pp in GER

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- **Negative demand shock**
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  - Plants need to work at $\approx 80\%$ capacity to cover fixed costs

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  ↪ Excessive productive capacity
- **Efect on prices**
  - Standardized product and inelastic demand
  - Industry representatives in a Senate hearing to discuss the ongoing crisis: *"The excessive productive capacity caused an unprecedented price competition."*

  ↪ The price of cement in Italy was 22% below the EU27 average cement price in 2015

Zombie Credit Channel

1. **Simple dynamic model of zombie firms and product inflation**
   - Zombie credit defined as credit that allows distressed firms not to default
   - ↪ Zombie credit prevents an adjustment in the productive capacity
   - ↪ Excess capacity puts downward pressure on markups and prices

Zombie Credit Channel

1. **Simple dynamic model of zombie firms and product inflation**
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2. **Empirical work to test this channel**
   - Sample of 1.1 million firms from 12 European countries across 65 industries
   - Data confirm the rise of cheap credit to impaired firms

Empirical Evidence

1. Markets (industry-country pairs) with large increase in zombie firms have
   - lower inflation and firm markups
   - lower default and entry rates
   - higher material and labor cost
   - higher sales growth and number of active firms
   - lower value added
2. Healthy firms in markets with high presence of zombie firms have
   - lower markups, profitability, sales growth
   - higher input costs
3. Misallocation of labor and capital in markets with large increase in zombie firms
   - lower net investment and productivity
   - lower employment growth for non-zombie firms in zombie markets

Related Literature

Zombie credit

- Japan in the 1990s – Peek and Rosengren (2005), Caballero et al (2008), Giannetti and Simonov (2013)
- Similar dynamics in Europe during the sovereign crisis – Acharya et al. (2019), Schivardi et al. (2017), Blattner et al. (2019), Adalet McGowan et al. (2018), Banerjee and Hofmann (2018)

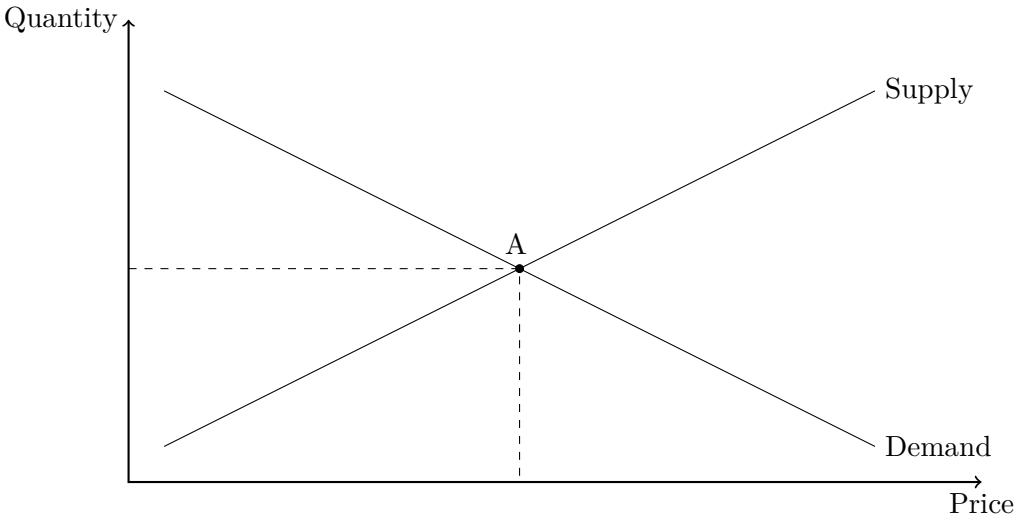
Effect of financial frictions on inflation dynamics

- "Liquidity squeeze channel" – Chevalier and Scharfstein (1996), Gilchrist et al (2017), de Almeida (2015)
- "Cost channel" – Barth III and Ramey (2001), Christiano et al (2015)

Resource Misallocation

- Bertrand et al. (2007), Peters (2020), Liu et al. (2020), Gopinath et al. (2017)

Intuition



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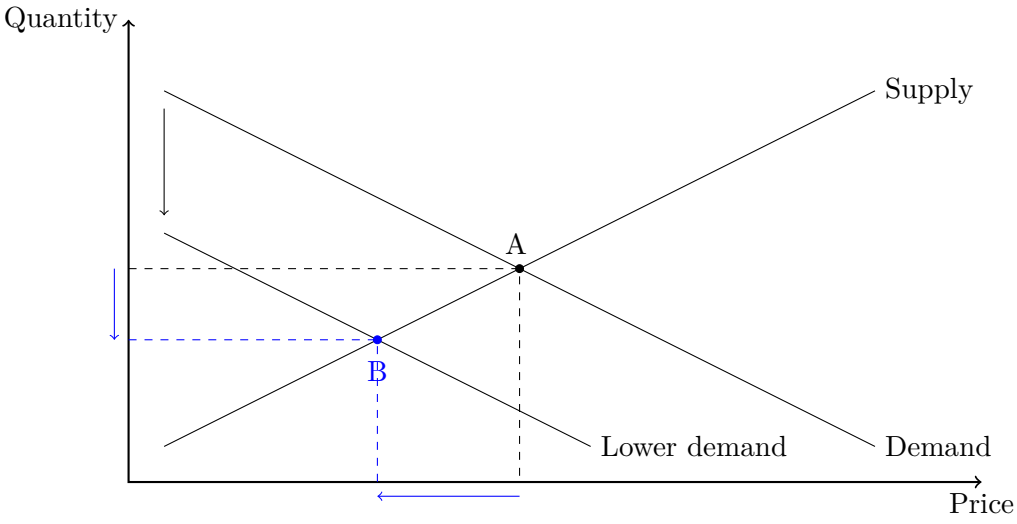

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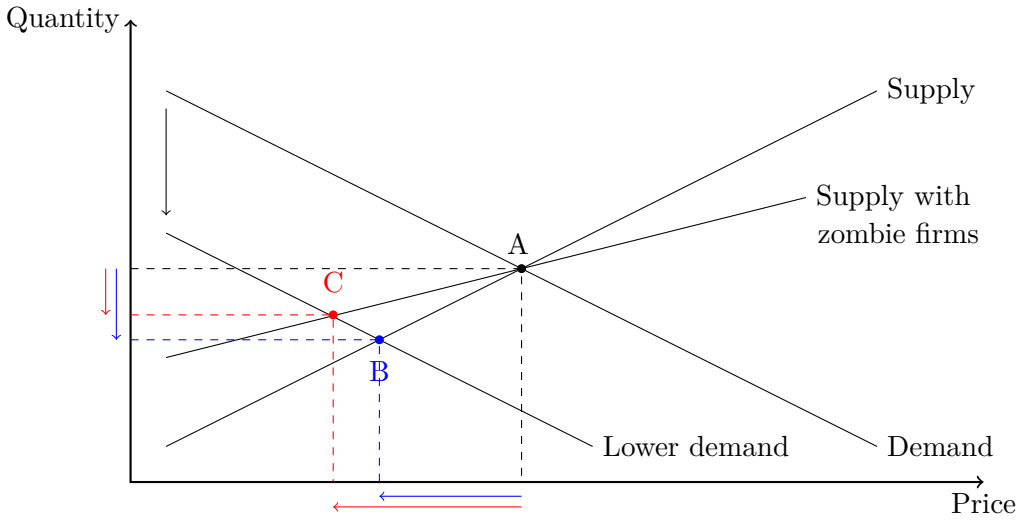
Quantity
Supply
Supply with
zombie firms
A
C
B
Lower demand
Demand
Price

Takeaways

Effect of demand shock on equilibrium price $p(\alpha, Entry(\alpha), Survival(\alpha))$

$$\frac{dp}{d\alpha} = \underbrace{\frac{\partial p}{\partial \alpha}}_{>0} + \underbrace{\frac{\partial p}{\partial Entry}\frac{\partial Entry}{\partial \alpha}}_{<0} + \underbrace{\frac{\partial p}{\partial Survival}\frac{\partial Survival}{\partial \alpha}}_{<0}$$

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In steady state, EqZ is characterized by:

- Lower product price and firm markups
- Less entry and default
- More active firms

compared with EqN

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Suppose p is exogenous and firms compete for inputs:
EqZ is characterized by higher input costs compared with EqN

Data

Setting and Data

- **Detailed frm level data**
  - Characteristics and financial info from Bureau van Dijk's Amadeus
  - Covers 75-80% of economic activity in Eurostat for selected EU countries (Kalemli-Ozcan et al., 2015)
- **Detailed product level inf ation data**
  - Consumer price data from Eurostat (covers all EU countries)
  - Product level at the COICOP five-digit level
- **Eurostat**
  - Official European Statistical Office
  - Industry-country level data on no. active firms, entry, exit, labor costs, labor productivity, value added

From Product- to Industry-level Inflation

- Merge firm-level data (industry level) and inflation data (product level)
  - NACE-COICOP linking tables from national statistical institutions

▸ Transition Matrix

Ex: Inflation for "Textiles" industry (NACE 13) as weighted average of

- Clothing
- Furniture and furnishings, carpets and other floor coverings
- Household textiles
- Goods and services for routine household maintenance
- Other major durables for recreation and culture

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→ **Final sample**
- Firm-time and industry-country-time level
- 1,167,460 firms in 12 European countries and 65 industries in 2009-16

Identifying Zombie Firms

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Zombie frms: distressed frms obtaining credit at very low rates

1) Distressed firms ...
   - Below median interest coverage ratio (EBIT/interest expenses; 2-year avg)
   - Above median leverage (debt/assets)
2) ... obtaining credit at very low rates
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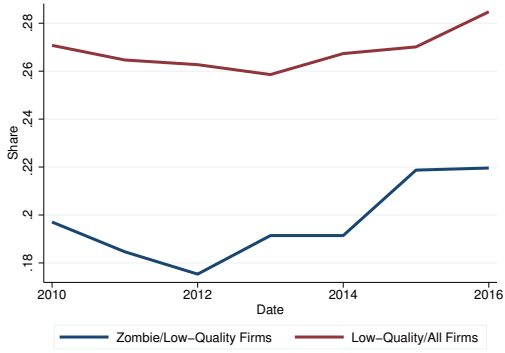

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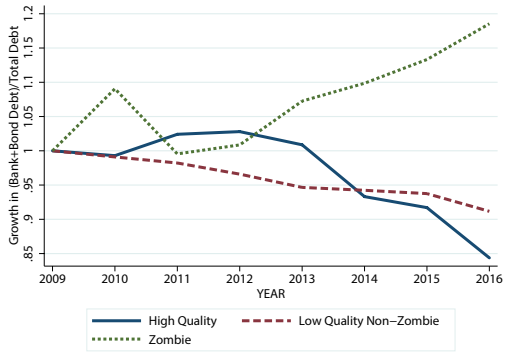
Panel B: Growth in Bank and Bond Financing



Descriptive Statistics

	High-Quality	Low-Quality No Zombie	Low-Quality Zombie	(2)-(3)
Markup	1.13	1.05	1.01	✓
EBITDA/Assets	0.090	0.046	0.014	✓
Material Cost	0.424	0.476	0.552	✓
Total Assets	1,617	1,726	1,607	✓
Tangibility	0.327	0.312	0.190	✓
IC ratio	4.90	1.01	-0.53	✓
Net Worth	0.224	0.107	0.069	✓
Leverage	0.161	0.351	0.437	✓
Share ST Debt	0.337	0.510	0.525	
Firm Age (years)	17.5	17.3	17.8	
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Zombie firms weaker than low-quality non-zombie firms along several observable dimensions

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Zombie firms not younger nor more reliant on ST credit than low-quality non-zombie firms

Validating our Classifcation of Zombie Firms

Are we capturing temporarily weak frms?

Analyze ex-post firms' characteristics: **Zombie** Vs. **Low-Quality Non-Zombie**

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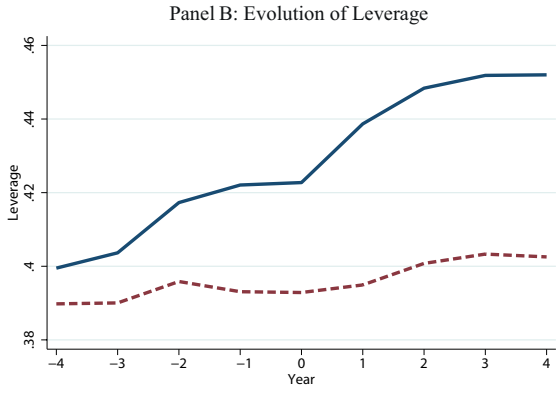

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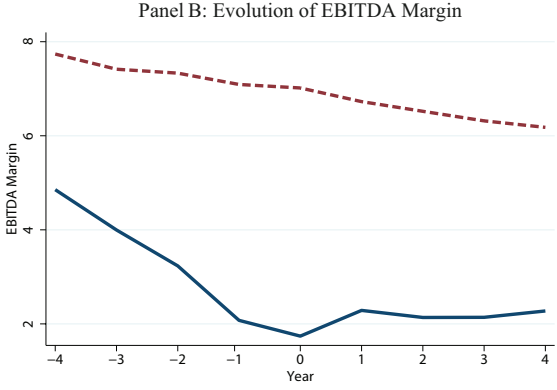
2) Profitability
   (EBITDA margin)



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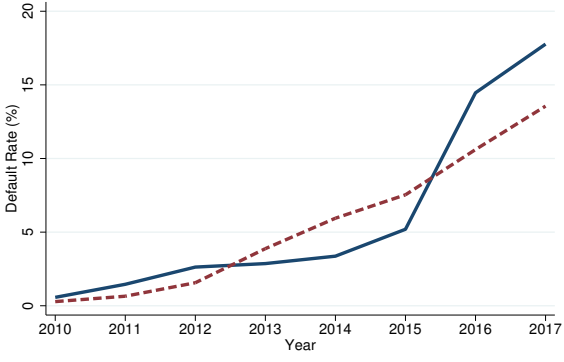
   (EBITDA margin)
3) Defaults ▸ Regression



CPI Growth

Analysis at Industry-Country Level

$$\Delta CPI_{hjt,t-1} = \beta \times \textit{Share Zombies}_{hj,t-1} + \gamma_{ht} + \nu_{jt} + \mu_{jh} + \epsilon_{hjt}$$

- Country h, industry j, year t
- *Share Zombies* is the asset-weighted share of zombie firms in a market
- Stringent fixed effects:
  - country-year to absorb country specific (demand) shocks
  - industry-year to absorb industry specific (demand) shocks
  - industry-country to absorb time-invariant market characteristics

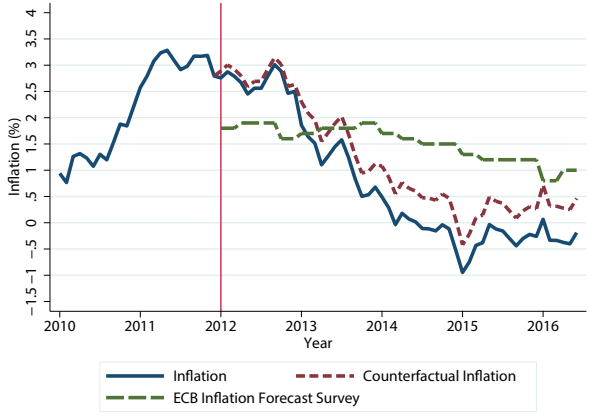
↑ Zombie Firms → ↓ Inflation

$$\Delta CPI_{hjt,t-1} = \beta \times \textit{Share Zombies}_{hj,t-1} + \gamma_{ht} + \nu_{jt} + \mu_{jh} + \epsilon_{hjt}$$

	ΔCPI				
Share Zombies	-0.021**	-0.018***	-0.025***	-0.023***	-0.024***
	(0.008)	(0.007)	(0.009)	(0.007)	(0.007)
Share Low-Quality					0.002
					(0.003)
Observations	3,880	3,880	3,880	3,880	3,880
R-squared	0.496	0.732	0.526	0.764	0.764
Country-Industry FE	✓	✓	✓	✓	✓
Year FE	✓				
Industry-Year FE		✓		✓	✓
Country-Year FE			✓	✓	✓

Standard errors clustered at industry-country level. ***p<0.01, **p<0.05, *p<0.1

Counterfactual Evolution of Inf ation



With no rise in zombie credit, inflation in Europe would have been 0.4pp higher post-2012

Manufacturing Industry in Italy and Germany

Country	ΔCPI (%)	ΔShare Zombie	Effect (pp)	Counterfactual ΔCPI (%)
ITA	-2.60	22.44	-0.52	-2.08
GER	2.60	-0.5	0.01	2.59

Efect obtained by multiplying ΔShareZombie with −0.023 (coefficient most restrictive specification)

Bartik Type Instrument

$$\Delta CPI_{hjt,t-1} = \beta \times \widehat{ShareZombies}_{hj,t-1} + \gamma_{ht} + \nu_{jt} + \mu_{jh} + \epsilon_{hjt}$$

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Bartik type instrument =
bank-level tier 1 ratio $\times$ country-level loan growth

bank-level tier 1 ratio
cross-sectional variation
$\rightarrow$ quality of connected banks in 2009

country-level loan growth
time-series variation
$\rightarrow$ country-level macro conditions

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bank-level tier 1 ratio
cross-sectional variation
→ quality of connected banks in 2009

country-level loan growth
time-series variation
→ country-level macro conditions

Markets linked to ex-ante weaker banks are more likely to see an increase in zombie lending when the country's economic conditions decline

↑ Zombie Firms → ↓ Inflation (IV)

$$\Delta CPI_{hjt,t-1} = \beta \times \widehat{ShareZombies}_{hj,t-1} + \gamma_{ht} + \nu_{jt} + \mu_{jh} + \epsilon_{hjt}$$

Second Stage	ΔCPI	ΔCPI	ΔCPI
$\widehat{Share\ Zombies}$	-0.174**	-0.192***	-0.174**
	(0.071)	(0.072)	(0.071)
Observations	2,080	1,839	2,080
First Stage	Share Zombie	Share Zombie	Share Zombie
Avg T1R (2009) ×	-11.702***	-13.877***	-11.663***
Country Loan Growth	(3.591)	(4.294)	(3.582)
F-Test	24.0	26.5	23.9
Observations	2,080	1,839	2,080
R-squared	0.693	0.693	0.693
Sample	Amadeus+DealScan	Amadeus Only	Amadeus+DealScan IT

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$$\Delta CPI_{hjt,t-1} = \beta \times \widehat{ShareZombies}_{hj,t-1} + \gamma_{ht} + \nu_{jt} + \mu_{jh} + \epsilon_{hjt}$$

Second Stage	ΔCPI	ΔCPI	ΔCPI
$\widehat{Share\ Zombies}$	-0.175*	-0.220**	-0.174*
	(0.089)	(0.101)	(0.089)
Observations	2,080	1,839	2,080

First Stage	Share Zombie	Share Zombie	Share Zombie
Avg T1R (2009) ×	-0.642***	-0.674***	-0.642*
-(NPL Growth)	(0.170)	(0.201)	(0.170)
F-Test	13.9	12.2	13.9
Observations	2,080	1,839	2,080
R-squared	0.691	0.690	0.691

Sample	Amadeus+DealScan	Amadeus Only	Amadeus+DealScan IT

Other Predictions

Number of Active Firms, Default, Entry

$$Y_{hjt} = \beta ShareZombies_{hj,t-1} + \gamma_{ht} + \nu_{jt} + \mu_{jh} + \epsilon_{hjt}$$

	Δ#Firms	Default	Entry
Share Zombies	0.075****	-0.020**	-0.021**
	(0.020)	(0.008)	(0.011)
Observations	3,844	3,626	3,824
R-squared	0.675	0.885	0.895
Country-Industry FE	✓	✓	✓
Industry-Year FE	✓	✓	✓
Country-Year FE	✓	✓	✓

Standard errors clustered at industry-country level. *** p<0.01, ** p<0.05, * p<0.1

Δ # Firms: change in no. of firms; Default and entry: Fraction of firms defaulting and entering

Comprehensive publicly available data from Eurostat

Input Costs and Markup

$$Y_{hjt} = \beta ShareZombies_{hj,t-1} + \gamma_{ht} + \nu_{jt} + \mu_{jh} + \epsilon_{hjt}$$

	Material Cost	Labor Cost	ΔMarkup
Share Zombies	0.046**	-0.008	-0.073***
	(0.023)	(0.027)	(0.026)
High Vacancy		-0.003	
		(0.004)	
Share Zombies × High Vacancy		0.138**	
		(0.052)	
Observations	3,701	922	3,261
R-squared	0.953	0.500	0.296
Country-Industry FE	✓	✓	✓
Industry-Year FE	✓	✓	✓
Country-Year FE	✓	✓	✓

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Labor cost: change in Eurostat Labor Cost Index; material cost: material Cost/turnover

Markup estimation follows De Loecker and Warzynski (AER 2012) Details

- ↑ 10pp zombie share → ↓ 73bp in markups
- Consistent with the recent disconnect b/w cost and product price inflation

Sales and Value Added

$$\Delta Y_{hjt,t-1} = \beta ShareZombies_{hj,t-1} + \gamma_{ht} + \nu_{jt} + \mu_{jh} + \epsilon_{hjt}$$

	ΔSales	ΔValue Added
Share Zombies	0.193***	-0.109***
	(0.067)	(0.040)
Observations	3,894	4,100
R-squared	0.496	0.488
Country-Industry FE	✓	✓
Industry-Year FE	✓	✓
Country-Year FE	✓	✓

St. errors clustered at industry-country level. *** p<0.01, ** p<0.05, * p<0.1

Robust to using Value Added/GDP or ln(value added)

Spillovers to Non-Zombie Firms

Analysis at Firm Level

$$Y_{ihjt} = \beta_1 \text{Non-Zombie}_{ihjt} + \beta_2 \text{Non-Zombie}_{ihjt} \times \text{ShareZombies}_{hjt-1} + \gamma_{hjt} + X_{it} + \epsilon_{ihjt}$$

- Firm i, country h, industry j, year t
- Non-Zombie: dummy=1 if firm is not a zombie
- ShareZombies: share of zombies in given country-industry at $t-1$
- Country-industry-year fixed effects γ
- Firm level controls: net worth, interest coverage, leverage, and log(assets)

Spillovers to Non-Zombie Firms

$$Y_{ihjt} = \beta_1 Non - Zombie_{ihjt} + \beta_2 Non - Zombie_{ihjt} \times ShareZombies_{hjt-1} + \gamma_{hjt} + X_{it} + \epsilon_{ihjt}$$

	Markup	EBIT/Sales	Sales Growth	Input Cost
Non-Zombie	0.063***	0.086***	0.060***	-0.023***
	(0.007)	(0.008)	(0.007)	(0.002)
Non-Zombie × ShareZombies	-0.235***	-0.198***	-0.153***	0.074***
	(0.044)	(0.033)	(0.032)	(0.019)
Observations	4,211,633	5,910,165	5,922,959	4,653,410
R-squared	0.565	0.157	0.033	0.517
Industry-Country-Year FE	✓	✓	✓	✓
Firm-Level Controls	✓	✓	✓	✓

Standard errors clustered at industry-country. *** p<0.01, ** p<0.05, * p<0.1

Real Efects

Net Investment and Capital Misallocation

$$Y_{hjt,t-1} = \beta ShareZombies_{hj,t-1} + \gamma_{ht} + \nu_{jt} + \mu_{jh} + \epsilon_{hjt}$$

	Net Investment	Capital Misallocation
Share Zombies	-0.068**	0.142**
	(0.028)	(0.063)
Observations	3,464	2,976
R-squared	0.397	0.920
Country-Industry FE	✓	✓
Industry-Year FE	✓	✓
Country-Year FE	✓	✓

St. errors clustered at industry-country level. *** p<0.01, ** p<0.05, * p<0.1

Net investment: growth of fxed assets (set to zero if < 0); capital misallocation: log(MRPK)

Employment

$$Y_{hjt,t-1} = \beta ShareZombies_{hj,t-1} + \gamma_{ht} + \nu_{jt} + \mu_{jh} + \epsilon_{hjt}$$

	Employment Growth	Labor Misallocation	Labor Productivity
Share Zombies	0.002	0.113**	-0.019**
	(0.018)	(0.056)	(0.009)
Observations	3,896	2,976	3,892
R-squared	0.497	0.905	0.948
Country-Industry FE	✓	✓	✓
Industry-Year FE	✓	✓	✓
Country-Year FE	✓	✓	✓

Standard errors clustered at industry-country level. *** p<0.01, ** p<0.05, * p<0.1

Labor misallocation: log(MRPL); labor productivity: value added/no. of employees

Conclusion

Broader Implications

- **Increase in zombie frms around the world** (Banerjee and Hofmann, 2018)
  - China: govt injected funds indiscriminately into state firms post-crisis (steelmaking)
  - US: the share of zombie firms also recently increased in the US (shale oil sector)

- **Broader implications in light of the Covid-19 crisis**
  - Crisis hits firm profits and health $\Rightarrow$ loan losses will likely hit bank capital
  - Policies adopted to "freeze" the economy, including loan forbearance

- **Need for models to analyze the GE efects of zombie credit**
  - Zombie credit likely has a temporarily positive stabilizing effect ...
    ... but it might depress growth and inflation in the medium and long term

Appendix

Transition Matrix: NACE-COICOP Mapping

Table 25 **Final consumption expenditure by households ÖCPA x COICOP**

current prices, in 1000 €

ÖCPA x COICOP		01.1 Food	01.2 Non-alcoholic beverages	02.1 Alcoholic beverages	02.2 Tobacco	03.1 Clothing	03.2 Footwear	04.1 Actual rentals for housing	In
01	Products of agriculture, hunting and related services	2383080	-	-	61651	-	-	-	
02	Products of forestry, logging and related services	-	-	-	-	-	-	-	
03	Fish and fishing products	123244	-	-	-	-	-	-	
05-07	Coal a.lignite; crude petroleum a.natural gas; metal ores	-	-	-	-	-	-	-	
08-09	Other mining a. quarrying prod.; mining support services	-	-	-	-	-	-	-	
10	Food products	13300811	1163304	-	-	-	-	-	
11-12	Beverages, Tobacco products	-	776455	2414455	3150004	-	-	-	
13	Textiles	-	-	-	-	70888	-	-	
14	Wearing apparel	-	-	-	-	8382707	-	-	
15	Leather and related products	-	-	-	-	-	1944450	-	
16	Wood and products of wood and cork	-	-	-	-	-	-	-	
17	Paper and paper products	-	-	-	-	-	-	-	
18	Printing and recording services	-	-	-	-	-	-	-	
19	Coke and refined petroleum products	-	-	-	-	-	-	-	
20	Chemicals and chemical products	-	-	-	-	-	-	-	
21	Basic pharmaceutical products and preparations	-	-	-	213855	-	-	-	
22	Rubber and plastic products	-	-	-	-	-	-	-	
23	Other non-metallic mineral products	-	-	-	-	-	-	-	
24	Basic metals	-	-	-	-	-	-	-	

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Firm IC and "Synthetic" Rating

For all emerging market firms and developed market firms with market cap < $5 billion			
If interest coverage ratio is			
greater than	**≤ to**	**Rating is**	**Spread is**
-100000	0.499999	D2/D	19.38%
0.5	0.799999	C2/C	14.54%
0.8	1.249999	Ca2/CC	11.08%
1.25	1.499999	Caa/CCC	9.00%
1.5	1.999999	B3/B-	6.60%
2	2.499999	B2/B	5.40%
2.5	2.999999	B1/B+	4.50%
3	3.499999	Ba2/BB	3.60%
3.5	3.9999999	Ba1/BB+	3.00%
4	4.499999	Baa2/BBB	2.00%
4.5	5.999999	A3/A-	1.56%
6	7.499999	A2/A	1.38%
7.5	9.499999	A1/A+	1.25%
9.5	12.499999	Aa2/AA	1.00%
12.5	100000	Aaa/AAA	0.75%

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Markup Estimation - Intuition

- We follow De Loecker and Eeckhout (2019) and De Loecker and Warzynski (2012) for the firm-level markup estimation
- Output elasticity of variable input factor is only equal to its expenditure/total revenue share if price equals marginal costs (perfect competition case)
- With imperfect competition, markup drives wedge between input's revenue share and its output elasticity

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Markup Estimation - Theory

- Firm i minimizes contemporaneous production cost
- Production function with output $Q_{it}(V_{it}, K_{it}, \Omega_{it})$, where

$$\begin{aligned} V_{it} &= \text{variable input} \\ K_{it} &= \text{capital stock (dynamic input)} \\ \Omega_{it} &= \text{Hicks-neutral productivity term} \end{aligned}$$

- Resulting Lagrangian:

$$\mathcal{L}(V_{it}, K_{it}, \lambda_{it}) = P_{it}^{V} V_{it} + r_{it} K_{it} + F_{it} - \lambda_{it}(Q(\cdot) - \overline{Q}_{it}),$$

where

$$\begin{aligned} P^{V} &= \text{price of variable input} \\ r &= \text{user cost of capital} \\ F_{it} &= \text{fxed cost} \\ \lambda_{it} &= \text{Lagrange multiplier} \end{aligned}$$

Markup Estimation - Theory

- FOC w.r.t. variable input V is thus given by:

$$\frac{\partial \mathcal{L}_{it}}{\partial V_{it}} = P_{it}^{V} - \lambda_{it} \frac{\partial Q(\cdot)}{\partial V_{it}} = 0$$

- Rearranging yields output elasticity of input V:

$$\theta_{it}^{V} \equiv \frac{\partial Q(\cdot)}{\partial V_{it}} \frac{V_{it}}{Q_{it}} = \frac{1}{\lambda_{it}} \frac{P_{it}^{V} V_{it}}{Q_{it}}$$

- λ measures marginal cost (value of obj. function as output constraint is relaxed)
- Markup defined as $\mu = P/\lambda$, where P is output price
- Substituting λ yields following markup expression:

$$\mu_{it} = \theta_{it}^{V} \frac{P_{it} Q_{it} (= \text{turnover})}{P_{it}^{V} V_{it} (= \text{variable expenses})}$$

Markup Estimation - Empirics

- Two step procedure to get output elasticity of input, θ^v_{it}.
- For each industry we consider following translog production function:

$$q_{it} = \beta_{v1} v_{it} + \beta_{k1} k_{it} + \beta_{v2} v_{it}^2 + \beta_{k2} k_{it}^2 + \omega_{it} + \epsilon_{it}$$

where

$$\begin{aligned} q_{it} &= \text{log of defated revenue (turnover)} \\ v_{it} &= \text{log of defated variable input (COGS + other OPEX)} \\ k_{it} &= \text{log of defated capital stock (tangible assets)} \\ \omega_{it} &= \text{frm's productivity} \end{aligned}$$

1) First step:
   - Obtain estimates of expected output ($\widehat{\psi_{it}}$) and ϵ_{it} by running

$$q_{it} = \psi_{it}(v_{it}, k_{it}) + \epsilon_{it}$$

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Markup Estimation - Empirics

2) Second step:
   - Use law of motion for productivity: $\omega_{it} = g_t(\omega_{it-1}) + \varepsilon_{it}$
   - Compute productivity using

$$\omega_{it} = \widehat{\psi_{it}} - \left(\beta_{v1} v_{it} + \beta_{k1} k_{it} + \beta_{v2} v_{it}^2 + \beta_{k2} k_{it}^2\right)$$

   - Nonparametrically regressing ω_{it} on its lag yields $\varepsilon_{it}(\beta)$
   - Rely on moment conditions to estimate production function parameters:

$$E\left(\varepsilon_{it}(\beta)\begin{pmatrix} v_{it-1} \\ k_{it} \\ v_{it-1}^2 \\ k_{it}^2 \end{pmatrix}\right) = 0$$

   - Using GMM techniques and block bootstrapping for SDs
   - Assume capital stock is decided a period ahead (thus not correlated with ε_{it})

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Markup Estimation - Empirics

3) Final step:
   - Compute estimated output elasticities using estimated PF coefficients:

$$\widehat{\theta}_{it}^{V} = \widehat{\beta}_{v1} + 2\widehat{\beta}_{v2} v_{it}$$

   - Firm level markups follow from

$$\mu_{it} = \theta_{it}^{V} \frac{P_{it} Q_{it}}{P_{it}^{V} V_{it}}$$

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Growth in Bank and Bond Debt

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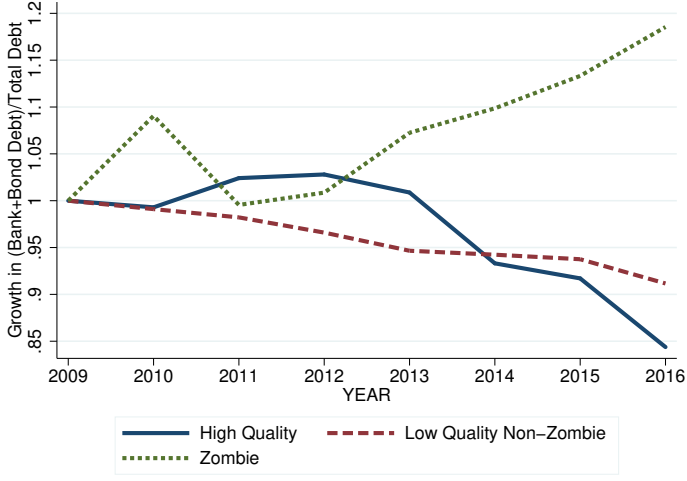
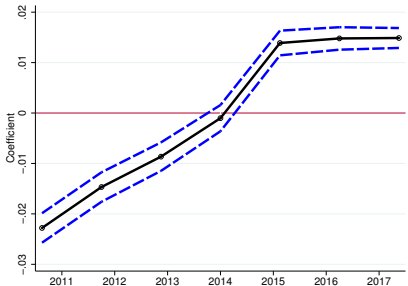


Ex-Post Defaults

Separately for every year τ: Back

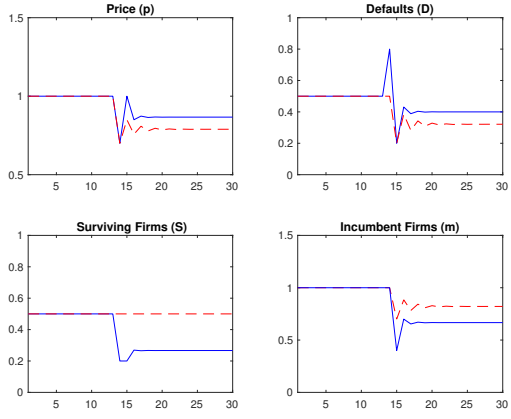
$$Default_{it} = \alpha + \beta_\tau \mathcal{I}_{t\tau} \times Zombie_{it} + \gamma X_{it} + \epsilon_{it}$$

- $\mathcal{I}_{t\tau}$ is a yearly indicator variable equal to 1 if $t = \tau$ and 0 otherwise
- X_{it} includes the uninteracted *Zombie* variable and other firm characteristics
- industry-country-year fixed effects



EqN Vs. EqZ following a Demand Shock ($\downarrow \alpha$)

Suppose the two eqm are identical before the negative demand shock



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