Debt Overhang, Rollover Risk, and Corporate Investment: Evidence from the European Crisis[†]

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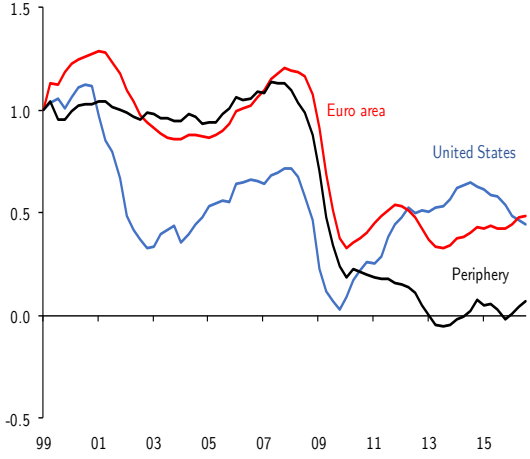
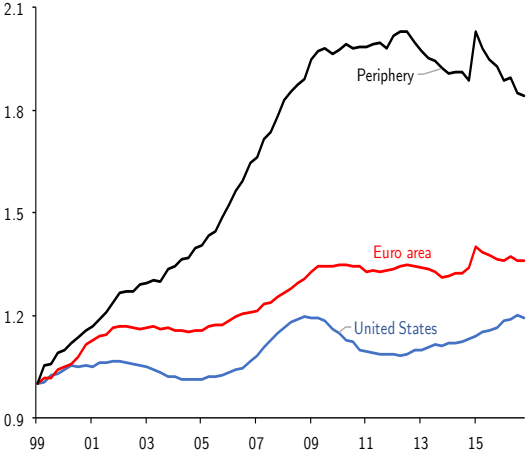
[†]The views expressed here are solely those of the authors and do not necessarily reflect the views of the European Central Bank or the Banco Central de Chile.

Corporate debt and investment

(percent of GDP, indices 1999q1=100)



(a) Investment/GDP



(b) Debt/GDP

Sources: Bank for International Settlements, Bureau of Economic Analysis, and Eurostat

Is sluggish investment due to corporate indebtedness?

Do high levels of corporate debt discourage investment and if so how?

1. We consider:
   - Corporate indebtedness → **debt overhang**
   - Maturity structure → **rollover risk**

2. **Identification challenge:** Aggregate demand shocks and bank weakness affect firm investment and correlate with firm indebtedness

3. **Big data approach to overcome the challenge:**
   - We use matched firm-bank data based on banking relationships in 8 euro-area countries (over 2 million observations)
   - We measure firm and bank balance sheet deterioration and quantify their **separate** effects on firm investment
   - Use 4-digit-sector-country-year fixed effects to control for aggregate demand shocks

Debt overhang and rollover risk

- **Debt overhang**: High indebtedness curtails new investments because its benefits would accrue to debtholders rather than shareholders (Myers, 1977)
  - → A debt burden large enough to prevent a firm from taking additional debt
  - → It may slow investment via deleveraging and low net worth
  - → **measured by debt/assets**

- Short-term debt increases **rollover risk** during crises, as collateral values drop and lenders do not renew credit lines (Diamond, 1991)
  - → **measured with residual short-term debt/total assets**

Related literature

- Macroeconomic models with corporate-debt overhang:
  - Lamont (1995); Whited (1992); Occhino and Pescatori (2010)
- Empirical debt-overhang literature:
  - Focus on banks, sovereigns and households:
    - Philippon and Schnabl (2013); Becker and Ivashina (2014); Melzer (2012)
  - Lack of corporate sector focus due to data limitations. With listed US firms:
    - Bond and Meghir (1994); Hennessy (2004); Hennessy, Levy, and Whited (2007)

Debt overhang and rollover risk: relation to other channels

- Literature on low investment blends several channels and cannot explain firm heterogeneity
  - **Sovereign-bank doom loop**:
    - Sovereign stress imposes losses on banks with sovereign exposures
    - Deteriorates banks' funding conditions
    - Hence reduces credit supply

    → **affects all firms**
  - **Low aggregate demand and high uncertainty**

    → **affects all firms**
- In reality:
  - Both channels might **affect more high debt-overhang** firms
  - **These may not choose to invest** even if its **bank is strong** and face **high demand**

Our contribution: an overlooked channel

1. Focus on identifying corporate indebtedness for investment slump, conditional on other channels
2. Pan-European setting where we quantify the effect for real outcomes of **heterogeneity** at three levels : **sovereigns, banks, and firms**
3. Unique hand-matched firm-bank-sovereign data from 8 countries, including SMEs
   - Different from literature, which focuses on listed firms (1% of our sample)
   - Small firms comprise a large fraction of economic activity in Europe (70 percent)
   - Unable to switch funding sources
   - Debt-overhang presumably larger in small firms, given higher information asymmetry and riskiness

Findings

- Low firm investment linked to high leverage, elevated debt service, and relation to a weak bank
- Firms with a higher long-term share of debt invest more, suggesting these face lower rollover risk
- The direct negative effect of weak banks on the *average* firm's investment disappears once demand shocks are controlled for
  - $\rightarrow$ Differential effects via firm indebtedness remain
- **Debt overhang and rollover risk channels explain $\sim$20 percent** of the cumulative decline in **aggregate private sector investment** over the crisis period

Firm-level financial data

- ORBIS database provided by Bureau van Dijk (BvD)
  - → Harmonised worldwide (+200 million firms, from +200 countries)
  - → Focus on AMADEUS, the European subset of ORBIS starting 1999
  - ⇒ For more details, see Kalemli-Özcan et al. (2015)
- **Balance sheets** and **income statements** at 4-digit NACE industry classification
- Collected from official business registers, annual reports, and newswires
- **Private** and **public** firms (advantage over Compustat/Worldscope)
- Mimics official size distribution:
  - → Firms under 250 employees account for 70 per cent of the economic activity in Europe

Matching firm to their banks, and banks' to their sovereigns

- We use **KOMPASS** database to match bank and firms
  - → Firms report their main bankers, and also secondary banker in most cases
- Then match to **Bankscope** for banks' balance sheets
- We match both the direct relationship bank, and its parent bank
  - to capture internal capital market effects
- For most observations, bank and firm sovereign are identical
  - except in Eastern Europe, which we exclude in our sample to keep monetary policy constant

Measurement

- **Net investment/capital** $= \Delta K_t / K_{t-1}$, where K_t are fixed assets net of depreciation

- **High leverage**: Avg. Debt/Assets between 2000-07 $> p_{75}$ (Total, LT, and ST)
- **Post**: binary variable **0** until 2008, **1** afterwards
- **Periphery**: binary variable **0** centre / **1** peripheral economies

- **Debt-coverage ratio**: Interest payments/EBITDA
- **Cash flow ratio**: Cash flow/Assets
- **Firm growth opportunities** $\approx$ Sales growth
- **Firm size** $\approx$ log (Real Assets)

- **Weak bank**: Sovereign bondholdings/total bank assets

Benchmark regressions

$$\left(\frac{\text{Investment}}{\text{Capital}}\right)_{i,s,c,t} = \beta_t \text{ High Leverage}_{i,s,c} + \boldsymbol{\gamma}' \text{ Controls}_{i,s,c,t-1} + \alpha_i + \alpha_b + \delta_{s,c,t} + \varepsilon_{i,s,c,t}$$

$$\left(\frac{\text{Investment}}{\text{Capital}}\right)_{i,s,c,t} = \beta_{1,t} \text{ Periphery}_c \times \text{High Leverage}_{i,s,c} + \beta_{2,t} \text{ High Leverage}_{i,s,c} + \boldsymbol{\gamma}' \text{ Controls}_{i,s,c,t-1} + \alpha_i + \alpha_b + \delta_{s,c,t} + \varepsilon_{i,s,c,t}$$

Identifying assumptions I

- **Parallel trends**: Investment trends differ less pre-crisis among high and low leverage firms when adding firm-level controls.

Figure: Evolution of net investment rates of high-leverage vs low-leverage firms. This figure illustrates results of the estimation of the model given in equation (1). 'Baseline' model features firm-level FE; 'Full FEs' model adds country-sector-year FE; and 'Controls + full FEs' model adds lagged firm-level control variables. Dashed lines corresponds to the confidence intervals at 5% significance.

Identifying assumptions II

- **Parallel trends**: Investment trends do not differ less pre-crisis among high and low leverage firms in each region of the euro area, when adding firm-level controls.

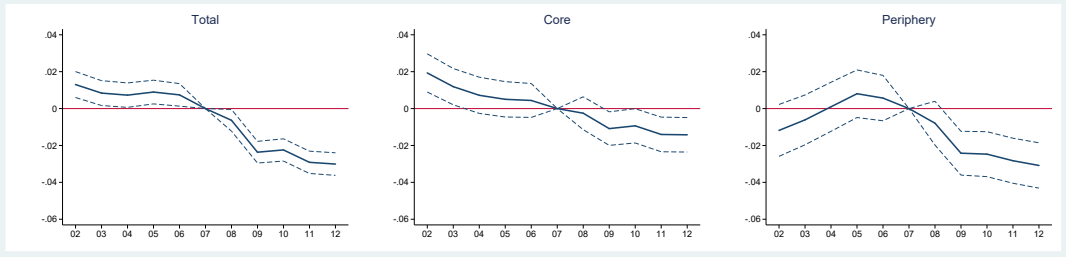


Figure: Evolution of net investment rates of high-leverage vs low-leverage firms. Total figure uses a double interaction model; Core and Periphery figures use coefficients estimated using a triple interaction model with a Periphery binary variable. Dashed lines corresponds to the confidence intervals at 5% significance.

Identifying assumptions III

- Firms face **granular demand shocks at the 4-digit sector level** regardless of indebtedness
  - Valid strategy when remaining variation in *ex post* firm-specific demand conditions does not vary systematically with *ex ante* debt level and maturity of the firm
  - Invalid if firms enduring idiosyncratic negative demand shocks, operate in different 4-digit industries, and accumulated more long than short-term debt during a boom

Extended benchmark regressions

$$\left(\frac{\text{Investment}}{\text{Capital}}\right)_{i,s,c,t} = \beta_1 \, \text{POST}_t \times \text{Periphery}_c \times \text{High Leverage}_{i,s,c} +$$
$$\beta_2 \, \text{POST}_t \times \text{High Leverage}_{i,s,c} +$$
$$\boldsymbol{\gamma}' \, \text{Controls}_{i,s,c,t-1} + \alpha_i + \alpha_b + \delta_{s,c,t} + \varepsilon_{i,s,c,t}$$

Benchmark results with total firm leverage

Dependent variable: (Net investment/Capital)$_{i,s,c,t}$

	(1)	(2)	(3)	(4)
$\text{Post}_t \times \text{Periphery}_c \times \text{High Leverage}_{i,s,c}$			-0,029***	-0,022***
			(0,003)	(0,003)
$\text{Post}_t \times \text{Periphery}_c$			-0,037***	
			(0,002)	
$\text{Post}_t \times \text{High Leverage}_{i,s,c}$	-0,033***	-0,028***	-0,017***	-0,017***
	(0,001)	(0,002)	(0,002)	(0,002)
Total effect: Post_t	-0,053***	-0,028***	-0,085***	-0,039***
	(0,001)	(0,002)	(0,001)	(0,002)
Total effect: Periphery_c			-0,066***	-0,022***
			(0,002)	(0,003)
Total effect: $\text{High Leverage}_{i,s,c}$	-0,033***	-0,028***	-0,046***	-0,039***
	(0,001)	(0,002)	(0,002)	(0,002)
Firm FE	Yes	Yes	Yes	Yes
Country-sector-year FE	No	Yes	No	Yes
Bank FE	No	Yes	No	Yes
Obs.	2,431,265	2,426,548	2,431,265	2,426,548
R^2	0.17	0.18	0.17	0.18

Role of weak banks

Dependent variable: (Net investment/Capital)$_{i,s,c,t}$

	(1)	(2)	(3)	(4)
Post$_t$ × Periphery$_c$ × High Leverage$_{i,s,c}$			-0,034***	-0,026***
			(0,005)	(0,006)
Post$_t$ × Periphery$_c$			-0,041***	
			(0,004)	
Post$_t$ × High Leverage$_{i,s,c}$	-0,032***	-0,027***	-0,008*	-0,010**
	(0,003)	(0,003)	(0,004)	(0,005)
Weak bank$_{i,t-1}$	-0,212***	0,037	-0,241***	0,038
	(0,022)	(0,030)	(0,022)	(0,030)
Total effect: Post$_t$	-0,067***	-0,027***	-0,091***	-0,036***
	(0,002)	(0,003)	(0,002)	(0,003)
Total effect: Periphery$_c$			-0,074***	-0,026***
			(0,004)	(0,006)
Total effect: High Leverage$_{i,s,c}$	-0,032***	-0,027***	-0,042***	-0,036***
	(0,003)	(0,003)	(0,003)	(0,003)
Firm FE	Yes	Yes	Yes	Yes
Country-sector-year FE	No	Yes	No	Yes
Bank FE	No	Yes	No	Yes
Obs.	1,052,146	1,048,091	1,052,146	1,048,091
R^2	0.26	0.28	0.26	0.28

Additional role of weak banks in periphery countries

Dependent variable: (Net investment/Capital)$_{i,s,c,t}$

	(1)	(2)	(3)	(4)
$Post_t \times Periphery_c \times$ High Leverage$_{i,s,c}$			-0,034***	-0,027***
			(0,004)	(0,004)
$Post_t \times$ High Leverage$_{i,s,c}$	-0,034***	-0,029***	-0,011***	-0,011***
	(0,002)	(0,002)	(0,003)	(0,003)
$Post_t \times Periphery_c$			-0,036***	
			(0,003)	
$Post_t \times Periphery_c \times$ Weak bank$_i$			-0,003	0,002
			(0,004)	(0,004)
$Post_t \times$ Weak bank$_i$	-0,001	-0,002	-0,002	-0,003
	(0,002)	(0,002)	(0,003)	(0,003)
Firm FE	Yes	Yes	Yes	Yes
Country-sector-year FE	No	Yes	No	Yes
Bank FE	No	Yes	No	Yes
Obs.	1,582,082	1,577,267	1,582,082	1,577,267
R^2	0.18	0.20	0.18	0.20

Benchmark results with short-term leverage

Dependent variable: $(\text{Net investment}/\text{Capital})_{i,s,c,t}$

	(1)	(2)	(3)	(4)
$\text{Post}_t \times \text{Periphery}_c \times \text{High Leverage}_{i,s,c}$			-0,034***	-0,019***
			(0,003)	(0,003)
$\text{Post}_t \times \text{Periphery}_c$			-0,033***	
			(0,002)	
$\text{Post}_t \times \text{High Leverage}_{i,s,c}$	-0,021***	-0,000	0,008***	0,010***
	(0,001)	(0,002)	(0,002)	(0,002)
Total effect: Post_t	-0,047***	-0,000	-0,072***	-0,010***
	(0,001)	(0,002)	(0,001)	(0,002)
Total effect: Periphery_c			-0,067***	-0,019***
			(0,002)	(0,003)
Total effect: $\text{High Leverage}_{i,s,c}$	-0,021***	-0,000	-0,026***	-0,010***
	(0,001)	(0,002)	(0,002)	(0,002)
Firm FE	Yes	Yes	Yes	Yes
Country-sector-year FE	No	Yes	No	Yes
Bank FE	No	Yes	No	Yes
Obs.	2,420,571	2,415,809	2,420,571	2,415,809
R^2	0.17	0.18	0.17	0.18

Benchmark results with long-term leverage

Dependent variable: (Net investment/Capital)$_{i,s,c,t}$

	(1)	(2)	(3)	(4)
Post$_t$ × Periphery$_c$ × High Leverage$_{i,s,c}$			-0,011 ***	0,001
			(0,003)	(0,003)
Post$_t$ × Periphery$_c$			-0,037***	
			(0,002)	
Post$_t$ × High Leverage$_{i,s,c}$	-0,063***	-0,064***	-0,049***	-0,065***
	(0,001)	(0,002)	(0,002)	(0,002)
Total effect: Post$_t$	-0,068***	-0,064***	-0,087***	-0,063***
	(0,001)	(0,002)	(0,001)	(0,002)
Total effect: Periphery$_c$			-0,048***	0,001
			(0,002)	(0,003)
Total effect: High Leverage$_{i,s,c}$	-0,063***	-0,064***	-0,060***	-0,063***
	(0,001)	(0,002)	(0,002)	(0,002)
Firm FE	Yes	Yes	Yes	Yes
Country-sector-year FE	No	Yes	No	Yes
Bank FE	No	Yes	No	Yes
Obs.	2,430,249	2,425,533	2,430,249	2,425,533
R^2	0.17	0.19	0.17	0.19

Sluggish investment: dynamic persistent effects

To investigate the dynamic responses in the baseline model, we run the following regressions by local projections:

$$\left(\frac{\text{Investment}}{\text{Capital}}\right)_{it+h} = \beta_{1h}\ \text{POST}_t +$$

$$\beta_{2h}\ \text{POST}_t \times \text{Periphery}_i +$$

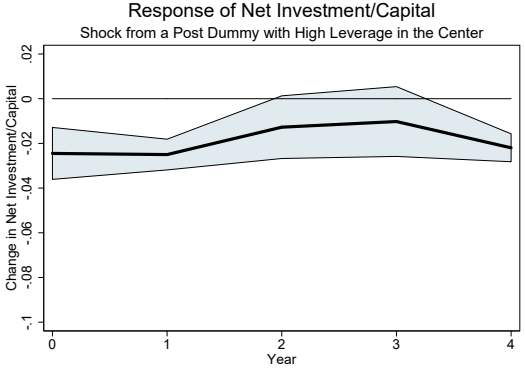
$$\beta_{3h}\ \text{POST}_t \times \text{High Leverage}_i +$$

$$\beta_{4h}\ \text{POST}_t \times \text{Periphery}_i \times \text{High Leverage}_i +$$

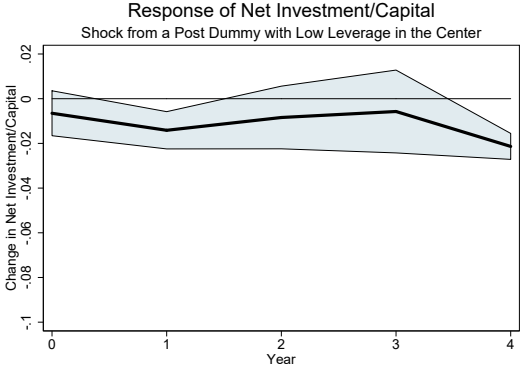
$$\mathbf{X}_{it-1}{}'\boldsymbol{\beta_h} + \alpha_i + \alpha_{c,s} + \alpha_b + \epsilon_{it}$$

Impulse responses of investment

(Euro-area centre economies)



(a) High leverage, Centre

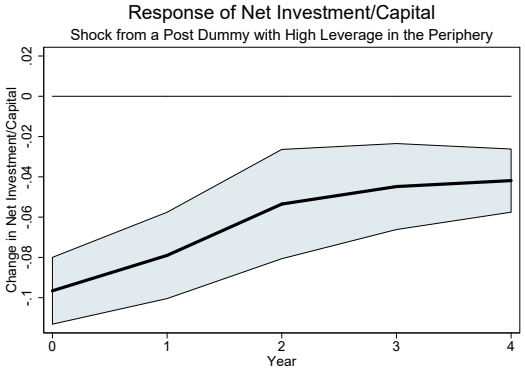


(b) Low leverage, Centre

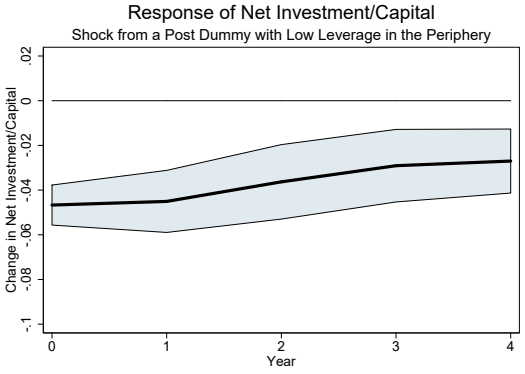
Note: We plot 95 percent confidence interval (calculated using two-way clustered standard errors by firm and year) as a shaded area

Impulse responses of investment

(Euro-area periphery economies)



(c) High Leverage, Periphery



(d) Low Leverage, Periphery

Note: We plot 95 percent confidence interval (calculated using two-way clustered standard errors by firm and year) as a shaded area

Conclusions

1. Significant debt overhang and rollover risks dampen investment in euro area
   - Initially high leverage discourages investment during crisis, in a manner consistent with debt overhang
   - Initially shorter debt maturity reduces investment more in crisis and in the Periphery euro area, consistent with higher rollover risk associated to sovereign risk

2. **Policy implication:**
   - **Debt overhang and rollover risk help explain 20 percent of the investment decline**
   - Bank recapitalisation and legacy debt approaches help but do not solve completely the investment problem

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