Borrowing Constraints in Emerging Markets

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Motivation

- Borrowing constraints are key in international macro models
  - Pro-cyclical & volatile firm debt → Neumeyer and Perri [2005]
  - Amplify & propagate economic shocks → Mendoza [2010]
- Two main strategies to model borrowing constraints
  - Collateral based
  - Cash flow based

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  - Cash flow based

This paper:

- Collateral constraints are not supported by the data
- Cash flow constraints have important quantitative & policy implications

This Paper: Empirical Analysis

Use credit-registry data from Argentina to study firms' borrowing constraints

- Firms' debt is primarily cash flow based
- Cash flow borrowing constraints are highly sensitive to interest rates
- Greater prevalence than in the US or other Advanced Economies

This Paper: Structural Analysis

SOE model with working capital & cash flow based borrowing constraints

- Study impact of shocks & transmission channels
- Cash flow constraints lead to higher amplification than collateral constraints
  - Solves the US monetary policy *Spillover Puzzle*
  - Policies designed to limit exchange rate volatility are counterproductive

Related Literature & Contribution

1. Borrowing constraints in Emerging Markets: Kiyotaki and Moore [1997], Mendoza [2010], Bianchi [2010], Bianchi [2011], Korinek et al. [2014], Schmitt-Grohé and Uribe [2017]
   - **Contribution:** Firms' primarily borrow cash-flow based
   - **Contribution:** Firms' borrowing constraints are highly sensitive to interest rates
   - **Contribution:** Cash flow constraints lead to higher amplification than collateral

2. Cash-flow based lending: Drechsel et al. [2019], Greenwald et al. [2019], Lian and Ma [2021]
   - **Contribution:** Greater prevalence in Argentina than in the US

3. Transmission of US interest rate shocks: Eichenbaum and Evans [1995], Uribe and Yue [2006], Rey [2015], Dedola et al. [2017], Camara [2021], Camara and Ramirez-Venegas [2022]
   - **Contribution:** Provide a solution to the *Spillover Puzzle*

4. Optimal policy in open economies: Gali and Monacelli [2005], Faia and Monacelli [2008], De Paoli [2009], Cugat et al. [2019], Bianchi and Lorenzoni [2021], Camara et al. [2021]
   - **Contribution:** Policies that limit exchange rate volatility are counterproductive

Outline

1. Introduction
2. Empirical Analysis
   - Prevalence of cash flow based lending
   - Cash flow borrowing constraints are highly sensitive to interest rates
3. Structural Analysis
   - Cash flow constraints lead to higher amplifications than collateral constraints
   - Quantitative & policy implications

Empirical Analysis

Empirical Analysis: Data Description

Firm Bank Credit Registry: "*Central de Deudores*" - BCRA

- Coverage: universe of **firm - bank - loan** linkages
- Sample: 1998 - 2020
- Type of credit line, line status, collateralized assets

  $\Rightarrow \approx$ **250,000 - 500,000 firms** $\approx$ **2 - 4 million observations per year**

- **Banks provide vast majority of financing in Emerging Markets**

▸ International Comparison Bank Financing ▸ International Comparison Equity Markets ▸ Comparison with US

Additional datasets:

- Corporate loans

Empirical Analysis: Collateral vs Cash Flow Lending

- Characterize types of debt contracts
  - General definition
  - BCRA regulations
  - Default resolution & bankruptcy procedures
- Modelling strategies
- Show empirical prevalence of cash flow lending

Empirical Analysis: Collateral Based Lending

- General definition:
  - Based on the liquidation value of specific assets
- BCRA regulations:
  - Asset categorization
  - Bounds by type of asset ▸ Bounds
- Default resolution & bankruptcy procedures:
  - Recovery upon bankruptcy

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Collateral Constraint: $\overbrace{b_t}^{\text{Total debt}} \leq \theta^k \times \overbrace{p_t^k k_t}^{\text{Value of capital}} \qquad \theta^k \in (0,1)$

Empirical Analysis: Cash Flow Based Lending

- General definition:
  - Based on the projected value of continuing operations
- BCRA regulations:
  - Monitoring role of banks over firms
- Default resolution & bankruptcy procedures:
  - Priority over debt re-structuring

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$$\text{Debt to Cash Flow:} \quad \overbrace{b_t}^{\text{Total debt}} \leq \theta^{DC} \times \overbrace{\Phi(L)\pi_t}^{\text{Cash flows}}, \qquad \theta^{DC} > 1$$

$$\text{Interest Coverage:} \quad \underbrace{r_t b_t}_{\text{Interest payments}} \leq \theta^{IC} \times \Phi(L)\pi_t, \qquad \theta^{IC} > 0$$

$\rightarrow \pi_t = \text{EBITDA}_t,$ ▸ Identification of Cash Flow Lending

Empirical Analysis: Collateral vs Cash-Flow Lending - *Aggregate Level*

	Banks - 2000 (1)	Banks - 2017 (2)	Corp. Loans 2022 (3)
Collateral Based	35.5%	15.9%	1.3%
Cash Flow Based	64.5%	84.1%	98.7%

$\Rightarrow$ Prevalence of **cash flow lending** at the **aggregate level**

Empirical Analysis: Collateral vs Cash-Flow Lending - *Firm Level*

	Total (1)	Legal Entities (2)	$L \geq 100$ (3)	$L \geq 500$ (4)
(I) - Firms with only CFB	**80.92%**	79.86%	85.14%	87.85%
(II) - Median Share of CFB	**100%**	100%	100%	100%
(III) - Mean Share of CFB	**89.34%**	89.53%	91.58%	92.37%

Evidence for the year 2017

$\Rightarrow$ Prevalence of **cash-flow based** debt contracts at the **firm level**

Empirical Analysis: Collateral vs Cash Flow Lending - *Financing Needs*

Credit line (evidence for 2017)	**Share of CFB** (1)	**Share of Total Debt** (2)
Capital Expenditures	**42.31%**	**17.02%**
Automotive loans	4.8%	0.3%
Machinery & equipment loans	38.4%	5.6%
Real estate loans	43.1%	5.8%
Credits for financial leasing	47.9%	5.3%
Working Capital Expenditures	**92.24%**	**82.98%**
Discounted documents	89.3%	42.4%
Short term credit lines (<30 days)	92.6%	16.6%
Financing of working capital for exporting	96.5%	18.6%
Credit card debt	99.5%	5.5%

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$\Rightarrow$ Firms borrow **cash flow based** primarily to finance **working capital**

Comparison with US

Empirical Analysis: Identification of Borrowing Constraints

1. BCRA - Macro prudential policy & regulations
   - Credit regulations over banks' balance sheet exposure to firm risk
   - Risk assessment of firms: $r_t \times b_t \leq \theta \times \pi_t$
2. Corporate Loans
   - Debt covenants & events of technical default
3. Survey of Banks' Corporate Risk Departments

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Additional Evidence:

- Aggregate evidence
- Firm level evidence

Empirical Analysis: Borrowing Constraints - *Results*

Collateral vs. Cash Flow Lending

	Banks - 2000	Banks - 2017	Corp. Loans 2022
Collateral Based	35.5%	15.9%	1.3%
Cash Flow Based	64.5%	84.1%	98.7%
Debt to Cash Flow	14.9%	25.8%	83.0%
Interest Coverage	**49.6%**	**58.4%**	**98.7%**

$\Rightarrow$ Prevalence of **interest sensitive borrowing constraints**

Empirical Analysis: International Comparison - Cash Flow Lending

	Lian and Ma [2021]		**Argentina**	
	US	Rest of the World	BCRA	Corporate Loans
Aggregate Share CFB	80%	54%-66%	83%	98%
Firms with CFB	62%		100%	100%
Mean Share CFB	85%	21%-37%	89%	98%

$\Rightarrow$ **Argentina** shows greater prevalence of **cash flow based** lending

Empirical Analysis: International Comparison - Cash Flow Constraints

	US - Greenwald et al. [2019]	**Argentina** - BCRA
Debt to Cash Flow	70%	31%
Interest Coverage	30%	69%

$\Rightarrow$ **Argentina** shows greater prevalence of **interest sensitive** constraints

Empirical Analysis: Taking Stock

- Vast majority of firm lending is **cash flow based**, *not* **collateral based**
- Most prevalent constraint is **interest sensitive** or "Interest Coverage"
- **Cash flow lending** may be more **prevalent in EMs** than in the US

Additional results:

- Conjectures on causes of greater prevalence ▸ Why Earnings? ▸ Micro foundations ▸ Interest Coverage
- Borrowing constraint violations ▸ Evidence
- Collateral & cash flow borrowing across firm characteristics ▸ Sector of activity
- Aggregate evidence ▸ Evidence
- Extrapolating results to other EMs

Structural Analysis

Structural Analysis: Road Map

1. **Real Model**
   - Financial frictions → Jermann and Quadrini [2012]
   - Foreign interest rate shock R_t^*
   - Amplification: Collateral vs Cash Flow based constraints
2. Nominal frictions
   - Policy implication: exchange rate regimes
3. **Quantitative application**
   - *Spillover Puzzle*

Structural Analysis: Real Model

- Households
  $\Rightarrow$ Consume, save, provide labor
- Continuum of firms
  $\Rightarrow$ Produce & accumulate capital, subject to borrowing constraint
- Government
  $\Rightarrow$ Levies lump sum taxes to keep balanced budget
- Exogenous shock
  $\Rightarrow$ Foreign interest rate shock R_t^*

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Structural Analysis: Households

- Households consume, save and supply labor to maximize

$$\mathbb{E}_0 \sum_{t=0}^{\infty} \beta^t \frac{\left(c_t - \theta \omega^{-1} h_t^{\omega}\right)^{1-\gamma} - 1}{1-\gamma}$$

subject to budget constraint

$$w_t h_t + b_t + s_t \left(p_t + d_t\right) = \frac{b_{t+1}}{R_t} + s_{t+1} p_t + c_t + t_t$$

Structural Analysis: Firm's Financial Frictions

Features of the Data

- Borrowing constraints matter
- Working capital debt explain large share
- Equity, dividends & debt imperfect substitutes

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Modelling Assumptions

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Modelling Assumptions

$\Rightarrow$ **Tax advantage of debt**

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Modelling Assumptions

$\Rightarrow$ **Tax advantage of debt**

$\Rightarrow$ $\phi \in (0,1)$ **input paid in advance**

Structural Analysis: Firm's Financial Frictions

Features of the Data	**Modelling Assumptions**
• **Borrowing constraints matter**	⇒ **Tax advantage of debt**
• **Working capital debt explain large share**	⇒ $\phi \in (0,1)$ **input paid in advance**
• **Equity, dividends & debt imperfect substitutes**	⇒ **Dividend adjustment costs**

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⇒ Model by Jermann and Quadrini [2012] with cash flow borrowing constraints

▸ Violations of Borrowing Constraints

Structural Analysis: Firms' Characteristics

- Owned by share-holders $\rightarrow$ maximize present value of dividends d_t
- Production technology:

$$y_t = z_t k_t^{\alpha} m_t^{\eta} n_t^{1-\alpha-\eta}$$

- Capital accumulation subject to adjustment costs:

$$k_{t+1} = (1-\delta) k_t + i_t \times \Phi\left(\frac{i_t}{i_{t-1}}\right)$$

- Tax subsidy on debt

$$\tilde{R}_t = 1 + (R_t - 1)(1-\tau) \quad \rightarrow \tau, \text{ is a tax subsidy}$$

financed through lump sum tax on households

Structural Analysis: Working Capital & Flow of Funds

- Firms must cover fraction ϕ of input purchases in advance

$$\underbrace{l_t}_{\text{Working capital borrowing}} = \phi \overbrace{(w_t n_t + p_t^m m_t)}^{\text{Input expenditure}}$$

$\Rightarrow$ Pays interest $\tilde{R}_t$

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- Flow of funds constraint

$$y_t + \frac{b_{t+1}}{\tilde{R}_t} = (1-\phi)\left(w_t n_t + p_t^m m_t\right) + \tilde{R}_t l_t + b_t + i_t + d_t$$

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$$y_t + \frac{b_{t+1}}{\tilde{R}_t} = \left(1 - \phi + \phi \tilde{R}_t\right)(w_t n_t + p_t^m m_t) + b_t + i_t + d_t$$

Structural Analysis: Borrowing Constraint & Equity Frictions

- Borrowing constraint

$$\underbrace{\bar{B}_t(.)}_{\text{Borrowing limit}} \geq \overbrace{\frac{b_{t+1}}{\tilde{R}_t}}^{\text{Intertemporal}} + \underbrace{l_t}_{\text{Working capital}}$$

Structural Analysis: Borrowing Constraint & Equity Frictions

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- Dividend adjustment cost

$$\Psi(d_t) = d_t + \psi\left(d_t - \bar{d}\right)^2$$

Structural Analysis: Firm's borrowing limit $\bar{B}_t(.)$

Benchmark collateral: $B_t^k \leq \theta^k \times p_t^k k_{t+1}$

Debt to Cash Flow: $\times B_t^{DC} \leq \theta^{DC} \times \Phi(L)\pi_t$

Interest Coverage: $\tilde{r}_t \times B_t^{IC} \leq \theta^{IC} \times \Phi(L)\pi_t$

where

$$\pi_t = y_t - w_t n_t - p_t^m m_t$$
$$\Phi(L)\pi_t = \frac{1}{4} \times (\pi_t + \pi_{t-1} + \pi_{t-2} + \pi_{t-3})$$

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- Dividend adjustment cost

$$\Psi(d_t) = d_t + \psi\left(d_t - \bar{d}\right)^2$$

- Labor decision under **collateral constraint** ▸ Labor Cash Flow Constraint - ▸ Debt Issuance - ▸ Model Graph - ▸ Recursive Problem

$$MPL_t = w_t \left[\overbrace{\left(1 - \phi + \phi\tilde{R}_t\right)}^{\text{Working Capital Wedge}} + \overbrace{\mu_t \times \Psi'_{d,t} \times \phi}^{\text{Borrowing Constraint Wedge}} \right]$$

μ_t is Lagrange multiplier on borrowing constraint

Structural Analysis: Borrowing Constraint & Equity Frictions

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- Investment decision ▸ Labor Cash Flow Constraint - ▸ Debt Issuance - ▸ Model Graph - ▸ Recursive Problem

$$\frac{1}{\Psi'_{d,t}} = Q_t \Phi'_{i_t} + \mathbb{E}_t Q_{t+1} \Phi'_{i_{t+1}}$$

μ_t is Lagrange multiplier on borrowing constraint

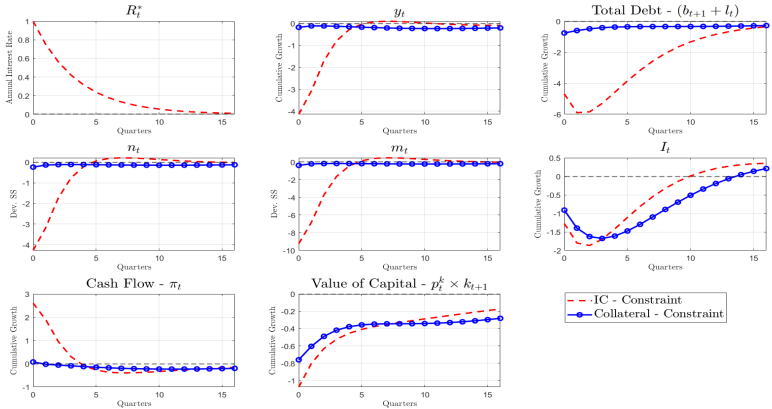
Structural Analysis: Real Model - Calibration

Parameter	Value	Details / target
ϕ_i	Investment Adjustment Cost	2 - between Christiano et al. [2011]
α	Capital share in production	0.32 - Garcia-Cicco et al. [2010]
η	Imported Input share in production	0.10 - Garcia-Cicco et al. [2010]
δ	Capital depreciation rate -	0.1255/4 Garcia-Cicco et al. [2010]
β	Household discount factor	0.9852 - Thoenissen et al. [2014] $\rightarrow R = 6\%$
σ	Household risk aversion	2 - Mendoza [2010]
ϕ	Working capital requirements	0.25 - Mendoza [2010]
ψ	Dividend adjustment cost	0.20 - Jermann and Quadrini [2012]
τ	Tax advantage on debt	0.35 - Data - Thoenissen et al. [2014]
θ^k	Tightness Collateral Const.	0.3093 - Match average observed in the data
θ^{DC}	Tightness DC Const.	4.1437 - Match average observed in the data
θ^{IC}	Tightness IC Const.	0.1225 - Match average observed in the data

h_t in steady state are calibrated to 0.2, net foreign assets are calibrated to match a $TB/GDP = 0.5\%$.

▸ Alternative Calibration

Structural Analysis: Real Model - IRF R_t^* - $\Uparrow$ 100bp - $\rho_{R^*} = 0.75$



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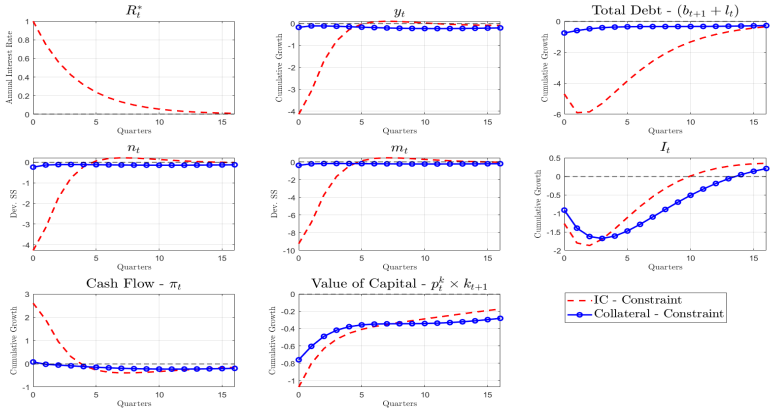

$\Rightarrow$ **IC constraints** lead to **greater amplification**

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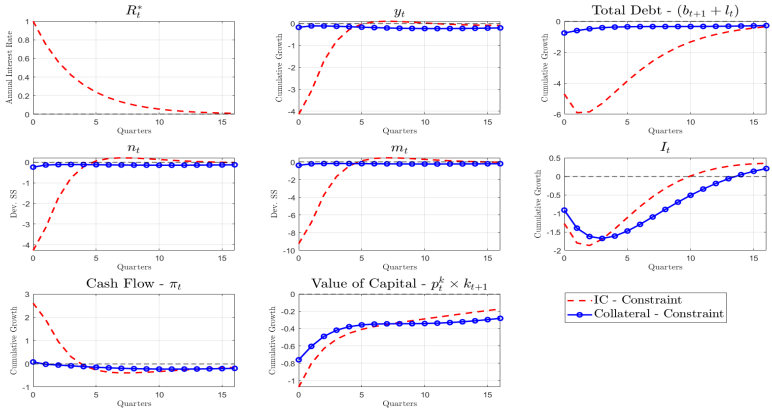

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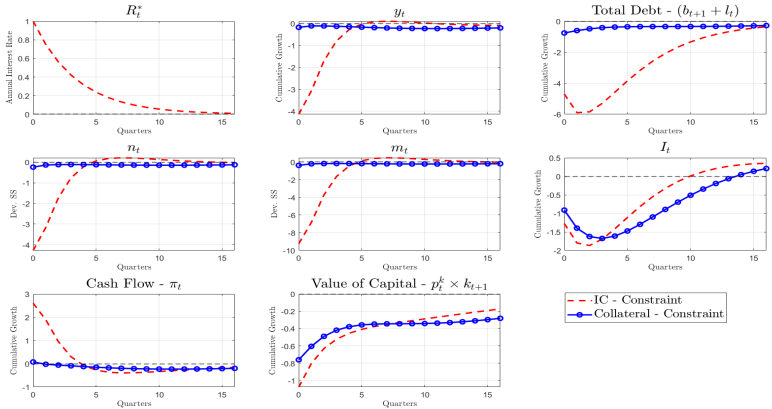

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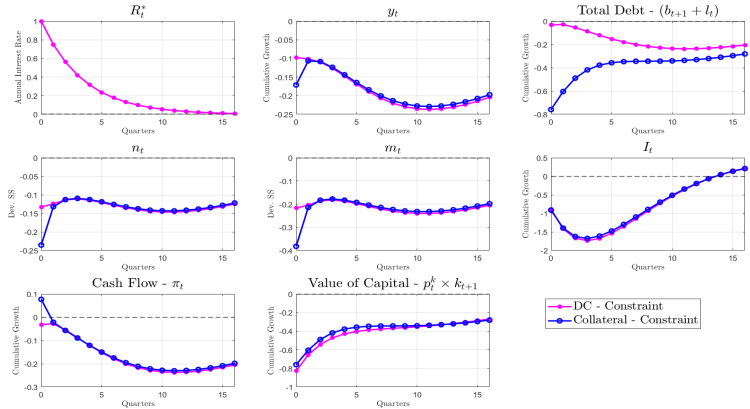

$\Rightarrow$ **Interest sensitivity** drives the **greater amplification**

Structural Analysis: IRF R_t^* - $\Uparrow$ 100bp - $\rho_{R^*} = 0.75$ - Debt Smoothing

- Computed every period: $\tilde{r}_t B_t^{IC} \leq \theta^{IC} \times \Phi(L_t)\, \pi_t$
- Update rule: $\bar{B}_t = (1 - \rho_B)\, \bar{B}_{t-1} + \rho_B B_t^{IC}$

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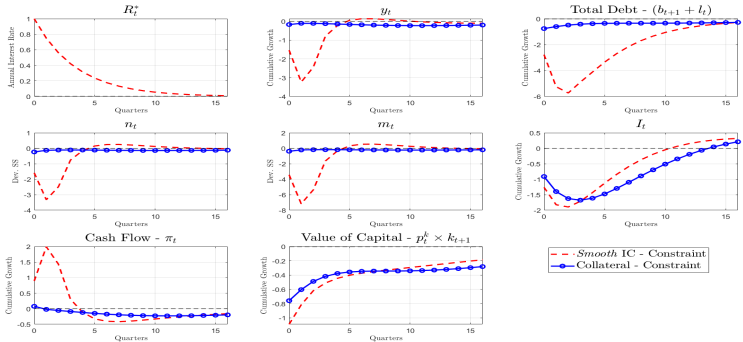

Structural Analysis: Real Model - Results

- **Cash flow** constraints lead to greater amplification than **collateral**
- **Greater amplification** driven by **interest sensitivity**

Structural Analysis: Real Model - Results

- **Cash flow** constraints lead to greater amplification than **collateral**
- **Greater amplification** driven by **interest sensitivity**
- Parameter sensitivity
  - Working capital requirements - ϕ - ϕ
  - Dividend adjustment costs - ψ - ψ
  - Timing of constraints - $\Phi(L_t)\pi_t$ - Timing
- Additional economic shocks
  - Borrowing constraint shock
  - Productivity shock

Quantitative Applications

Quantitative Applications: Road Map

1. **US Monetary Policy Spillover Puzzle**
   - 1.1 US interest rates have greater spillovers outside the US, particularly in EMs
   - 1.2 Differences in borrowing constraints across countries provide a solution

Quantitative Applications: Road Map

1. **US Monetary Policy Spillover Puzzle**
   - 1.1 US interest rates have greater spillovers outside the US, particularly in EMs
   - 1.2 Differences in borrowing constraints across countries provide a solution
2. Borrowing Constraints & Monetary Policy Regimes
3. Borrowing Constraints & Firm Heterogeneity

US Monetary Policy - Spillover Puzzle

- US monetary policy shocks have greater spillovers in EMs vs. Adv.
  - Estimated impact → Kalemli-Ozcan [2019], Degasperi et al. [2020], Camara [2021]
  - Trigger of financial crises → Sahay et al. [2014], Eichengreen and Gupta [2016]
- Empirically test the hypothesis for a panel of EMs. & Adv.
  - SVAR models
  - Local projection regressions
  - Identification Jarociński and Karadi [2020]
- Rationalize it through differences in borrowing constraints across countries

US Monetary Policy - Spillover Puzzle - Econometric Specification

Local projection regression → Jordà [2005] + Jarociński and Karadi [2020] details

- Advanced Economies: 7 *including the US*
- Emerging Markets: 11

$$\ln y_{i,t+h} = \beta_h^{MP} i_t^{\text{MP}} + \gamma_h^{INT} \mathbb{1}[i \neq \text{US}] \times i_t^{\text{MP}} + \sum_{j=1}^{J_y} \delta_i^j y_{i,t-j} + \sum_{j=1}^{J_x} \alpha_i^j x_{i,t-j} + \gamma t + \mu_i + \epsilon_{i,t}$$

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$\Rightarrow \beta_h^{MP} \rightarrow$ impact in the US in period $t + h$

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$\Rightarrow \beta_h^{MP} \rightarrow$ impact in the US in period $t + h$

$\Rightarrow \gamma_h^{INT} \rightarrow$ marginal impact outside the US in period $t + h$

US Monetary Policy - Spillover Puzzle - Econometric Specification

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- Advanced Economies: 7 *including the US*
- Emerging Markets: 11

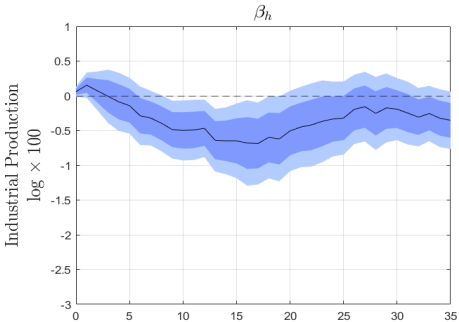
$$\ln y_{i,t+h} = \beta_h^{MP} i_t^{\text{MP}} + \gamma_h^{INT} \mathbb{1}[i \neq \text{US}] \times i_t^{\text{MP}} + \sum_{j=1}^{J_y} \delta_i^j y_{i,t-j} + \sum_{j=1}^{J_x} \alpha_i^j x_{i,t-j} + \gamma t + \mu_i + \epsilon_{i,t}$$

$\Rightarrow \beta_h^{MP} \rightarrow$ impact in the US in period $t + h$

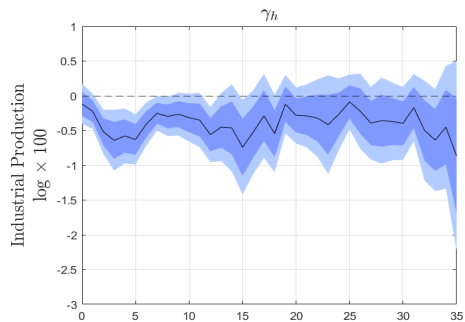
$\Rightarrow \gamma_h^{INT} \rightarrow$ marginal impact outside the US in period $t + h$

$\Rightarrow \beta_h^{MP} + \gamma_h^{INT} \rightarrow$ impact outside the US in period $t + h$

US Monetary Policy - Spillover Puzzle - Results



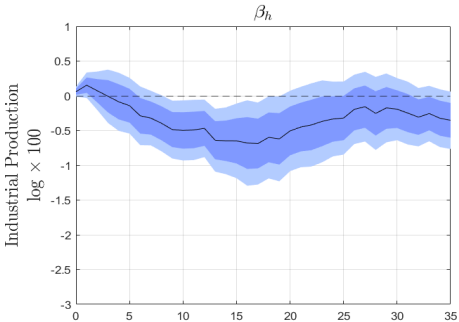
Impact in US β_h^{MP}



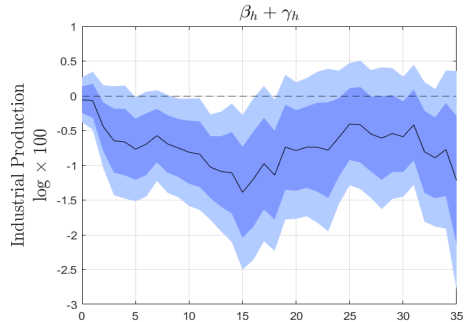
Impact outside US γ_h^{INT}

$\Rightarrow$ **US interest rate shocks** lead to greater spillovers **<u>outside the US</u>**

US Monetary Policy - Spillover Puzzle - Results



Impact in US β_h^{MP}



Impact outside US $\beta_h^{MP}+\gamma_h^{INT}$

$\Rightarrow$ **US interest rate shocks** lead to greater spillovers **<u>outside the US</u>**

US Monetary Policy - Spillover Puzzle - Econometric Specification

Local projection regression $\rightarrow$ Jordà [2005] + Jarociński and Karadi [2020]

- Advanced Economies: 6 *excluding the US*
- Emerging Markets: 11

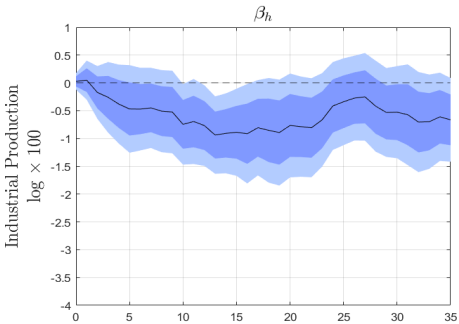
$$\ln y_{i,t+h} = \tilde{\beta}_h^{MP} i_t^{\text{MP}} + \gamma_h^{INT-EM} \mathbb{1}[i = \text{EM}] \times i_t^{\text{MP}} + \sum_{j=1}^{J_y} \delta_i^j y_{i,t-j} + \sum_{j=1}^{J_x} \alpha_i^j x_{i,t-j} + \gamma t + \mu_i + \epsilon_{i,t}$$

$\Rightarrow \tilde{\beta}_h^{MP} \rightarrow$ impact in Adv. Economies in period $t + h$

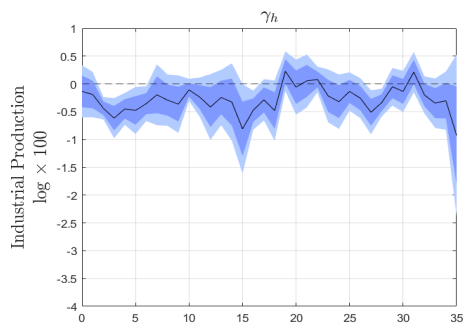
$\Rightarrow \gamma_h^{INT-EM} \rightarrow$ marginal impact in Emerging Markets in period $t + h$

$\Rightarrow \tilde{\beta}_h^{MP} + \gamma_h^{INT-EM} \rightarrow$ impact in EM in period $t + h$

US Monetary Policy - Spillover Puzzle - Results



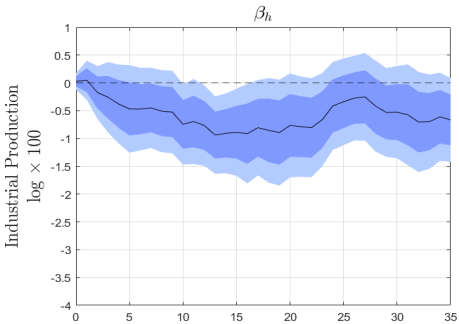
Impact in AE $\tilde{\beta}_h^{MP}$



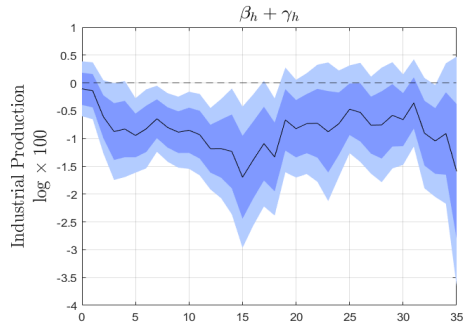
Impact in EM γ_h^{INT}

$\Rightarrow$ **US interest rate shocks** lead to greater spillovers **in EMs**

US Monetary Policy - Spillover Puzzle - Results



Impact in AE $\tilde{\beta}_h^{MP}$



Impact in EM $\tilde{\beta}_h^{MP} + \gamma_h^{INT}$

$\Rightarrow$ **US interest rate shocks** lead to greater spillovers **in EMs**

US Monetary Policy - Spillover Puzzle - Constraint Heterogeneity

- Share of **collateral** & **cash flow** constraints differ across countries
  - Lian and Ma [2021] show larger share of **cash flow** based $\rightarrow$ US vs. other *AE*
  - **Cash flow** lending more prevalent in Argentina vs US
  - **Interest sensitive** constraints more prevalent in Argentina vs US
- Interest sensitive (IC) constraints provide greater amplification of R_t^* shocks

US Monetary Policy - Spillover Puzzle - Constraint Heterogeneity

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- Interest sensitive (IC) constraints provide greater amplification of R_t^* shocks

Proposed solution:

$\Rightarrow$ Greater share of IC constraints in EMs $\Rightarrow$ Greater spillovers of R_t^*

Borrowing limit Argentina vs US: weighted average of *IC* & *DC* constraints

$$\bar{B}_t = \omega \times B_t^{IC} + (1-\omega) \times B_t^{DC}, \quad \omega \in (0,1)$$

US Monetary Policy - Spillover Puzzle - Heterogeneity in Constraints

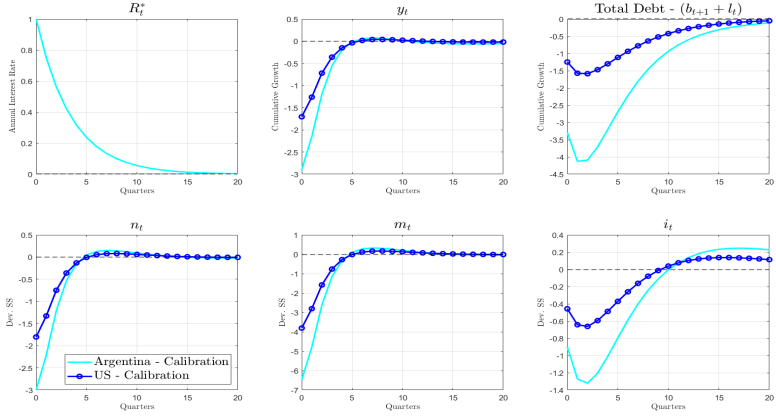
Borrowing limit Argentina vs US: weighted average of *IC* & *DC* constraints

$$\bar{B}_t = \omega \times B_t^{IC} + (1-\omega) \times B_t^{DC}, \quad \omega \in (0,1)$$

Parameter	Description	Argentina	US - Greenwald [2018]
ω	Share of IC	0.70	0.30
θ^{IC}	Tightness θ^{IC}	0.0955	0.154
θ^{DC}	Tightness θ^{DC}	4.2261	8.613

$\Rightarrow \{\theta^{IC}, \theta^{DC}\}$ calibrated to match private sector debt to GDP

US Monetary Policy - Spillover Puzzle - Argentina & US



$\Rightarrow$ Greater prevalence of **IC constraints** in **Argentina** leads to **greater amplification**

Additional Results & Going Forward

- Nominal Frictions & Policy Implications
  - Benchmark results are present in presence of nominal frictions
  - Interest sensitive borrowing constraints amplifies cost of exchange rate pegs
- Cash flow borrowing constraints & firm heterogeneity
  - Firms differ in their currency patterns of revenues, expenditures & debt
  - Policy implications for firm's foreign currency debt
- Impact of violating borrowing constraints

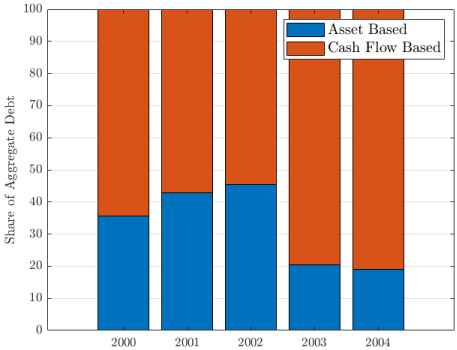
Conclusions

- Show that vast majority of firm's debt is cash flow based
- Most prevalent borrowing constraint is highly sensitive to interest rates
- Interest coverage constraints generate greater amplification than collateral
- Higher share of IC constraints in EMs provides solution to *Spillover Puzzle*

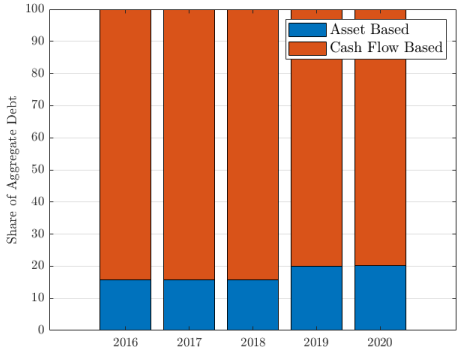
Appendix - Empirical Analysis

Empirical Analysis: Collateral vs Cash-Flow Lending Historical

Composition of Argentinean Debt: Collateral vs Cash-Flow Based



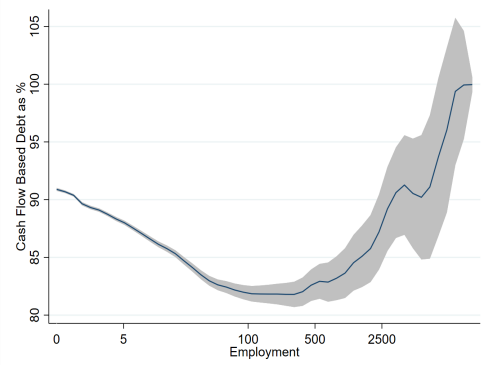
(a) Around 2002 Financial Crisis



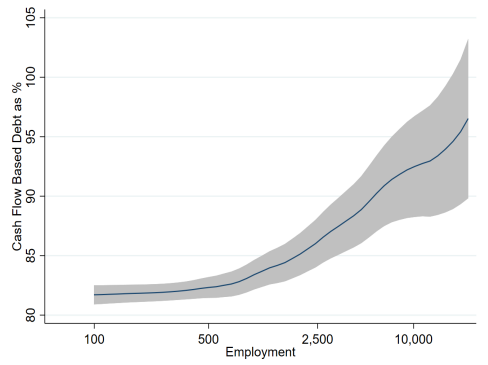
(b) Around 2018 Financial Crisis

Empirical Analysis: Collateral vs Cash-Flow - *By firm size*

Relationship between Cash Flow Based Debt & Firm Size



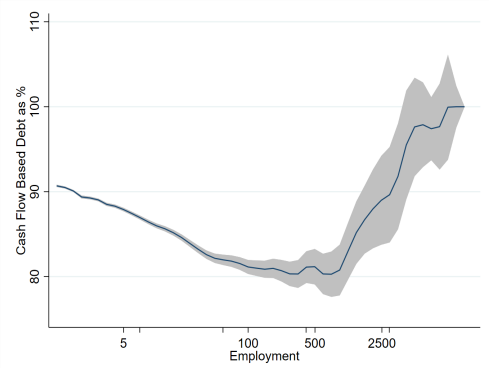
(a) Total Sample



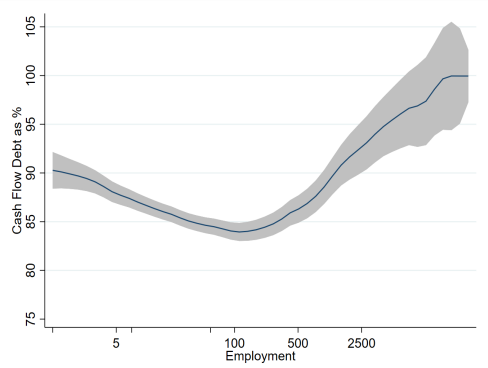
(b) Large Firms

Empirical Analysis: Collateral vs Cash-Flow Lending - *Exporters*

Cash Flow Based Debt according to Export Performance



(a) Non Exporters



(b) Exporters

Ben S Bernanke and Mark Gertler. Inside the black box: the credit channel of monetary policy transmission. *Journal of Economic perspectives*, 9(4):27–48, 1995.

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Gabriela Cugat et al. Emerging markets, household heterogeneity, and exchange rate

Empirical Analysis: Why Earnings?

1. Creditors
   - Share of aggregate debt by banks in the US: 25%
   - Share of aggregate debt by banks in Argentina: 95%

2. Debt maturity
   - Average in the US $\approx$ 4.5 years
   - Average in Argentina $<$ 1 year

3. Working capital vs Capital expenditures
   - Average in the US: 20% vs 80%
   - Average in Argentina: 80% vs 20%

4. Bankruptcy procedure & liquidation length
   - Average in the US $\approx$ 4 months
   - Average in Argentina $>$ 1 year

Back

Empirical Analysis: Earnings - Micro - foundation

- Default on debt leads to creditor taking control of firm
- Creditor can operate the firm herself or sell it
- Creditor is uncertain about the value of the firm *ex ante* - V_t^{end}
- Valuation by multiples Liu et al. [2002]
  - EBITDA, Interest Coverage, etc
- Creditor makes approximation

$$V_t^{end} \approx \theta^{DC} \pi_t, \text{ or } V_t^{end} \approx \theta^{IC} \frac{\pi_t}{r_t}$$

Back

Empirical Analysis: Empirical Validity of Interest Coverage Constraints

- Gertler and Gilchrist [1994] higher coverage ratios associated with greater decline in manufacturing firm output after monetary policy shock
- Bernanke and Gertler [1995] movements in coverage ratios associated with significant decline in factor demand
- Palomino et al. [2019] find coverage ratios are high predictive power of firms' default & business cycle dynamics

Back

Empirical Analysis: Theoretical Validity of Interest Coverage Constraints

- Leland [1994, 1998] shows that an interest coverage ratio covenant may remove the incentive of stockholders to increase asset volatility either when asset volatility is unobservable or when covenants that limit it directly are costly to enforce
- Goldstein et al. [2001] shows that under proportional financial distress costs there is an optimal leverage ratio range
- Dothan [2006] shows that under non-linear financial distress cost an interest coverage ratio is value enhancing

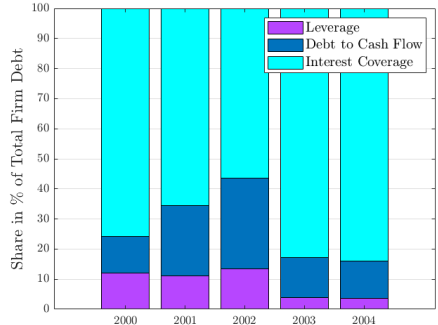
Back

Empirical Analysis: Debt Covenants along the Business Cycle

Leverage $b_t \leq \theta^k p_t^k k_t$

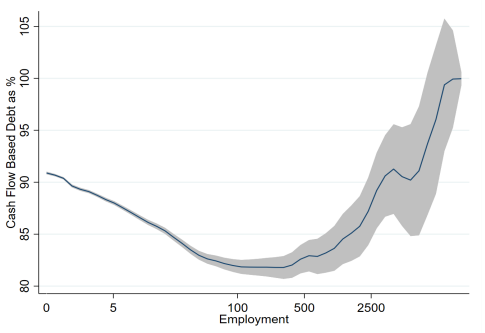
Debt to Cash-Flow $b_t \leq \theta^{DC} \pi_t$

Interest Coverage $r_t b_t \leq \theta^{IC} \pi_t$



$\Rightarrow$ Prevalence of interest coverage covenants, *but counter-cyclical*

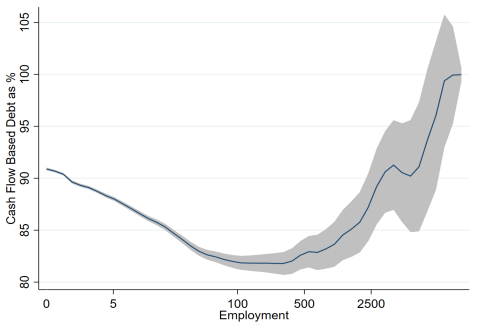
Empirical Analysis: Collateral vs Cash Flow Lending - *By Size & Age*



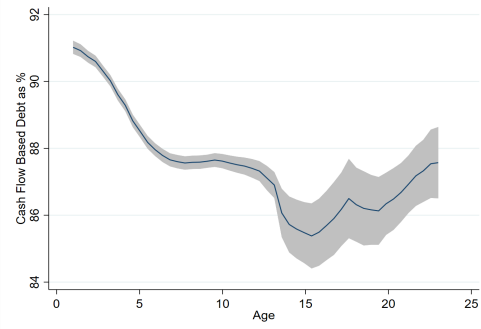
By Employment

$\Rightarrow$ Larger firms borrow cash flow based

Empirical Analysis: Collateral vs Cash Flow Lending - *By Size & Age*



By Employment



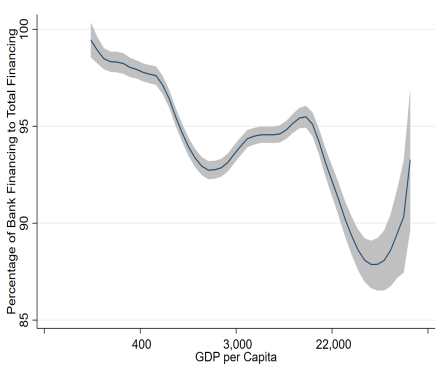
By Age

$\Rightarrow$ Larger firms borrow cash flow based

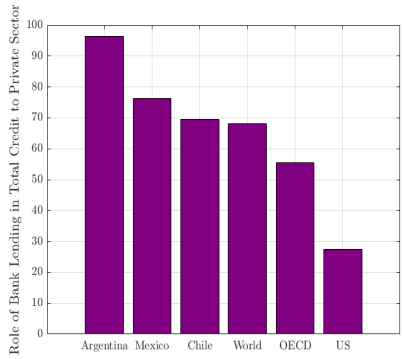
$\Rightarrow$ U shaped relationship

Empirical Analysis: Banks as % of Private Sector Financing

GDP per Capita & Role of Banks



Selected Examples

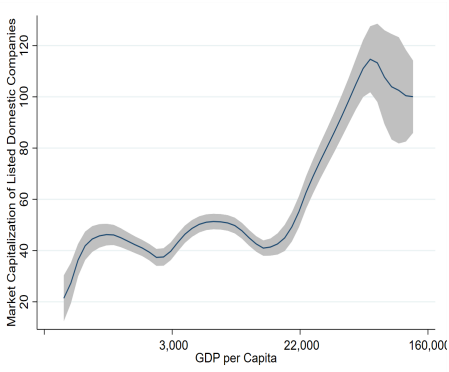


$\Rightarrow$ Banks explains the vast majority of private sector credit in EMs

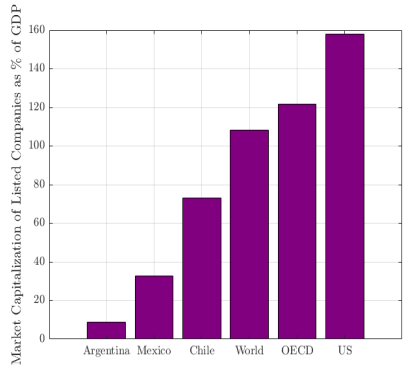
Back to Data Description

Empirical Analysis: Equity Markets as % of Private Sector Financing

GDP per Capita & Equity Markets



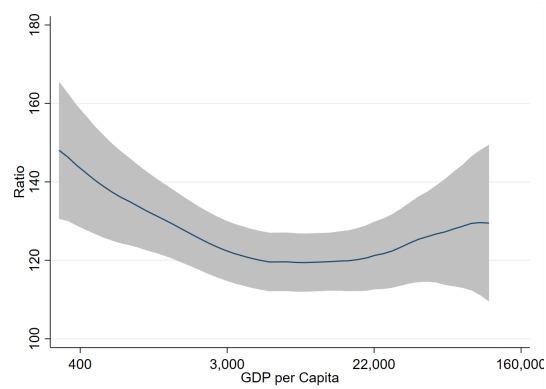
Selected Examples



$\Rightarrow$ Equity markets explains a small share of private sector credit in EMs

Empirical Analysis: Working Capital vs Capital Expenditure Financing

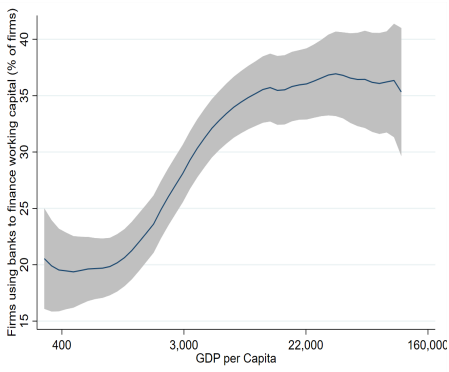
Working Capital vs Capital Expenditures



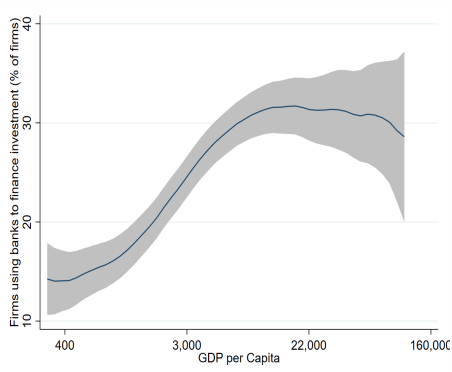
$\Rightarrow$ Firms in EMs rely on banks primarily for working capital financing

Empirical Analysis: Working Capital vs Capital Expenditure Financing

% of Firms which finance WK through Banks



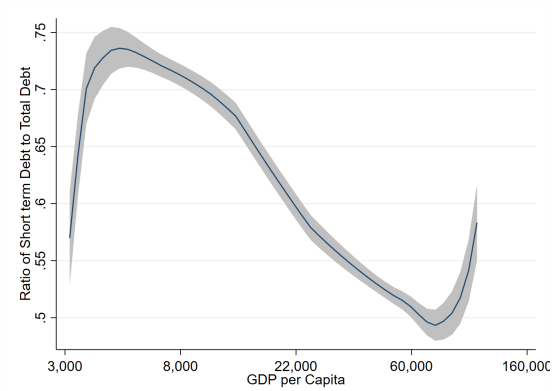
% of Firms which finance CE through Banks



$\Rightarrow$ Firms in EMs rely on banks primarily for working capital financing

Empirical Analysis: Short Term Financing in EMs

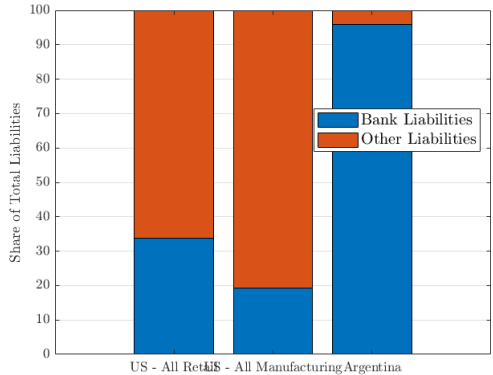
Ratio Short Term to Total Liabilities



$\Rightarrow$ Firms in EMs exhibit greater share of short term debt than AE

Empirical Analysis: Role of Banks across Countries

Banks vs Non-Bank Liabilities

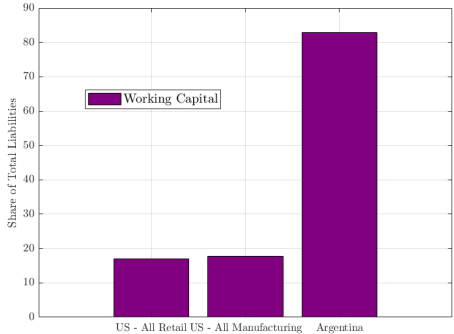


$\Rightarrow$ Firms in Argentina rely heavily more in banks than in the US

Back to Data Description

Empirical Analysis: Working Capital across Countries

Share of Working Capital Liabilities



⇒ Working capital explains majority of financing in Argentina, opposite to the US

Back to financing needs

Structural Analysis: New Keynesian Model

- **Intermediate good firms**
  - ⇒ Produce & accumulate capital subject to borrowing constraint
  - ⇒ Rotemberg price adjustment costs
  - ⇒ Domestic & foreign currency borrowing
- **Final good firms:** Consumption, investment, export
  - ⇒ Aggregates domestic & foreign intermediate goods
- Households
  - ⇒ Consume, save in domestic & foreign currency bonds, provide labor
- Government
  - ⇒ Levies lump sum taxes to keep balanced budget
  - ⇒ Monetary Authority follows Taylor Rule
- Exogenous shock
  - ⇒ Foreign interest rate shock R_t^*

Empirical Analysis: Identification of Collateral Based Lending

Firm - Bank Data Set:

- BCRA data set identifies credit lines with standard collateral
  - Real estate
  - Agricultural land & stocks
  - Machinery & equipment
  - Financial assets

- BCRA + bankruptcy law impose regulations
  - Collateral must be registered
  - Bounds on "*Loan-to-Value*" by type of collateral
  - Collateral lending is not subject to risk assessment regulations
  - Creditors have no voting power in debt restructuring processes

Corporate Loans Data Set:

- Debt covenants specified in terms of collateral

Empirical Analysis: Bounds on Collateral Based Lending

	Bound as % of Asset Value
Type "A" assets	
Cash or Highly-Liquid Domestic Currency assets	100%
Cash or Highly-Liquid Foreign Currency assets	80%
Gold	80%
Sovereign Bonds	75%
Central Bank Liabilities	100%
Private Equity Claims	70%
Type "B" assets	
Real Estate	50%-100%
Automotive vehicles & agricultural machinery	60%-75%
Road & industrial machinery	60%
Cattle stock	60%

Back to Collateral Lending

Empirical Analysis: Identification of CFB: BCRA Regulations

1. Monitoring Role over Firms
   - High frequency monitoring of firms performance & risk assessment
   - Risk assessment $\approx$ firm's cash flows
   - Cash flows must not take into account sale of assets
   - **Collateral lending** not subject to **risk assessment**

Empirical Analysis: Identification of CFB: BCRA Regulations

1. Monitoring Role over Firms
   - High frequency monitoring of firms performance & risk assessment
   - Risk assessment $\approx$ firm's cash flows
   - Cash flows must not take into account sale of assets
   - **Collateral lending** not subject to **risk assessment**

2. Macro Prudential Policy & Bank's Credit Policy
   - Constraint on "*Risky-Assets* to *Bank Capital*"
   - *Riskiness* of bank lending stipulated in detail as function $f\left(\Phi\left(L_t\right)\pi_t\right)$
   - Banks must capitalize or curtail lending if

$$r_t \times b_t \quad \leq \quad \theta^{IC} \times \Phi\left(L_t\right)\pi_t$$

3. BCRA regulations over credit lines
   - Working capital for exporting, ...

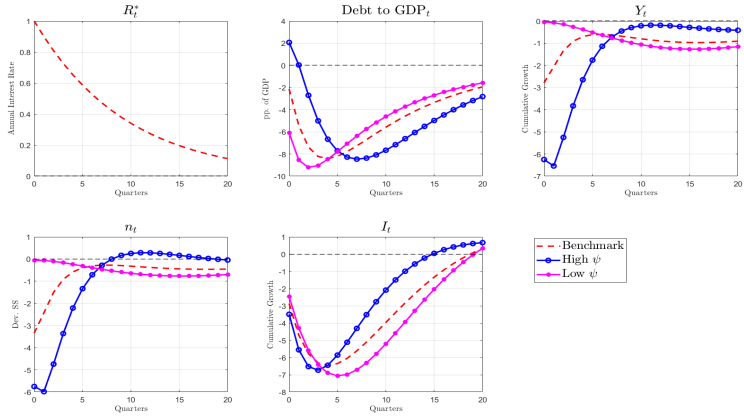
Back to Cash Flow Lending

Empirical Analysis: Identification of CFB: Corporate Loans

Collateral vs Cash Flow Based
"*Obligaciones Negociables*"

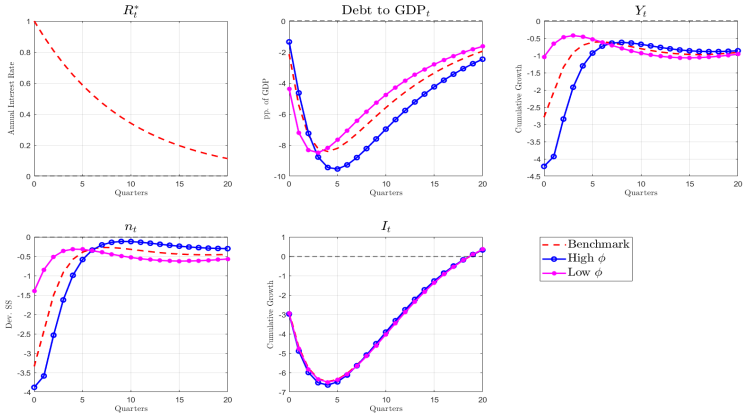
Category	**Total**	Without State Owned	LC	Dollar
Collateral Based in %	1.27	1.45	0.74	4.46
Cash Flow Based in %	98.73	98.55	99.26	95.54
Debt to Cash Flow	83.0			
Interest Coverage	98.7			
Total Value (in millions of USD)	$63,235	$55,041	$54,265	$8,970
Share of Total ONs in %	100.00	87.04	85.82	14.18

Structural Analysis: IRF R_t^* - Debt & Equity Frictions ψ



Back to Model Results page

Structural Analysis: IRF R_t^* - Working Capital Requirement ϕ



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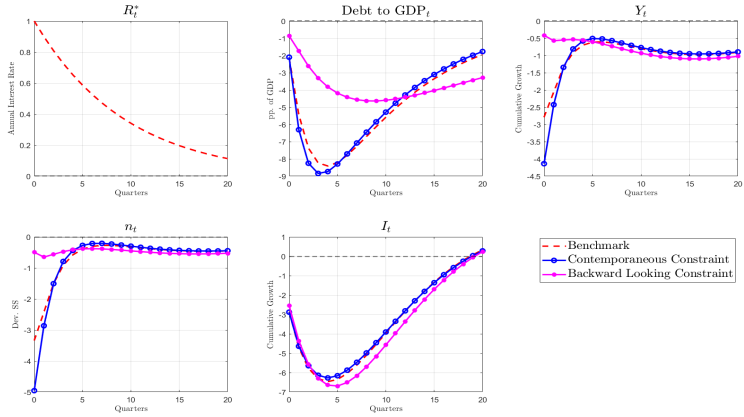
Structural Analysis: IRF R_t^* - Timing of Constraint



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Structural Analysis: New Keynesian Model

- **Intermediate good firms**
  - ⇒ Produce & accumulate capital subject to borrowing constraint
  - ⇒ Rotemberg price adjustment costs
  - ⇒ Domestic & foreign currency borrowing
- **Final good firms:** Consumption, investment, export
  - ⇒ Aggregates domestic & foreign intermediate goods
- Households
  - ⇒ Consume, save in domestic & foreign currency bonds, provide labor
- Government
  - ⇒ Levies lump sum taxes to keep balanced budget
  - ⇒ Monetary Authority follows Taylor Rule
- Exogenous shock
  - ⇒ Foreign interest rate shock R_t^*

Structural Analysis: Final Good Producers

Final good producers: combine domestic & foreign final goods

- Consumption goods

$$C_t = \left[(1-\omega_c)^{\frac{1}{\eta_c}} \left(C_{d,t}\right)^{\frac{\eta_c - 1}{\eta_c}} + \omega_c^{\frac{1}{\eta_c}} \left(C_{m,t}\right)^{\frac{\eta_c - 1}{\eta_c}} \right]^{\frac{\eta_c}{\eta_c - 1}}$$

- Investment good

$$I_t = \left[\gamma_I^{\frac{1}{\nu_I}} I_{d,t}^{\frac{\nu_I - 1}{\nu_I}} + (1-\gamma_I)^{\frac{1}{\nu_I}} I_{m,t}^{\frac{\nu_I - 1}{\nu_I}} \right]^{\frac{\nu_I}{\nu_I - 1}}$$

- Export good

$$X_t = \left(\frac{P_t^x}{P_t^f} \right)^{-\eta_f} Y_t^f$$

Structural Analysis: Government Policy

- Fiscal authority

$$t_t = b_t \left(R_t - \tilde{R}_t \right)$$

- Monetary Policy Taylor Rule

$$\log \left(\frac{R_{d,t}}{R_d} \right) = \rho_R \log \left(\frac{R_{d,t-1}}{R_d} \right) + (1 - \rho_R) \left[r_\pi \log \left(\frac{\pi_t}{\bar{\pi}} \right) \right] + \epsilon_t^R$$

Structural Analysis: New Keynesian Model - Additional Features

- Monopolistic competition

$$y_t = \left[\int_0^1 y_{i,t}^{\frac{1}{\eta}} di \right]^{\eta}, \eta > 1$$

- Domestic & Foreign currency borrowing

$$B_t^{\text{peso}} = \phi^b B_t$$
$$S_t B_t^{\text{dollar}} = \left(1 - \phi^b\right) B_t$$

$$R_{t+1} = \phi R_{d,t} + (1 - \phi) \frac{S_{t+1}}{S_t} R_t^*$$

Structural Analysis: Debt & Equity Frictions

- Flow of funds constraint

$$y_t + \frac{b_{t+1}}{\tilde{R}_t} = \left(1 - \phi + \phi \tilde{R}_t\right)\left(w_t n_t + p_t^m m_t\right) + b_t + i_t + d_t$$

- Borrowing constraint

$$\underbrace{\theta \bar{B}_t}_{\Downarrow} \quad = \quad b_{t+1} + l_t$$

where $\theta < 1$

Structural Analysis: Real Model - Debt & Equity Frictions

- Flow of funds constraint

$$y_t + \underbrace{b_{t+1}}_{\Downarrow} = \left(1 - \phi + \phi \tilde{R}_t\right)\left(w_t n_t + p_t^m m_t\right) + \tilde{R}_t b_t + i_t + \underbrace{d_t}_{\Downarrow}$$

- Borrowing constraint

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where $\theta < 1$

$\Rightarrow$ Firms can reduce debt b_{t+1}, reduce dividends d_t, keep l_t **unchanged**

Structural Analysis: Real Model - Debt & Equity Frictions

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- Borrowing constraint

$$\underbrace{\theta \bar{B}_t}_{\Downarrow} \quad = \quad \underbrace{b_{t+1}}_{\Downarrow} + l_t$$

where $\theta < 1$

Dividend adjustment costs $\Psi\left(d_t\right) = d_t + \psi\left(d_t - \bar{d}\right)^2$

Structural Analysis: Real Model - Debt & Equity Frictions

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where $\theta < 1$

Dividend adjustment costs $\Psi\left(d_t\right) = d_t + \psi\left(d_t - \bar{d}\right)^2 \Rightarrow l_t$ & y_t **decrease**

Back to Model Description

Structural Analysis: Firm's Problem

$$V(s,k,b) = \max \quad d + \mathbb{E}\left[\overbrace{\Lambda'}^{\text{HH.'s SDF}} \times V(s',k',b')\right]$$

subject to

$$y + b' = \left(1 - \phi + \phi\tilde{R}\right)(wn + p^m m) + \tilde{R}b + i + \Psi(d)$$

$$\bar{B} \geq b + l$$

Back to Model Description

Structural Analysis: Borrowing Constraint & Equity Frictions

- Borrowing constraint

$$\underbrace{\bar{B}_t(.)}_{\text{Borrowing limit}} \geq \overbrace{\frac{b_{t+1}}{R_t}}^{\text{Intertemporal}} + \underbrace{l_t}_{\text{Working capital}}$$

- Dividend adjustment cost

$$\Psi(d_t) = d_t + \psi\left(d_t - \bar{d}\right)^2$$

- Example: Optimal debt issuance

$$1 = \mathbb{E}_t m_{t,t+1} \tilde{R}_t + \mu_t \Psi'_{d,t}$$

▸ Back to Borrowing Constraint & Equity Frictions

Structural Analysis: Borrowing Constraint & Equity Frictions

- Borrowing constraint

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- Example: Optimal debt issuance

$$1 = \mathbb{E}_t m_{t,t+1} \tilde{R}_t + \tilde{r}_t \mu_t \Psi'_{d,t}$$

Structural Analysis: Real Model - Firm's Problem

$$\max \quad \mathbb{E}_0 \sum_{t=0}^{\infty} \Lambda_t \times D_t$$

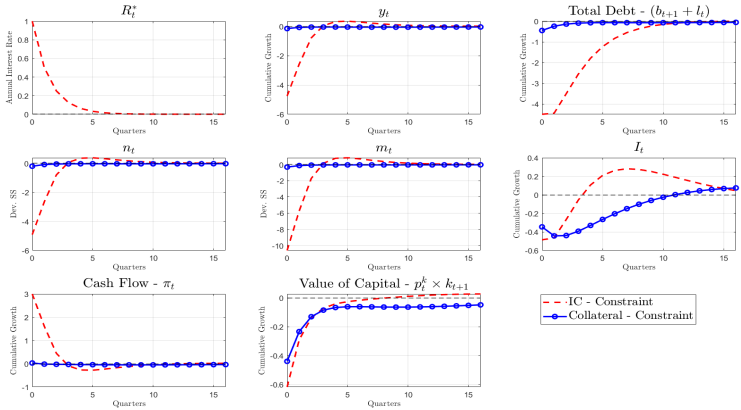
subject to

$$y_t + b_{t+1} = \left(1 - \phi + \phi \tilde{R}_t\right)\left(w_t n_t + p_t^m m_t\right) + \tilde{R}_t b_t + i_t + \Psi\left(d_t\right)$$

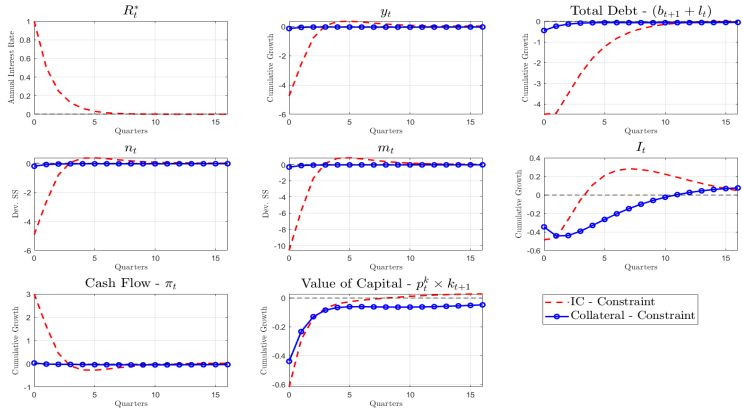
$$\bar{B} \geq b_t + l_t$$

Consider two economies: $\{B_t^k, B_t^{IC}\}$

Structural Analysis: Real Model - IRF R_t^* - $\Uparrow$ 100bp - $\rho_{R^*} = 0.50$

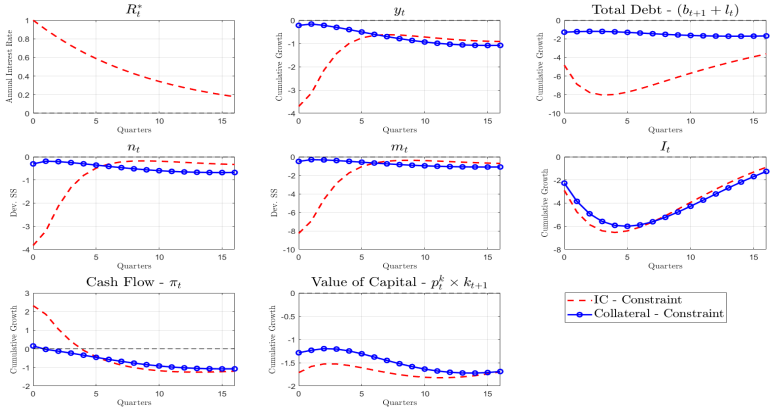


Structural Analysis: Real Model - IRF R_t^* - $\Uparrow$ 100bp - $\rho_{R^*} = 0.50$

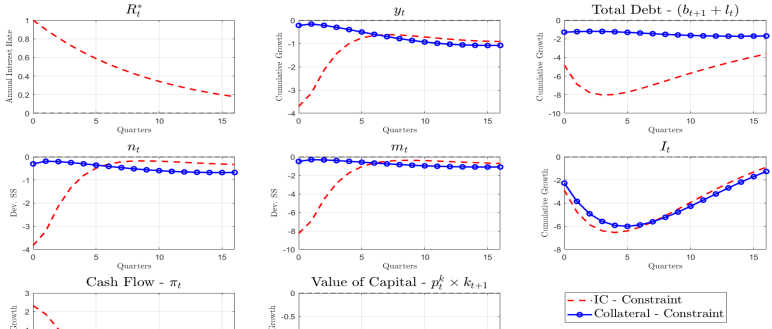


$\Rightarrow$ **IC constraints** lead to orders of magnitude **greater amplification**

Structural Analysis: Real Model - IRF R_t^* - $\Uparrow$ 100bp - $\rho_{R^*} = 0.95$



Structural Analysis: Real Model - IRF R_t^* - $\Uparrow$ 100bp - $\rho_{R^*} = 0.95$

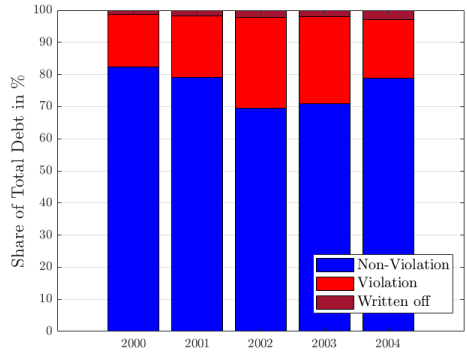


$\Rightarrow$ **IC constraints** lead to **greater amplification**, even with **really high** ρ_{R^*}

Empirical Analysis: Evidence on Violations of Borrowing Constraints

Dynamics around Financial Crisis - 2002

(a) GDP



(b) Borrowing Constraint Violations

▸ Back to Taking Stock ▸ Back to Model Features

Structural Analysis: Borrowing Constraint & Equity Frictions

- Borrowing constraint

$$\underbrace{\bar{B}_t(.)}_{\text{Borrowing limit}} \geq \overbrace{\frac{b_{t+1}}{\tilde{R}_t}}^{\text{Intertemporal}} + \underbrace{l_t}_{\text{Working capital}}$$

- Dividend adjustment cost

$$\Psi(d_t) = d_t + \psi\left(d_t - \bar{d}\right)^2$$

- Labor decision under **cash flow constraints**

$$MPL_t = w_t \left[\overbrace{\left(1 - \phi + \phi\tilde{R}_t\right)}^{\text{Working Capital Wedge}} + \overbrace{\frac{\mu_t}{\frac{1}{\Psi'_{d,t}} + \theta^{IC}\mu_t} \times \phi}^{\text{Borrowing Constraint Wedge}} \right]$$

μ_t is Lagrange multiplier on borrowing constraint

Back to Borrowing Constraint & Equity Frictions

US Monetary Policy - Spillover Puzzle - Econometric Specification - Details

- Emerging Market economies: Argentina, Brazil, Chile, Colombia, Ecuador, Indonesia, Mexico, Peru, Philippines, South Africa, Turkey
- Advanced economies: Australia, Canada, Japan, Korea, Norway, UK, USA

  Time sample: January 2004 to December 2018
- Variables: Industrial Production, CPI, Nominal Exchange Rate, Domestic Lending Rates, Equity Index

Back

Structural Analysis: Real Model - Alternative Calibration

Parameter	Value	Details / target
ϕ_i	Investment Adjustment Cost	2 - between Christiano et al. [2011]
α	Capital share in production	0.32 - Garcia-Cicco et al. [2010]
η	Imported Input share in production	0.10 - Garcia-Cicco et al. [2010]
δ	Capital depreciation rate -	0.1255/4 Garcia-Cicco et al. [2010]
β	Household discount factor	0.9852 - Thoenissen et al. [2014] $\rightarrow R = 6\%$
σ	Household risk aversion	2 - Mendoza [2010]
ϕ	Working capital requirements	0.25 - Mendoza [2010]
ψ	Dividend adjustment cost	0.20 - Jermann and Quadrini [2012]
τ	Tax advantage on debt	0.35 - Thoenissen et al. [2014]
θ^k	Tightness Collateral Const.	0.2279 - Match 35% of Credit to GDP
θ^{DC}	Tightness DC Const.	4.2261 - Match 35% of Credit to GDP
θ^{IC}	Tightness IC Const.	0.0955 - Match 35% of Credit to GDP

h_t in steady state are calibrated to 0.2, net foreign assets are calibrated to match a $TB/GDP = 0.5\%$.

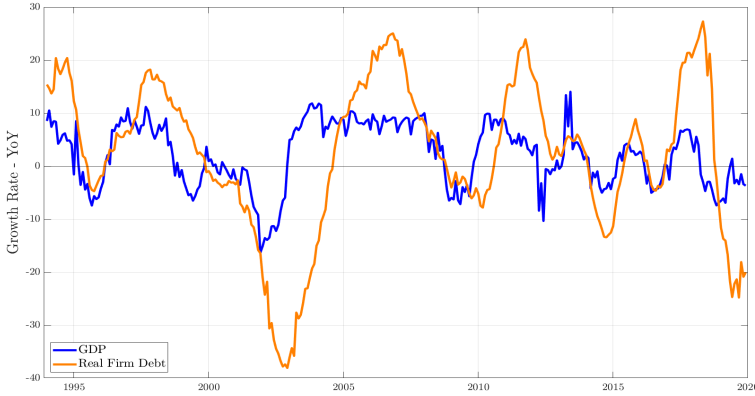
Back to Benchmark Calibration

Empirical Analysis: Collateral vs Cash-Flow Lending - *By sector*

Sector	Collateral Based	Cash Flow Based	Share of Total Debt
Fishing	42.6%	57.4%	0.1%
Transportation, storage and communications	40.8%	59.2%	4.0%
Construction	26.0%	74.0%	4.0%
Health and social services	25.4%	74.6%	1.2%
Education services	22.5%	77.5%	0.3%
Hotels and restaurants	21.9%	78.1%	0.7%
Real estate, business and rental activities	21.9%	78.1%	3.8%
Agriculture, livestock, hunting and forestry	21.0%	79.0%	12.7%
Wholesale, retail and repairs	14.6%	85.4%	20.7%
Manufacturing industry	10.2%	89.8%	35.4%
Utilities (Electricity, gas and water supply)	8.4%	91.6%	1.7%
Exploitation of mines and quarries	5.1%	94.9%	5.9%
Financial intermediation	4.4%	95.6%	4.6%

▸ Sector of activity

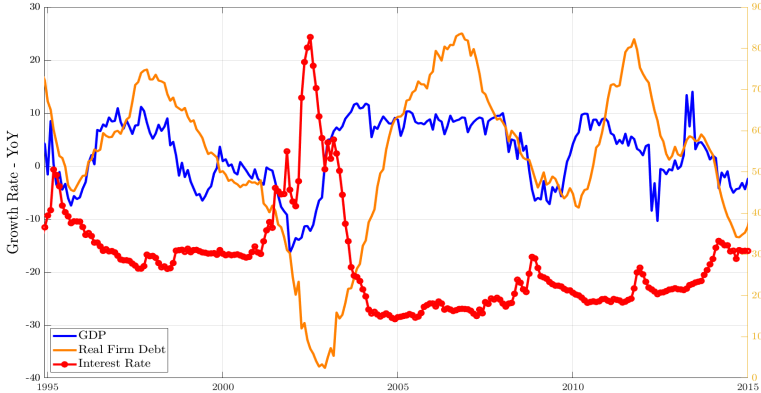
Empirical Analysis: Aggregate Evidence



Firm debt is strongly pro-cyclical & highly volatile

Back to Taking Stock

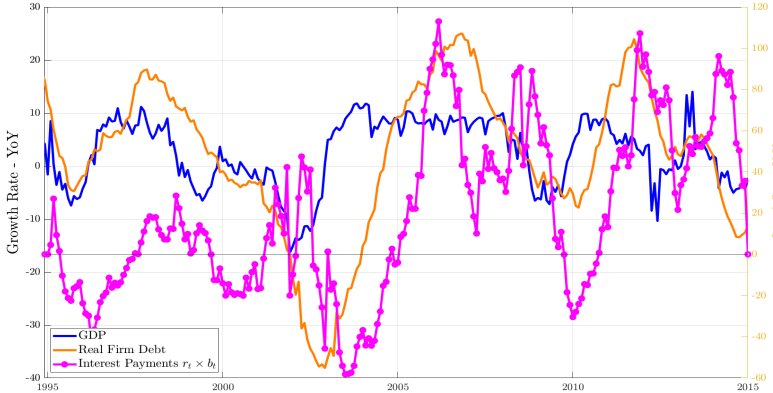
Empirical Analysis: Aggregate Evidence



Interest rates are strongly counter-cyclical

Back to Taking Stock

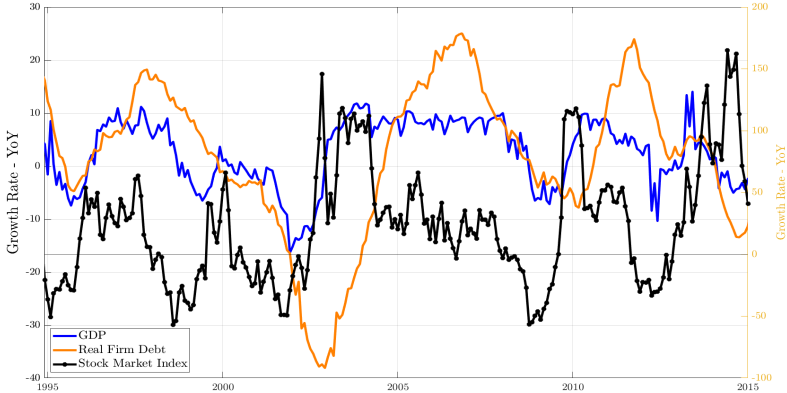
Empirical Analysis: Aggregate Evidence



Interest Payments are pro-cyclical & highly correlated to firm debt

Back to Taking Stock

Empirical Analysis: Aggregate Evidence



Stock market is pro-cyclical & but weakly correlated to firm debt

Back to Taking Stock