Monetary Policy Without Borrowing: Capacity Constraints and Lumpy Investment

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- Does financial access affect the transmission of monetary policy?

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- What aspects of the firm life cycle have we ignored in thinking about investment decisions?

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  - Span-of-control constraint limiting plant growth
  - Upper bound on amount of capital per plant

[Lucas (1978); Caballero & Engel (1999); Cooper & Haltiwanger (2006); Caliendo & Rossi-Hansberg (2012)]

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  - **Key result:** Investment of firms with no debt do not respond to monetary policy surprises.
- Build a model to identify the mechanism capable of reproducing empirical findings.
  - Multi-plant firms with limited span of control and plant-level capacity constraints.
  - **Firms with access:** Build to their ideal plant size immediately and are in an interior solution: $MPK' = R + \delta$.
  - **Firms without access but with desire to grow:** Save to build plants and operate their plants at full capacity: $MPK' > R + \delta$.
  - Firms without access do not respond to changes in the interest rate.

Literature

Section 1: Data Description

Firm Data

- **Tax records**
  - VAT form (F29), monthly: sales, purchase of inputs, purchase of machinery and equipment
  - Matched employee-employer (DJ1887): wage, months worked, etc.
  - Income tax form (F22), annual: balance sheet information (total assets)
  - Universe of firms

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  - Universe of firms
- **Credit Registry**
  - Monthly bank debt stock (C11): type of debt, normal outstanding amount, deteriorated debt amount (defaulted, restructured, in arrears). Source: Financial Markets Commission (CMF).
  - Loans issued (D32): amount, interest rate, type of loan, maturity (**flows**). Source: CMF.
  - Domestic and foreign bond issuance: monthly outstanding amount. CMF / CBCh
  - Universe of loans (stock and flow)

Firm-Level Data

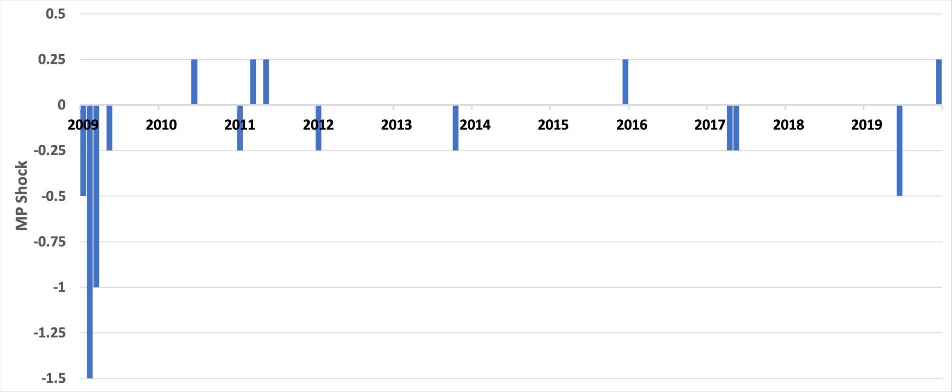
	Mean	Median	S.D.	95th Perc.
Sales*	324	43	1308	1142
Capital stock*	941	27	26000	1224
Total assets*	7666	434	41057	22034
Investment*	4.8	0	30	14
Share of Positive Investment (N° obs)	20.6	20.6	0	20.6
Age	12	10	7.1	24
N° employees	58	14	165	230
Normal debt stock*	509	16	2351	1838
Bad debt stock*	2.8	0	24	0
Total debt*	512	17	2352	1844
Sale-asset ratio	0.2	0.1	0.3	0.6
Leverage ratio	0.2	0.1	0.3	0.7
N° firms	57,459			
Observations	4,718,460			

Summary statistics of firm-level variables for the period 2009m1 to 2019m12. *All currency related variables in million pesos (CLP).

Cleaning criteria

Monetary Policy Surprises

- Deviations of Bloomberg forecast for each MP meeting from the actual MPR decision taken. Source: Aruoba et al (2021).
- 5 positive surprises and 10 negative surprises, mode is 25bp.



Table

Section 2: Empirical Analysis

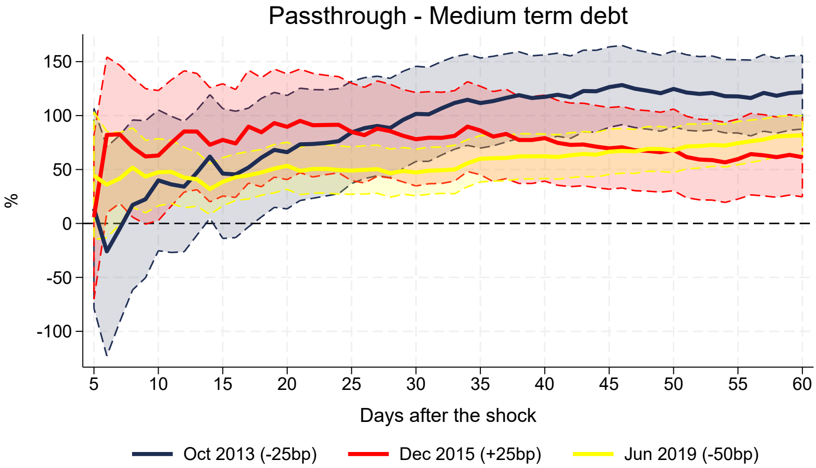
Result #1: Interest Rate Transmission

- Do MP surprises affect the borrowing cost of firms?
- Event study around 3 specific episodes for medium term (3-12 months) debt.
- Let $d = 5, 6, ..., 60$ (number of days after the MP surprise)

$$\ln\left(1 + r_{jt}\right) = \alpha_j + \beta_d D_t^d + \beta_x X_{jt} + \epsilon_{jt}, \text{ where } t = s - 30, s - 29, ..., s - 1, s + 1, ..., s + d$$

- r_{jt} is interest rate paid by firm j on day t for a new loan.
- α_j firm fixed effects.
- D_t^d is a dummy variable that takes value 1 for $t > s$.
- X_{jt} is a set of linear controls for each loan such as duration, maturity.
- Standard errors clustered at the firm level.

Result #1: Interest Rate Transmission



- Within the first 20 days we see a 70% pass-through from MP to commercial rates.

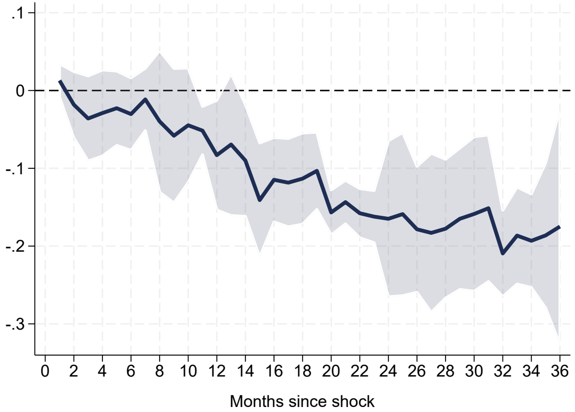
Result #2: Cumulative Investment Response

- Effect of MP surprises on investment across all 15 MP surprises.

$$\ln\left(K_{j,t+h}\right) - \ln\left(K_{jt}\right) \approx \sum_{i=t}^{h}\left(\frac{i_{j,t+h}}{A_{j,t+h}}\right) = \alpha_j + \alpha_{sq} + \beta_h \varepsilon_t + \beta_x X_{jt} + \epsilon_{j,t+h}$$

- i_{jt} is investment, h is the horizon of the projection
- α_j firm fixed effects firm, α_{sq} industry-time (quarter) fixed effects
- ε_t (MP surprise) is the main explanatory variable of interest
- X_{jt} is a set of linear controls including size (employment) (-), age (-) , sale-asset ratio (+), leverage (total debt/asset ratio) (-), bad debt ratio (-)
- Double cluster for standard errors at the firm level and industry-time (quarter) level.

Result #2: Cumulative Investment Response



- The **effect** becomes significant at 11 months onward and **stabilizes at 23 months**.
- A 100bp MPS decreases the accumulated investment to total assets by 0.2%, or a decrease in the stock K of 3.19% after 24 months.

Table

Result #3: The Financial Channel: Access to Debt

- How does **access to debt** shape the investment effect of MP?

$$\sum_{i=t}^{h}\left(\frac{i_{j,t+h}}{A_{j,t+h}}\right) = \alpha_j + \alpha_{sq} + \beta_h \varepsilon_t + \beta_{h,d}(\varepsilon_t \times D_{jt}) + \beta_x X_{jt} + \epsilon_{j,t+h}$$

- D_{jt} a dummy that takes value 1 if firm j has bank debt in period t.

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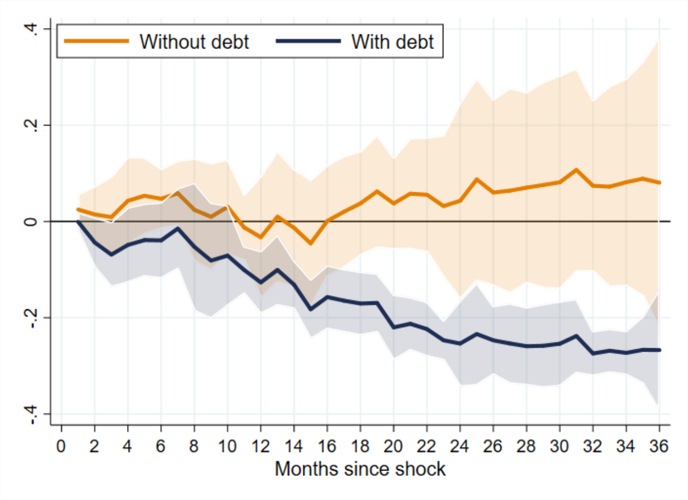

- **The investment response is driven by firms with debt access** Baseline LP Figure Leverage and O&W

Firms' Access to Debt

- Some facts:
  - In any given month 75% of firms have a stock of debt.
  - 8.5% of firms never have debt.
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- 2010 cohort of firms:
  - 60% born without debt.
  - 40% born with debt.
  - 76% have debt within first 5 years.

Firms' Access to Debt

Table: Firm-Month with Debt

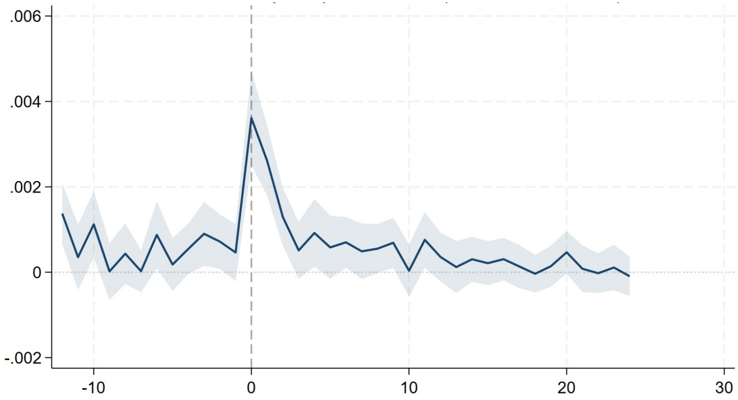
	p25	p50	p90
Sales	19	**52**	591
Capital stock	9	**33**	574
Total assets	164	**533**	9,886
Investment	0	0	**3.7**
Age	6	**11**	22
N^{o} employees	8	**17**	131
Total debt	8	53	1028
Observations	3,544,034		

Table: Firm-Month without Debt

	p25	p50	p90
Sales	9	**24**	216
Capital stock	3	**13**	209
Total assets	67	**217**	3,980
Investment	0	0	**0.6**
Age	4	**10**	22
N^{o} employees	5	**10**	53
Total debt	0	0	0
Observations	1,174,426		

- Median firms with debt are 70% larger in employment and 1 year older than median firms without debt.

What Happens to Investment when Firms Get Access?



- Investment / assets: pre-access (12m) vs. post-access (24m). FE: firm + time. Controls: age, sales, employment. More Details
- First time borrowing is associated with a sharp and lumpy increase in investment. ($\approx$ 0.35%)

Section 3: Model

Model primitives

- **Technology**
  - Firms have permanent productivity z
  - Per-plant production: $y = zk^{\alpha_k}\ell^{\alpha_\ell}, \qquad \alpha_k, \alpha_\ell \in (0,1), \alpha_k + \alpha_\ell < 1$
  - Total production: $Y = n^{\xi}y = z\,n^{\xi}k^{\alpha_k}\ell^{\alpha_\ell}. \qquad \xi \leq 1$ (span of control)
  - Resourcers split equally across plants: $K = nk$ and $L = n\ell$. (this is optimal)

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  - Resourcers split equally across plants: $K = nk$ and $L = n\ell$. (this is optimal)
- **Lumpy capacity**
  - Plants are discrete and costly
  - Adding a plant costs F,
  - Plants are discrete and irreversible: $n \in \mathbb{N}$ and $n' \geq n$.
  - Capacity constraint: $k \leq \bar{k}$.

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- **Financial access.** Two regimes:
  - No Access: no borrowing, $b' \geq 0$.
  - Access: can borrow freely, $b' \in (-\infty, \bar{b}]$.
  - No default. Borrow (if have access) and save using 1-period real bond with interest rate R.

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$$W \equiv b + nk + Fn, \qquad p'(W) > 0, \quad 0 \leq p(W) \leq 1.$$

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$$W \equiv b + nk + Fn, \qquad p'(W) > 0, \quad 0 \leq p(W) \leq 1.$$
- **Exit and entry.** Firms exit with probability $(1 - \zeta)$ each period; entry replaces exit.

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- Labor demand problem of a firm that starts the period with (n, k) and facing wage w.

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- $(1+R)\beta = 1$. Indifferent between dividends and b'. (Pay when $b' \geq \bar{b}$.)

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- Define the marginal product of total capital $K \equiv nk$ as

$$MPK(z,n,k) \equiv \frac{\partial \pi(z,n,k)}{\partial (K)} \propto z^{\frac{1}{1-\alpha_\ell}} n^{\frac{\xi-1}{1-\alpha_\ell}} k^{\frac{\alpha_k+\alpha_\ell-1}{1-\alpha_\ell}}.$$

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- Optimal capital given number of plants $MPK(z,n,\hat{k}(n,r)) = R + \delta$

$$\hat{k}(z,n,R) \propto z^{-\frac{1}{\alpha_k+\alpha_\ell-1}} n^{-\frac{1-\xi}{1-(\alpha_k+\alpha_\ell)}} (R+\delta)^{-\frac{1-\alpha_\ell}{1-(\alpha_k+\alpha_\ell)}}.$$

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- $\hat{k}$ is (weakly) decreasing in n (strictly if $\xi < 1$) and strictly decreasing in R.
- Denote $k^*(z,n,R) = \min(\hat{k}(z,n,R), \bar{k})$.

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- Optimal capital given number of plants $MPK(z,n,\hat{k}(n,r)) = R + \delta$

$$\hat{k}(z,n,R) \propto z^{-\frac{1}{\alpha_k+\alpha_\ell-1}} n^{-\frac{1-\xi}{1-(\alpha_k+\alpha_\ell)}} (R+\delta)^{-\frac{1-\alpha_\ell}{1-(\alpha_k+\alpha_\ell)}}.$$

- $\hat{k}$ is (weakly) decreasing in n (strictly if $\xi < 1$) and strictly decreasing in R.
- Denote $k^*(z,n,R) = \min(\hat{k}(z,n,R), \bar{k})$.
- Optimal plant size $n^*(z,R)$: ideal scale.

Firm with Access

$$V^A(b,k,n) = \max_{n',k',b',d} \left\{ d + \beta \left[\zeta V^A(b',k',n') + (1-\zeta)\Phi(b',k',n') \right] \right\}$$

s.t.

$$d + b' = (1+r)b + \pi(n,k) + (1-\delta)nk - n'k' - F(n'-n), \qquad d \geq 0,$$

$$n' \in \{n, n+1, \dots\}, \quad k' \in [0,\bar{k}], \quad b' \in (-\infty, \bar{b}].$$

Proposition: Immediate scale-up.

From any state (b,k,n), a firm with access chooses

$$n' = n^*(z,R), \qquad k' = k^*(z, n^*(z,R), R) \text{ and } b' \text{ as low as necessary.}$$

and every period they will be "on their Euler equation" with $MPK(z,n,k) = R + \delta$.

Firm with No Access

$$V^N(b,k,n) = \max_{n',k',b',d} \left\{ d + \beta \left[\zeta \, \widetilde{V}(b,k,n;b',k',n') + (1-\zeta)\Phi(b',k',n') \right] \right\}$$

where the continuation value reflects possible access next period:

$$\widetilde{V}(b,k,n;b',k',n') = p(W)\, V^A(b',k',n') + \big(1 - p(W)\big)\, V^N(b',k',n'), \qquad W = b + nk + Fn.$$

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  - Otherwise $k' = \dfrac{X}{n'}$ and $b' = 0$. "Off Euler Equation"
- Note: Off Euler Equation means $MPK(z, n', k') > R + \delta$ and $b' = 0$.
  $\Rightarrow$ "Wealthy hand-to-mouth" firms.

Calibration, Equilibrium and Stationary Distribution

Object	**Symbol(s)**	**Value**
Technology / span of control	$(\alpha_k, \alpha_\ell, \xi)$	(0.60, 0.30, 0.95)
Depreciation	δ	0.025
Interest rate (baseline)	R	0.025
Labor Supply	$\bar{L}$	0.57
Cost of building a plant	F	0.24
Exit probability	$1 - \zeta$	0.01
Per-plant capacity	$\bar{k}$	1.2
Access probability	$p(W)$	$(\bar{p}, \kappa) = (0.5,\ 0.05)$
Productivity $z \in \{0.67, 0.695, 0.72, 0.745, 0.77\}$ with probability $(0.14, 0.23, 0.28, 0.21, 0.15)$		

- **General Equilibrium:** w clears the market: $\bar{L} = \int n\,\ell(n,k;z,w)\,d\mu(z,a,b,k,n)$

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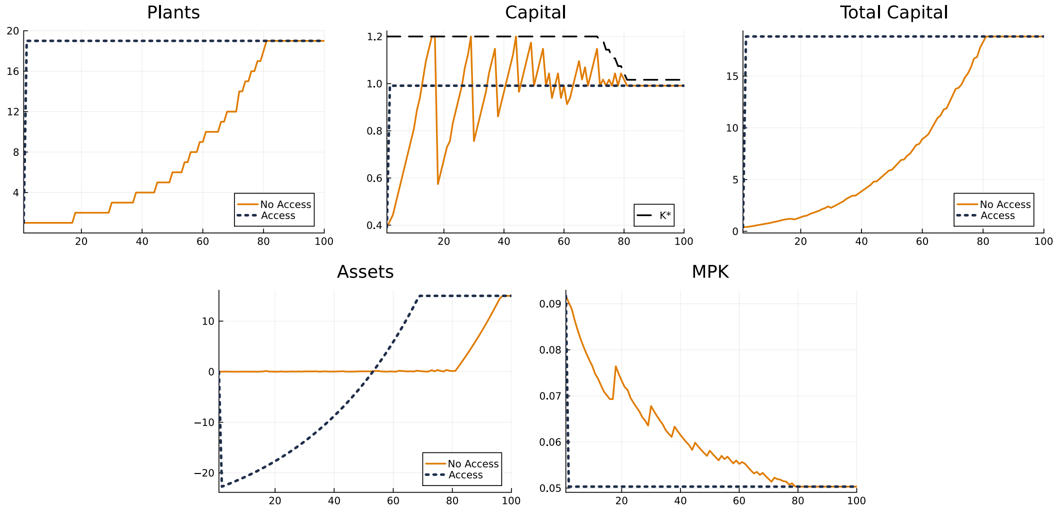
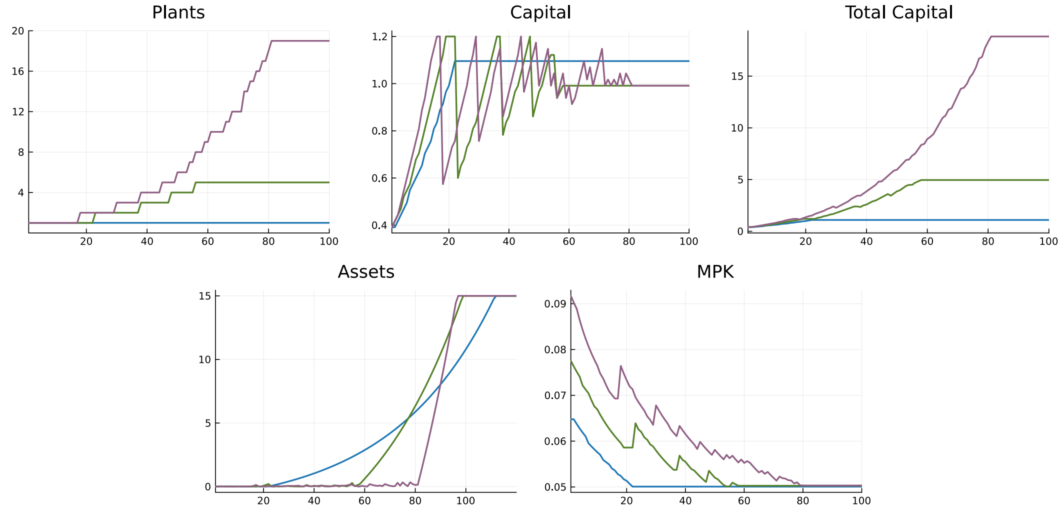
- Most plants are built when firms gain access; organic expansion typically requires selling capital to finance the fixed cost.
- Among no-access firms, 18% are still below target scale.

Life cycle (high z type): Access vs No Access

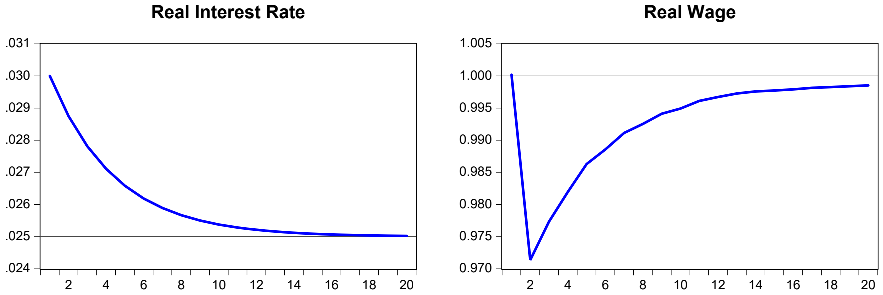


Life cycle (No Access only): Heterogeneity by z

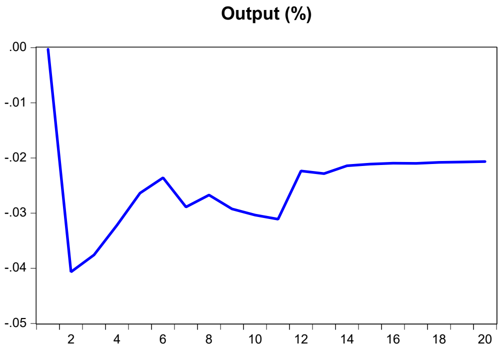


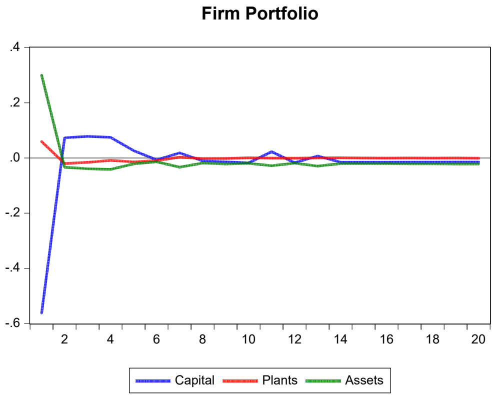
Monetary Policy Exercise

- Model is at the steady state in period $t = 0$.
- In period $t = 1$ interest rate goes up to 3% (a 50 bps increase) and returns to 2.5% in 20 periods.
  - Real Model. Assume prices are fully rigid and the nominal rate change is passed through to real rate.
- Solve for the perfect foresight transition in general equilibrium (wage adjusts).



Monetary Policy Exercise - Aggregate Responses





- Output contracts 4% in $t = 2$ and remains depressed.
- Firms drastically cut their capital expenses, slightly increase their plant building and grow assets in $t = 1$.

Monetary Policy Exercise - Micro Responses on Impact

Group	Share	Same K	Same n	New K	New n	New b
Access, At Target	77	0	90	-0.69	0.10	0.34
No Access, At Target	5	47	90	-0.13	0.23	0.07

- At-target firms reduce investment, increase assets. Access firms all change their investment.

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New Access	1	1	25	-2.86	-3.43	3.68
No Access, Newly Born	1	99	99	-0.04	-0.05	0.05

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No Access, Newly Born	1	99	99	-0.04	-0.05	0.05
All	100	19	90	-0.56	0.06	0.30
Access	78	0	89	-0.71	0.07	0.38
No Access	22	86	96	-0.03	0.03	0.02

- At-target firms reduce investment, increase assets. Access firms all change their investment.
- No-access firms not at target largely do not respond.
- New access and newly-born firms cut investment and plant building and buy assets.
- Large heterogeneity based on access. Aggregate response depends on share.

Conclusion

- **Question.** How does debt access shape the firm-level transmission of monetary policy?
- **Empirics.**
  - Monetary policy shocks pass through strongly to the rates firms pay on debt.
  - Firms with debt cut investment sharply and persistently after a tightening.
  - Firms without debt show little investment response on impact.
- **Mechanism (model).** With lumpy capacity expansion and borrowing frictions, firms early in the life cycle are often constrained ($MPK \gg r + \delta$), so small changes in r have weak effects; firms with access operate near $MPK = r + \delta$, so investment responds immediately.
- **Why it matters.** Monetary policy effectiveness depends on the economy's **composition**: the distribution of firms across life-cycle stages and debt access (and how that distribution shifts over time).
- **Next step.** Calibrate the model to direct targets from Chilean data and verify rich predictions of model.

THANKS!

Literature - Three Strands

1. **Heterogeneity in Firms' Responses to Monetary Policy**
   Financial Frictions & Balance-Sheet Strength: Gertler & Gilchrist (1994); Bougheas et al. (2006); Jimenez et al. (2012); Ippolito et al. (2018); Bahaj et al. (2019); Ottonello & Winberry (2020); González et al. (2023); Anderson & Cesa-Bianchi (2024); Caglio et al. (2024); Lakdawala et al. (2024); Jeenas (2025).
   Liquidity, Internal Funds & Capital Structure: Bahaj et al. (2019); Cloyne et al. (2023); Albrizio et al. (2024); Beyhaghi et al. (2024); Lakdawala et al. (2024); Jeenas (2025).
   Firm Lifecycle: Age, Size & Adjustment Costs: Crouzet & Mehrotra (2020); Durante et al. (2022); Krusell, Thürwächter & Weiss (2023).
   We document that access to debt shapes the way firms respond to monetary policy.
2. **Span of Control, Lumpy Investment & Firm Dynamics**
   Span of Control & Managerial Constraints: Lucas (1978); Rosen (1982); Garicano (2000); Caliendo & Rossi-Hansberg (2012).
   Lumpy Investment & Non-Convex Adjustment Costs: Caballero & Engel (1999); Cooper & Haltiwanger (2006); Gourio & Kashyap (2007); Asker et al. (2014); Bachmann & Bayer (2014).
   Empirical facts are accounted for with a setup that integrates span-of-control constraints and lumpy scale adjustment into a monetary-policy environment.
3. **Monetary Policy Surprises & Identification**
   High-Frequency Surprises as External Instruments: Gertler & Karadi (2015); Jarocinski & Karadi (2020); Aruoba et al. (2021).
   We extend this identification approach to the universe of Chilean firms, showing how MP surprises map into sharply heterogeneous investment responses depending on firms' access to finance.

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Criteria for data cleaning

1. Drop basic utilities and public administration
2. Keep firms that have invested at least twice
3. Keep observations with 3 or more employees.
4. Drop observations of sale = 0.
5. Keep firms with at least one run of 12 consecutive months or more
6. Keep firms with consistent data reporting. Keep firms reporting more than 75% of the possible months (from birth to death) that is present at the sample. An observation with sale = 0 is not considered as a reporting month.
7. Drop if observations have no info on assets
8. Winsor (variables: employment, age; ratios: investment, sales)

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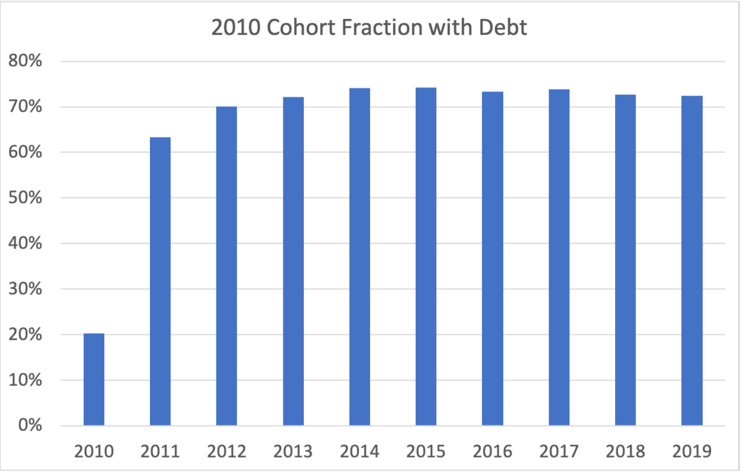
2010 Cohort Debt Access



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Monetary Policy Surprises

- Deviations of Bloomberg forecast for each MP meeting from the actual MPR decision taken. Source: Aruoba et.al (2021).
- 5 positive surprises and 10 negative surprises, mode is 25bp.

Jan-2009	-0.50	**Jan-2012**	-0.25
Feb-2009	-1.50	**Oct-2013**	-0.25
Mar-2009	-1.00	**Dec-2015**	+0.25
May-2009	-0.25	**Apr-2017**	-0.25
Jun-2010	+0.25	**May-2017**	-0.25
Jan-2011	-0.25	**Jun-2019**	-0.50
Mar-2011	+0.25	**Dec-2019**	+0.25
May-2011	+0.25		

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Financial Flow Data

Table: Summary Statistics of Financial Flow Data - Preliminary

	Mean	Median	S.D.	95th Perc.
Loans (MM $CLP)	79.4	2.6	392	258
Duration CLP (months)	9.5	2.4	28.4	37.3
Annual interest rate (%)	8.9	6.7	6.7	23.1
Nº observations	7,106,021			

Summary statistics of loan-level observations for the period 2012m4 to 2019m12. The values shown in the table have already being winsorized at the top and bottom 0.5%.

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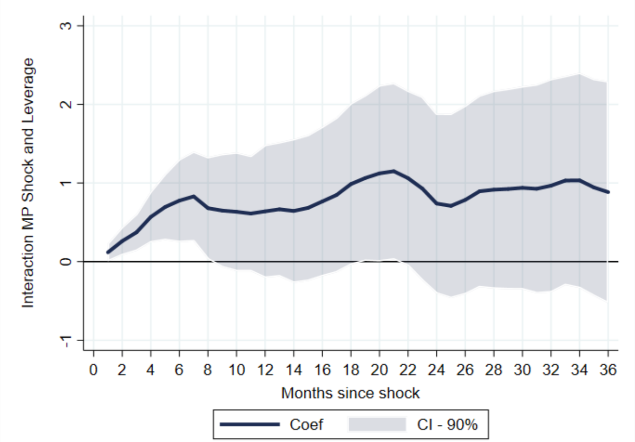
Result #5: Importance of Finance: Leverage



$$\sum_{i=t}^{h}\left(\frac{i_{j,t+h}}{A_{j,t+h}}\right) = \alpha_j + \alpha_{st} + \beta_{l,h}(\varepsilon_t \times L_{jt}) + \beta_x X_{jt} + \epsilon_{j,t+h}$$

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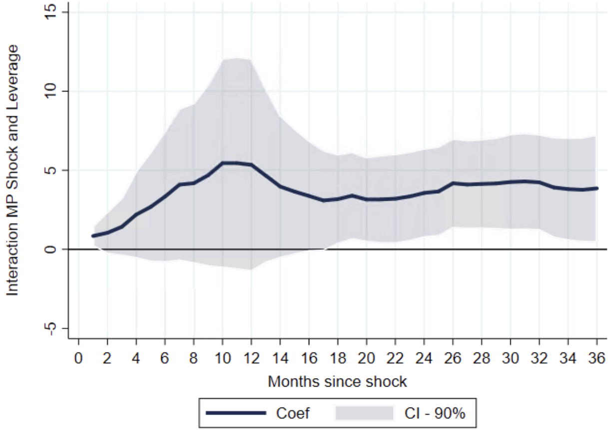
Result #5a: Importance of Finance - O&W (2020)



- Restricting our sample to public firms with debt, we find that firms with high leverage are consistently less responsive to the shock (as in Ottonello and Winberry, 2020)

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Event Study: Firm Getting Access to Debt

- **Identifying the Debt Event - For a an event at period (t)**
  - Firm does not have debt 18 months prior to period (t).
  - Firm exists at least 12 months prior to period (t) and 24 months after.
  - Firm acquires debt at period (t) and keep a positive debt stock for the next 4 months (until t+4).
  - Only observations for firms with at least an event is kept. 2,328 firms/254,033 observations.

$$\frac{i_{jt}}{A_{jt}} = \alpha_j + \alpha_t + \sum_{k=-12}^{24} \beta_k D_{kjt} + \beta_x X_{jt} + \epsilon_{jt}$$

- i_{jt} is investment, A_{jt} is the total assets
- α_j firm fixed effects firm, α_t time fixed effects
- D_{kjt} is dummy indicating period k relative to the event.
- X_{jt} is a set of linear controls including size (employment), age, sale-asset ratio
- Double cluster for standard errors at the firm level and time level.

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