

Cross-subsidization of Bad Credit in a Lending Crisis

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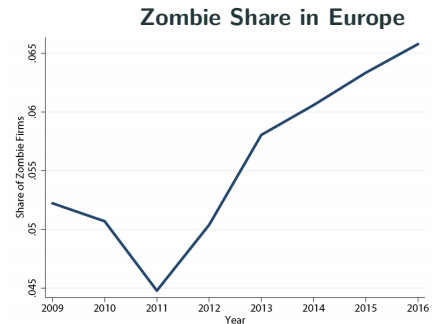
2024 Annual ECB Banking Supervision Research Conference, Frankfurt

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- **Subsidized lending** to insolvent firms is a common feature during crises
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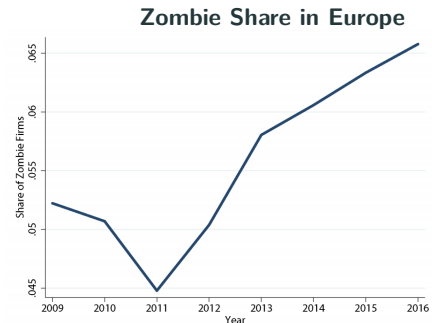
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- Issues related to subsidized (and zombie) lending practices:
 1. Misallocation of credit
 2. Cost of subsidization
 3. Lender motives (economic vs non-economic)

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- **Receiving below-market interest rate**

Caballero et al. (2008), Chari et al. (2021)

- **Low interest coverage ratio**

Acharya et al. (2018), McGowan et al. (2018), Acharya et al. (2020)

- **Credit rating, delinquency, under-reported losses**

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- **Accounting variables:** Market-to-Book, profitability, leverage, firm age

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Identifying **positive markups** can be more challenging because many of the aforementioned (distress) criteria cannot be used

This Paper

- We develop a theoretical model that predicts **cross-subsidization** in bank-to-firm lending **during a crisis**, due to

Collapsing collateral
values

Impaired access to
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Main Empirical Results:

- **Cross-subsidization** from safer to riskier firms
- **Asymmetric pass-through** in the intensive margin

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 3. Efficacy (and limits) of financial regulation
 4. Impaired financial intermediation during European sovereign crisis
Acharya et al. (2014), Acharya et al. (2018), Acharya et al. (2020)
 - Limited pass-through; **cross-sectional** not due to market power

Model Overview

Two states: **Crisis period** and Non-crisis period

Two firm-regimes: **High** (safe firm) and **Low** (risky firm)

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Upon liquidation, collects C^* in non-crisis and C in crisis period

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Crisis Period assumptions:

1. Collateral values are depressed ($C^* > C$)
2. Limited access to capital \Rightarrow Banks must liquidate their existing projects to finance new ones

Equilibrium Interest Rates - Non-crisis State

Assuming high enough π^H , low enough π^L , and low enough C

State \ Regime	Low (L)	High (H)
Non-crisis	Efficiently liquidated $V^L < C^*$	$R^H = r^* + p^L (1 - C^*)$ $V^H = 1$
Crisis	$R^{L,c} = \pi^L$ $V^{L,c} > C$	$R^{H,c} = r + (r + \rho) \left(\frac{D}{C} - 1 \right) + p^L \left(\frac{D}{C} - V^{L,c} \right)$ $V^{H,c} = \frac{D}{C} (\geq 1)$

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Non-crisis state:

- Firm L is efficiently liquidated ($V^L < C^*$)
- R^H accounts for bank's funding cost and credit risk ($V^H = 1$ due to competition)

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- Bank extracts the maximum from firm L ($R^{L,c} = \pi^L$); constrained
- Bank **extracts rents** from H charging a markup ($R^{H,c}$) - **limit pricing**
- **No-poaching** condition yields $V^{H,c} = \frac{D}{C} \geq 1$

Model Predictions Under Crisis

R1. The difference between $R^{L,c}$ and $R^{H,c}$ is **smaller** than the increase in expected loss upon default. That is, $R^{L,c} - R^{H,c} < \rho(1 - C^*)$

Limited cross-sectional pass-through

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R3. For firm L interest rate is **disconnected** from the riskiness of the loan and depends on the borrower's **ability to pay**

Asymmetric pass-through in the intensive margin

The Greek Financial Crisis

Severe financial crisis in terms of intensity and duration (2008-2016):

- Total GDP decreased by 25%
- Unemployment increased to 27%
- Greece excluded from financial markets (Greek spread > 1800bps)
- Required 3 Memoranda with creditors (2010, 2012, 2015)

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Severe effects on the banking sector:

- Dramatic rise in NPLs across portfolios, deposit withdrawals
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- Includes all loans made to large firms (top 5%), representative portfolio
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Main sample includes 1625 loans made to 150 firms

Summary Statistics

Panel A: Firm Characteristics

	Mean	St. Dev	P5	P25	P50	P75	P95
ROA (%)	4.59	5.97	-5.14	1.16	4.65	7.41	15.40
Deposits (million €)	18.88	81.72	0.38	1.48	4.18	9.18	58.11
Total Assets (million €)	237.88	655.06	15.86	43.02	78.35	175.72	832.10
Liabilities/Assets (%)	50.87	22.59	13.59	34.13	49.82	64.64	92.07

Panel B: Loan Characteristics

	Count	Mean	St. Dev	P5	P25	P50	P75	P95
Actual Rate (%)	1625	5.38	1.71	2.47	4.65	5.48	6.10	7.85
Breakeven Rate (%)	1625	4.76	3.34	1.97	2.36	4.64	5.57	10.98
Markup (%)	1625	0.62	2.73	-3.57	-0.02	0.49	2.28	4.46
Loan Amount (million €)	1625	3.62	14.35	0.04	0.20	0.90	2.50	10.04
Maturity (years)	1581	0.62	1.51	0.08	0.17	0.25	0.50	1.99
Collateralized (%)	1625	85.17	35.55	0.00	100.00	100.00	100.00	100.00

◀ Breakdown By Markup

◀ Breakdown by Product

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The model provides the **breakeven rate** (BE), which is directly the **marginal cost** of the loan:

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- Cross-sectional variation of BE rates comes mainly from **credit risk cost**

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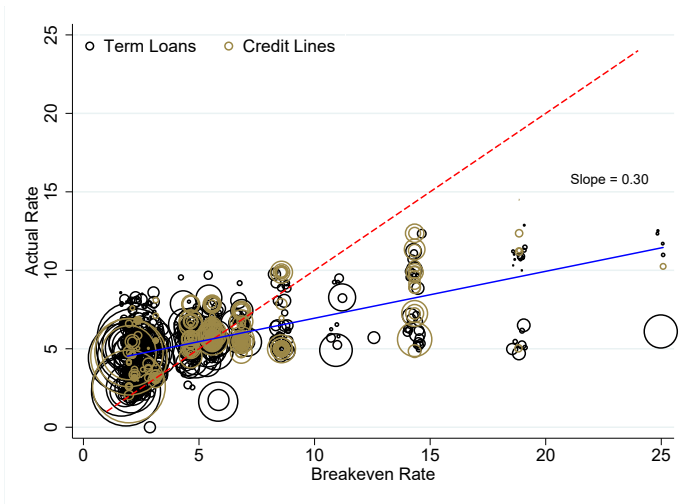
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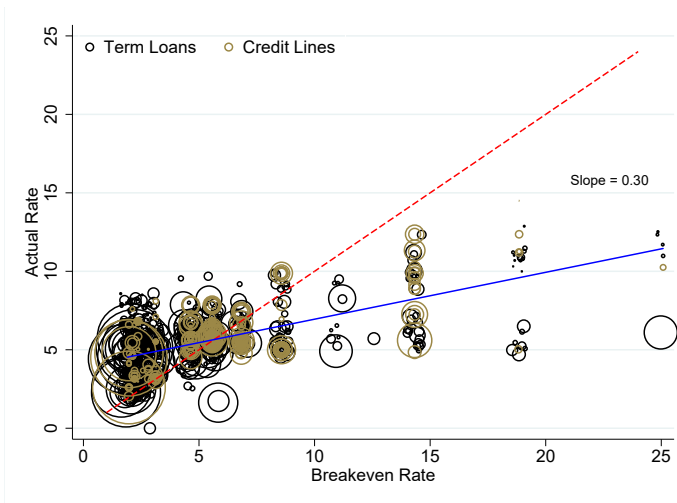
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Managers can freely offer loans above the BE rate, but have to obtain **internal approval** and **state the reason** for actual rates **below the BE rate**.

R1: Cross-subsidization and Limited Pass-Through



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- Most **safe** (**risky**) firms are **above** (**below**) the 45° line (BE rate)
- The slope of the regression line is substantially **less than one**

R1: Cross-subsidization and Limited Pass-Through

$$\text{OLS Regression: } AR_{imst} = \alpha_t + \alpha_s + \beta BE_{imst} + X_{it}\delta + X_m\eta + \varepsilon_{imst}$$

	(1)	(2)	(3)	(4)	(5)	(6)
Breakeven Rate	0.299*** (0.033)	0.310*** (0.031)	0.285*** (0.035)	0.292*** (0.039)	0.280*** (0.038)	0.095 (0.097)
OROA			-0.016 (0.019)	-0.017 (0.019)	-0.026* (0.016)	
Deposits			-0.076 (0.088)	-0.055 (0.091)	-0.157** (0.060)	
Assets			0.082 (0.132)	0.068 (0.138)	0.268*** (0.101)	
Maturity				-0.064 (0.064)	0.006 (0.043)	-0.002 (0.042)
Collateral				0.242 (0.194)	0.001 (0.163)	-0.245 (0.274)
Loan Amount				-0.034 (0.044)	-0.062 (0.040)	-0.023 (0.018)
Observations	1625	1625	1571	1529	1486	1549
R^2	0.339	0.389	0.390	0.396	0.446	0.601
Quarter FE	No	Yes	Yes	Yes	Yes	Yes
Industry FE	No	No	No	No	Yes	No
Firm FE	No	No	No	No	No	Yes

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- Limited cross-sectional pass-through; 1% change in breakeven rate results to a 30bps change in actual rate (unaffected by firm/loan characteristics)

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Collateral				0.242 (0.194)	0.001 (0.163)	-0.245 (0.274)
Loan Amount				-0.034 (0.044)	-0.062 (0.040)	-0.023 (0.018)
Observations	1625	1625	1571	1529	1486	1549
R ²	0.339	0.389	0.390	0.396	0.446	0.601
Quarter FE	No	Yes	Yes	Yes	Yes	Yes
Industry FE	No	No	No	No	Yes	No
Firm FE	No	No	No	No	No	Yes

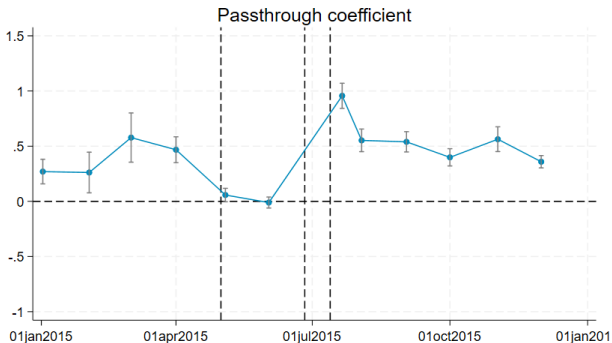
- Limited cross-sectional pass-through; 1% change in breakeven rate results to a 30bps change in actual rate (unaffected by firm/loan characteristics)
- Insignificant pass-through when we include firm-FEs

R2: Pass-Through and the Severity of the Crisis

- The Greek crisis peaks in May-June 2015, when negotiations fail and capital controls are imposed.

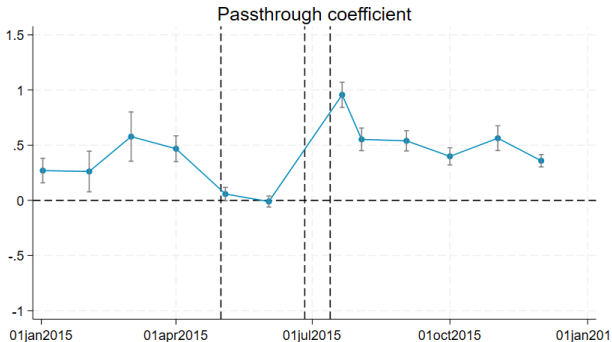
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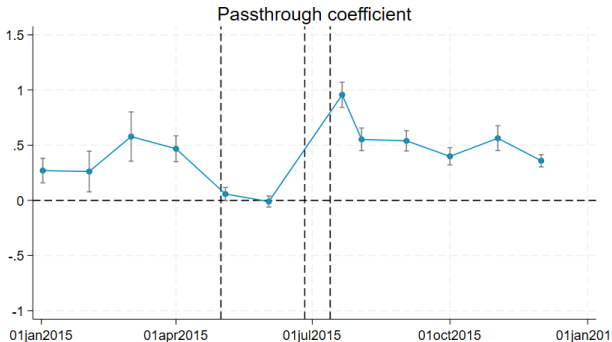
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- Pass-through coefficient drops to essentially **zero** at the peak of the crisis (May-June 2015)
- Once the Greek government signs the 3rd MoU (July 13th), the coefficient **jumps up** to a level of 0.5

R3: Asymmetric Pass-through (for safe and risky firms)

	Below-median BE		Above-median BE	
	(1)	(2)	(3)	(4)
Breakeven Rate	0.434** (0.190)	0.428** (0.181)	0.041 (0.093)	0.044 (0.092)
Maturity		0.083* (0.041)		-0.082 (0.077)
Collateral		-0.271 (0.246)		0.052 (0.231)
Loan Amount		-0.027 (0.033)		-0.023 (0.016)
Observations	544	532	883	863
R^2	0.480	0.497	0.411	0.432
Quarter FE	Yes	Yes	Yes	Yes
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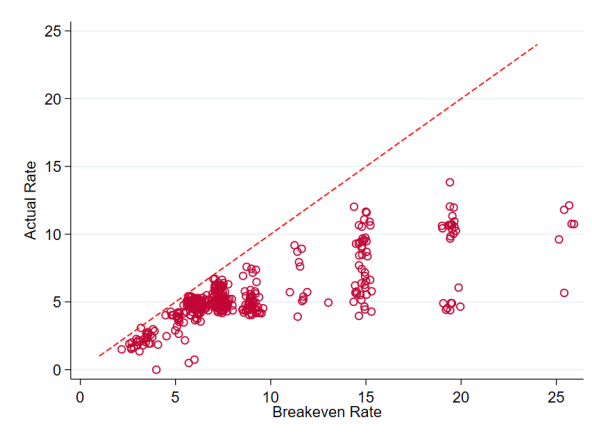
- Within-firm, significant pass-through of the breakeven rate **only for safe** borrowers
- No significant pass-through for **risky** borrowers, actual rate depends on the ability to pay (consistent with our model; $R^{L,c} = \pi^L$)

Discussion: Zombie Identification

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- Here, we directly observe negative markups:



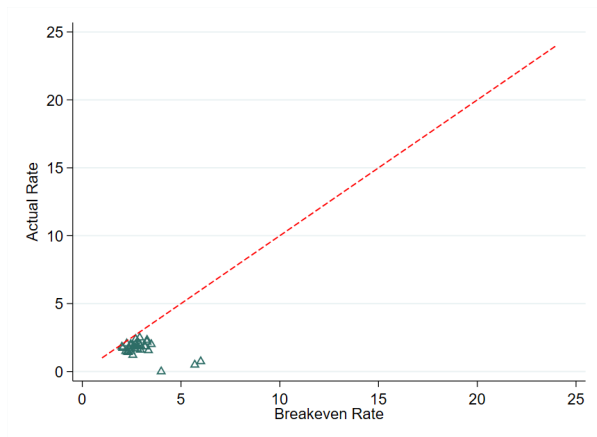
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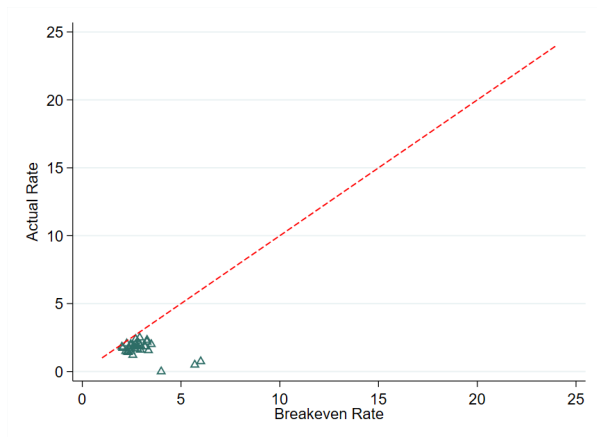
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Actual rate below prime rate is **overly conservative** and misses most (*and the most interesting*) subsidies.

Zombie Identification: Comparison

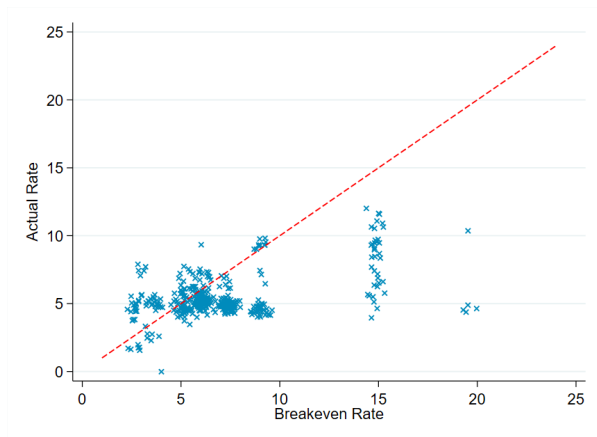
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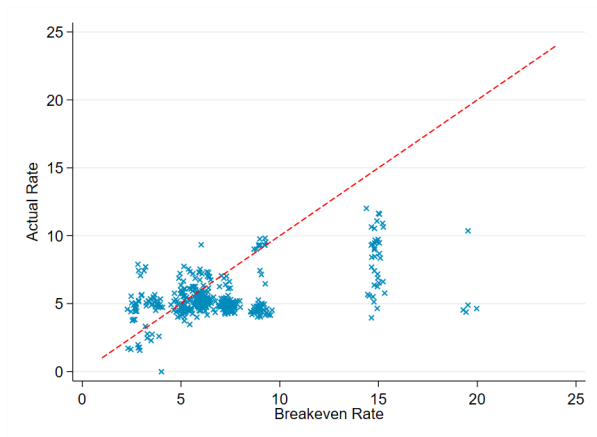
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Interest coverage ratio is a **noisy indicator** of subsidization (loans above and below the 45° line).

Introduction of the New Pricing Model (Break-even Rate)

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	AR ₂₀₁₅ - AR ₂₀₁₄		
	(1)	(2)	(3)
Breakeven ₂₀₁₅ - AR ₂₀₁₄	0.403*** (0.053)	0.397*** (0.055)	0.409*** (0.060)
Observations	70	65	63
R ²	0.627	0.665	0.696
Industry FE	No	No	Yes

- Clear **initial pass-through** from breakeven rates to actual rates

For every 1% difference between the initial year BE and the prior year's actual rate, the interest rate changes by 40 bps.

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4. Borrower "stickiness"

We find no relation between initial rate adjustment/markup and the probability of opening (or frequency of) new loans or loan balances

Conclusion

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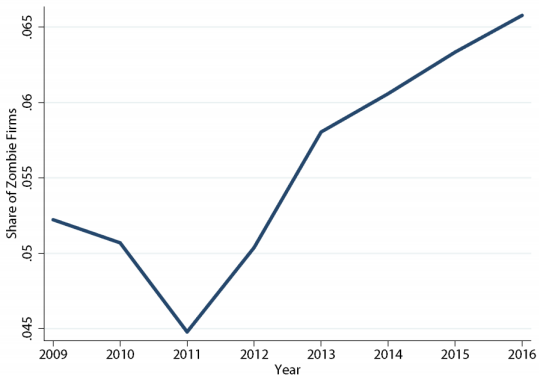
- Risky firms optimally avoid liquidation (depressed collateral values)
- Upcharging safe firms is sustainable (limited access to capital)

After the implementation of the break-even rate, we document:

- **Cross-subsidization** from safe firms to risky firms
- Pass-through that **declines** with the severity of the crisis
- **Asymmetric** pass-through in the intensive margin

Growing Zombie Lending Concerns

Share of Zombie firms in Europe



Source: Acharya, Eisert, Crosignani, and Eufinger (2019)

Non-crisis Period Equilibrium

- Bank profitability and competition constrains: $V^H = 1$ then

- Firms in low-profitability regime (L)

$$(2) \Rightarrow R^L + p^H (1 - V^L) = r^* V^L \Rightarrow V^L = \frac{R^L + p^H}{r^* + p^H} \text{ (max for } R^L = \pi^L)$$

Assuming $R^L = \pi^L < (r^* + p^H) C^* - p^H$ then $V^L < C^*$

and the low profitability firm is efficiently liquidated

- Firms in high-profitability regime (H)

$$(1) \Rightarrow R^H = r^* + p^L (1 - C^*)$$

Assuming that $\pi^H > r^* + p^L (1 - C^*)$ then $R^H < \pi^H$

and the bank charges a rate to break-even that the firm can afford to pay

Crisis Period Equilibrium

- Impaired access to capital markets \Rightarrow Bank has to liquidate $1/C$ of L loans to raise 1 and poach H .

Set $D = \min\{V^{L,c}\} > C$ (or else liquidate)

It follows that $\frac{D}{C} > 1$ and from non-poaching condition $V^{H,c} = \frac{D}{C} > 1$

- Firms in high-profitability regime (H)

$$(3) \Rightarrow R^{H,c} + p^L (V^{L,c} - \frac{D}{C}) + \rho (1 - \frac{D}{C}) = r \frac{D}{C} \Rightarrow$$

$$\Rightarrow R^{H,c} = r + (r + \rho) \left(\frac{D}{C} - 1 \right) + p^L \left(\frac{D}{C} - V^{L,c} \right)$$

- Firms in low-profitability regime (L)

For high enough π^H , low enough π^L (as previously), and **low enough C**

$$R^{L,c} = \pi^L \text{ and } V^{L,c} > C \text{ (no liquidation)}$$

Crisis Period Equilibrium - Proof

- We assume

$$\pi^L < (r^* + p^H) C^* - p^H \text{ and } r^* - p^H (1 - C^*) < r \frac{D}{C} + \rho \left(\frac{D}{C} - C^* \right)$$

- Proof by contradiction

Suppose that $R^{L,c} < \pi^L$, then also $V^{L,c} = \frac{D}{C}$ (poaching L loans)

$$(4) \Rightarrow R^{L,c} + p^H \left(\frac{D}{C} - \frac{D}{C} \right) + \rho \left(C^* - \frac{D}{C} \right) = r \frac{D}{C} \Rightarrow R^{L,c} = (r + \rho) \frac{D}{C} - \rho C^*$$

From (6),(7) we have $\pi^L < r^* - p^H (1 - C^*) < r \frac{D}{C} + \rho \left(\frac{D}{C} - C^* \right) = R^{L,c}$.

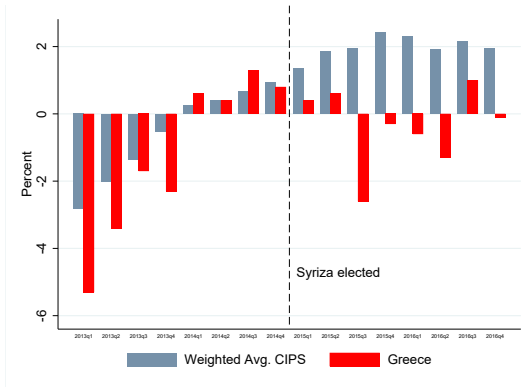
Further assuming $\frac{\pi^L + p^H \frac{D}{C} + \rho C^*}{r + \rho + p^H} > C$ and using $\pi^L = R^{L,c}$ in (4), we have:

$$\Rightarrow \pi^L + p^H \left(\frac{D}{C} - V^{L,c} \right) + \rho \left(C^* - V^{L,c} \right) = r V^{L,c} \Rightarrow V^{L,c} = \frac{\pi^L + p^H \frac{D}{C} + \rho C^*}{r + \rho + p^H} > C$$

Thus, the low profitability firm avoids liquidation

The Greek Crisis vs. CIPS

GDP Growth for Greece vs CIPS



Source: IMF CIPS = Cyprus, Italy, Portugal, Spain. Constant prices, seasonally adjusted

Summary Statistics: Loan & Firm Characteristics by BE rate

Panel A: All Loans

	Count	Mean	St. Dev
Actual Rate (%)	1626	5.38	1.71
Breakeven Rate (%)	1626	4.76	3.34
Actual - Breakeven (%)	1626	0.62	2.73
Loan Amount (million €)	1626	3.64	14.36
Maturity (years)	1582	0.63	1.51
Collateralized (%)	1626	85.12	35.60

Panel B: Above-breakeven Loans

	Count	Mean	St. Dev
Actual Rate (%)	1212	5.22	1.52
Breakeven Rate (%)	1212	3.56	1.52
Actual - Breakeven (%)	1212	1.66	1.52
Loan Amount (million €)	1212	3.88	16.09
Maturity (years)	1182	0.58	1.49
Collateralized (%)	1212	83.83	36.83

Panel C: Below-breakeven Loans

	Count	Mean	St. Dev
Actual Rate (%)	414	5.87	2.11
Breakeven Rate (%)	414	8.27	4.54
Actual - Breakeven (%)	414	-2.40	3.20
Loan Amount (million €)	414	2.93	7.19
Maturity (years)	400	0.76	1.54
Collateralized (%)	414	88.89	31.46

Panel A: All Customers

	Mean	St. Dev
OROA (%)	4.59	5.97
Deposits (million €)	18.88	81.72
Total Assets (million €)	236.18	653.01
Liabilities/Assets (%)	50.87	22.59

Panel B: Above-breakeven Customers

	Mean	St. Dev
OROA (%)	6.85	5.87
Deposits (million €)	24.94	118.53
Total Assets (million €)	259.24	932.61
Liabilities/Assets (%)	50.33	21.17

Panel C: Below-breakeven Customers

	Mean	St. Dev
OROA (%)	2.88	5.48
Deposits (million €)	14.31	34.11
Total Assets (million €)	218.37	300.20
Liabilities/Assets (%)	51.27	23.74

Summary Statistics: Loan Characteristics by Product

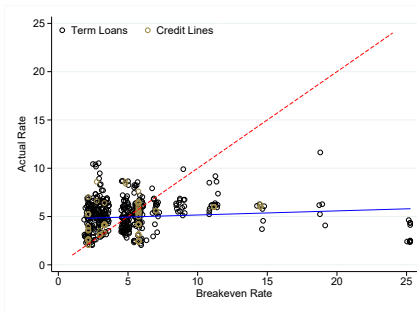
Panel A: Term Loans

	Count	Mean	St. Dev	P5	P25	P50	P75	P95
Actual Rate (%)	1163	5.21	1.76	2.36	4.45	5.25	6.10	7.85
Breakeven Rate (%)	1163	4.36	3.41	1.97	2.21	3.13	5.57	10.98
Markup (%)	1163	0.85	2.82	-3.57	0.12	0.72	2.53	4.63
Loan Amount (million €)	1163	4.59	16.68	0.05	0.30	1.00	3.01	16.83
Maturity (years)	1143	0.71	1.76	0.08	0.09	0.25	0.50	3.01
Collateralized (%)	1163	83.40	37.22	0.00	100.00	100.00	100.00	100.00

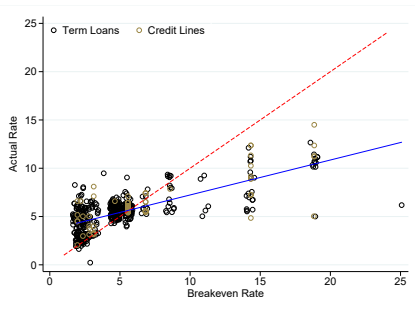
Panel B: Credit Lines

	Count	Mean	St. Dev	P5	P25	P50	P75	P95
Actual Rate (%)	462	5.82	1.51	3.26	5.25	5.59	6.42	8.90
Breakeven Rate (%)	462	5.76	2.94	2.21	4.64	5.57	6.83	8.57
Markup (%)	462	0.06	2.40	-3.57	-1.30	0.14	1.14	4.46
Loan Amount (million €)	462	1.18	3.94	0.03	0.11	0.31	1.16	3.95
Maturity (years)	438	0.41	0.27	0.14	0.21	0.38	0.41	0.96
Collateralized (%)	462	89.61	30.55	0.00	100.00	100.00	100.00	100.00

Cross-subsidization Pre-model and Post-model



Actual & Breakeven rates in 2014



Actual & Breakeven rates in 2015

Limited Pass-Through augmented with Lagged Actual Rate

$$\text{OLS Regression: } AR_{imst} = \alpha_t + \alpha_s + \beta BE_{imst} + \gamma AR_{t-1} + X_{it}\delta + X_m\eta + \varepsilon_{imst}$$

	(1)	(2)	(3)	(4)	(5)	(6)
Breakeven Rate	0.186*** (0.042)	0.199*** (0.042)	0.184*** (0.042)	0.193*** (0.045)	0.198*** (0.039)	0.079 (0.108)
Actual Rate _{t-1}	0.567*** (0.093)	0.556*** (0.091)	0.580*** (0.072)	0.583*** (0.074)	0.537*** (0.060)	0.523*** (0.105)
OROA			-0.012 (0.015)	-0.011 (0.016)	-0.014 (0.013)	
Deposits			0.053 (0.078)	0.070 (0.077)	-0.021 (0.066)	
Assets			0.063 (0.098)	0.049 (0.096)	0.232** (0.094)	
Liabilities/Assets			0.002 (0.005)	0.002 (0.005)	0.001 (0.005)	
Maturity				-0.011 (0.059)	-0.013 (0.057)	-0.009 (0.075)
Collateral				0.169 (0.158)	-0.013 (0.162)	-0.247 (0.287)
Observations	1423	1423	1389	1364	1331	1376
R ²	0.447	0.488	0.490	0.498	0.527	0.614
Quarter FE	No	Yes	Yes	Yes	Yes	Yes
Industry FE	No	No	No	No	Yes	No
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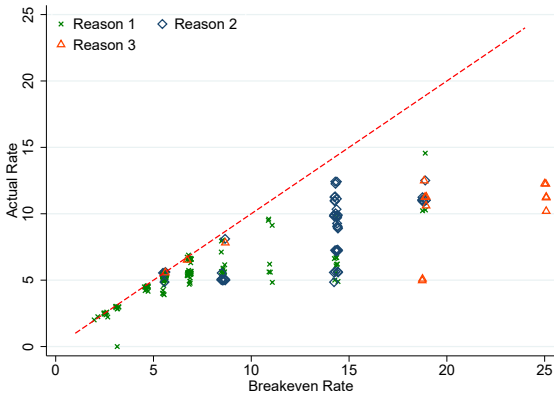
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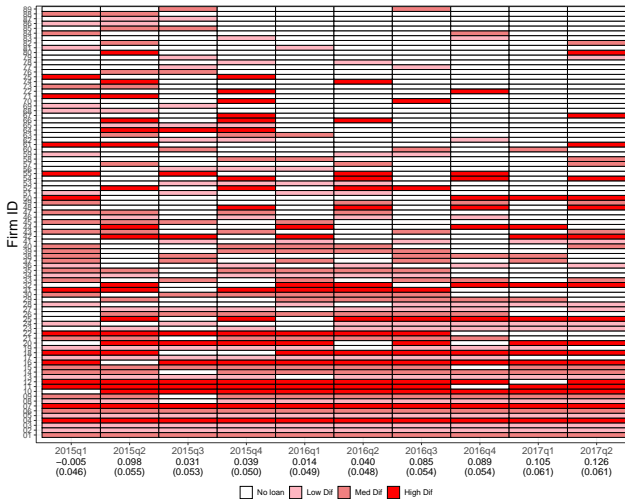
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Qualitative reasons for below-breakeven rates

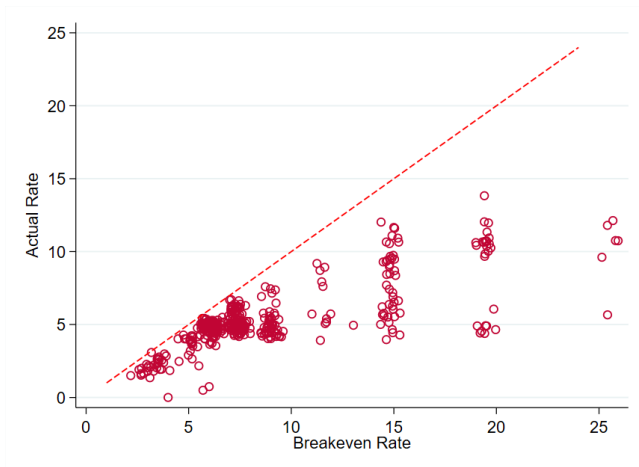
Codified qualitative reasons



New Loans by Date and Markup



Zombie Identification: Comparison



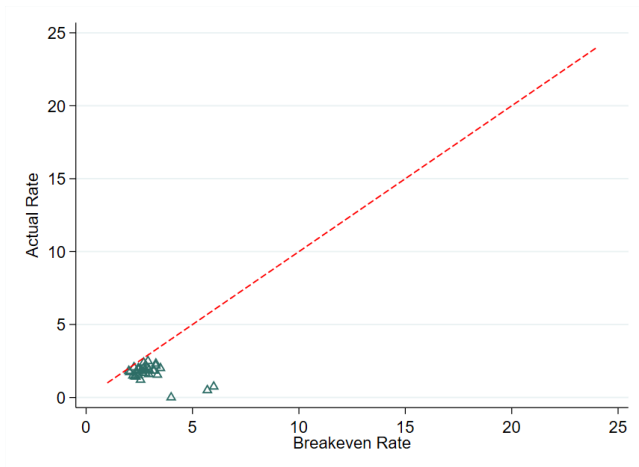
Actual rate below BE rate

Zombie Identification: Comparison



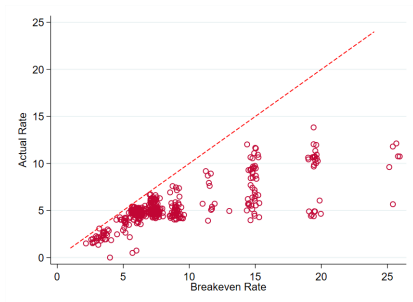
$ICR < 1$ for 2 years

Zombie Identification: Comparison

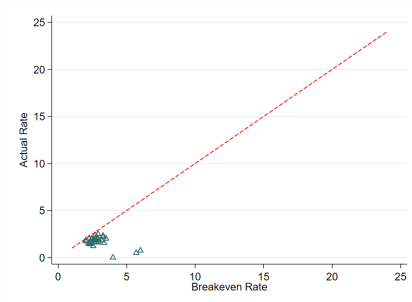


Actual rate below prime rate

Zombie Identification: Pairwise Comparison



Actual below BE rate: 25% (14.6%)



Actual below prime rate (1.9%)