Liability Dollarization and Exchange Rate Pass-Through to Domestic Prices

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Motivation: Strong Dollar & Spillover to Emerging Markets

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- The **negative balance sheet effect** of $ debt on **domestic inflation** is neglected in the literature.

Research Question

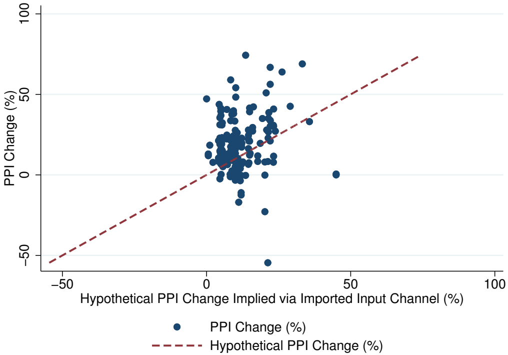
1. How do firms' pricing decisions vary with different levels of FC debt?

2. How significant is this balance sheet effect of FC debt
in explaining the exchange rate pass-through to domestic producer inflation?

Motivation: Domestic PPI Across Manufacturing Sectors in Korea

- From 1996-98, Realized PPI changes vs. $\underbrace{\text{PPI changes implied via the imported input channel}}_{\text{Imported Input Share} \times \Delta\text{Imported Input Price}}$

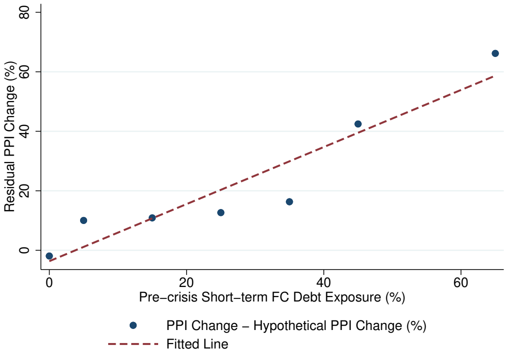
  assuming (i) Cobb-Douglas production function with CRTS, and (ii) a complete pass-through



- The imported input channel is in fall short of generating the level of PPI changes upon a large depreciation. Cross-country

Motivation: Positive Correlation Between FC Debt Exposure and Residual PPI Changes

- $\underbrace{\text{Unexplained PPI changes}}_{\text{Realized PPI changes - Implied PPI Changes via Imported Input Channel}}$ and Pre-crisis Short-term FC debt exposure



- Relatively neglected balance sheet channel may account for the much pronounced increase in domestic producer prices. Another Measure: Short-term FC Debt/Total Debt

Literature Review

Exchange Rate Pass-Through to Prices

- Exchange rate pass-through to domestic prices

  Goldberg, Campa (2010), Amiti, Itskhoki, Konings (2019)

⇒ **Exploring the neglected balance sheet channel in the exchange rate pass-through to prices**

  Ma, Schmidt-Eisenlohr (WP, 2023), Reinhart, Rogoff, Savastano (WP, 2003)

Contractionary Effects of Foreign Currency Debt

- Empirical and theoretical investigation of negative balance sheet effects on firm performance

  Krugman (1999), Aghion, Bacchetta and Banerjee (2001), Céspedes, Chang, Velasco (2004), Choi and Cook (2004), Kim, Tesar, Zhang (2015), Kalemli-Ozcan, Kamil, Villegas-Sanchez (2016), Kohn, Leibovici, Szkup (2018), Bruno, Shin (2023), Casas, Meleshchuk, Timmer (WP, 2023)

⇒ **Balance sheet effects of foreign currency debt on prices**

Financial Frictions and Firms' Pricing Decisions

- Closed Economy Setting

  Gilchrist, Schoenle, Sim, Zakrajšek (2017), Christiano, Eichenbaum, Trabandt (2015), Del Negro, Giannoni, Schorfheide (2015), Kim (2021), Renkin, Züllig (2023)

⇒ **Open economy setting in the sudden stop episodes with dollar debt and a large depreciation**

Summary

(1) Exploiting **a large devaluation** in Korea in 1997, we identify the **balance sheet channel**

Firms with high ST FC debt exposure

(ii) $\downarrow$ net worth growth, $\downarrow$ sales growth, and $\downarrow$ **markup growth**

Industries populated by firms with high ST FC debt exposure

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(i) An industry equilibrium & its transition dynamics upon an **unexpected depreciation**

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(3) The estimated model performs quantitatively well in explaining sectoral price dynamics

(4) A quantitatively sizable role of the balance sheet channel in explaining sectoral price dynamics

(i) 20% to 80% of the sectoral price changes during the devaluation

Empirical Analysis

Empirical Strategy & Data

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Firm-level balance sheet data: KISVALUE Dataset

1. **currency composition & maturity** of their debt:
   foreign currency vs. domestic currency, short-term vs. long-term ▸ Summary Stats
2. not only large but small and medium-sized firms:
   $\approx$ 3,000 firms in manufacturing sector (as of 1996)
3. a rich set of firm-level variables to mitigate concerns about potential endogeneity bias:
   e.g., liquid assets in LC & in FC, sales & exports ▸ Corr

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  Domestic Produce Price Index (PPI) for 156 industries in manufacturing sector (4-digit).

⋆ We exploit **a large devaluation** in Korea in 1997 & different **FC debt exposure** across firms and thus, across industries to identify the balance sheet effect on the exchange rate pass-through to domestic output prices. ▸ Won per $

What Makes 1996-1998 A Good Period for Identification?

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   "Korea has strong fundamentals, unlike Latin American countries and Thailand; therefore, the probability of Korea facing a currency crisis is abysmal "
   – BIS Chair, Alfons Verplaetse (Sept 1997)
   "One of the most unusual aspects of the Asian crisis is the extent to which it was unpredicted by market participants and market analysts"
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3. **Lack of regulation on FC borrowing**
   - no quantity regulation for both short-term and long-term FC debt
   - forcing firms to reveal the purpose of the loan for long-term borrowing only

Firm-level Investigation: Negative Balance Sheet Effects of Corporate Dollar Debt

$$\Delta y_{j,96-98} = \beta_0 + \beta_1 \text{ ST FC}_{j,96} + \beta_2 \text{LT FC}_{j,96} + \beta_3 \text{Size}_{j,96} + \beta_4 \text{ ST FC}_{j,96} \cdot \text{Size}_{j,96} + \beta_5 \text{ LT FC}_{j,96} \cdot \text{Size}_{j,96} + \beta_6 X_{j,96} + \epsilon_i$$

- Δy_j: the growth rates of firm j's y variables in 1996-98.
- y includes (1) net worth, (2) sales and (3) **estimated mark-ups**. ▸ mark-up estimation

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- LT FC$_j$: long-term foreign currency debt to total long-term debt of firm j correlation
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- X_j includes: leverage ratio (total debt to total assets ratio), short-term debt to total debt ratio, export/sales ratio, FC cash ratio, and industry fixed effects.

Firm-Level Investigation: Negative Balance Sheet Effects of Corporate Dollar Debt

- Firms with higher foreign currency debt exposure have lower mark-up growth during the crisis.

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	Net Worth Growth	Sales Growth	Markup Growth
ST FC	-1.4963*	-10.1710***	-0.8919***
	(0.7783)	(3.0596)	(0.2151)
LT FC	-0.2631	0.2174	0.1761
	(0.6347)	(2.2590)	(0.1638)
ST FC x Size	0.0596*	0.4109***	0.0348***
	(0.0311)	(0.1202)	(0.0085)
LT FC x Size	0.0124	0.0056	-0.0067
	(0.0257)	(0.0903)	(0.0066)
Adjusted R^2	0.0472	0.1319	0.0418
N	3169	3169	3167

Other Dependent Variables | Controlling More Cross Products | Figures | Another Definition

Industry-level Investigation

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▸ correlation

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  correlation
- X_i includes:
  - **Imported input** channel: imported intermediate input share
  - Other *industry-level* pass-through determinants: degree of the product differentiation (Rauch classification), degree of price stickiness
  - Weighted average of other **firm-level** variables: log of real sales, leverage ratio, short-term debt ratio, **export/sales ratio**, and FC cash/total current assets ratio
  - Broad **industry fixed effects** (two-digit)

Empirics: Industry-Level Analysis

- Industries with high foreign currency exposure increase their prices more during the crisis.

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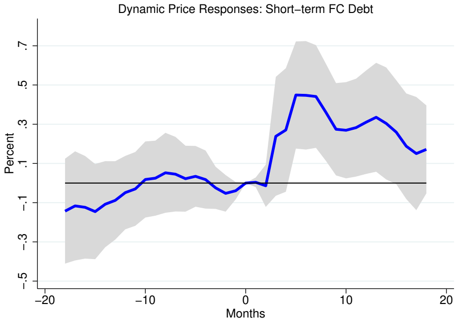
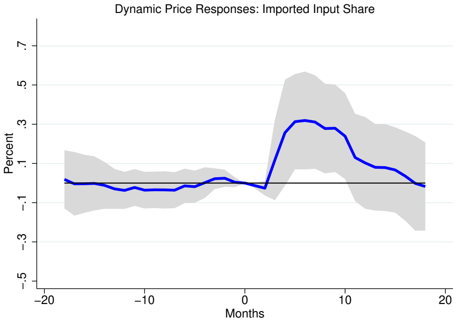
	(1)	(2)	(3)	(4)	(5)
ST FC	0.6950***	0.7109***	0.6722***	0.6565***	0.5685***
	(0.1607)	(0.1856)	(0.1783)	(0.2162)	(0.2038)
LT FC		-0.0295	-0.1302	-0.1899	-0.1846
		(0.1173)	(0.1245)	(0.1351)	(0.1365)
Rauch Dummy					0.0075
					(0.0447)
Imported Input Share					0.2830*
					(0.1656)
Degree of Price Stickiness					0.0317*
					(0.0168)
Broad Industry FE	No	No	Yes	Yes	Yes
Average Firm-level characteristics	No	No	No	Yes	Yes
Adjusted R^2	0.1400	0.1348	0.4245	0.4439	0.4513
N	156	156	156	156	156

w/o Outliers | Firm Exit | Domestic Firms Only | Pre-trend in Δp_i | Another Definition
Pre-crisis | Pre-crisis w/o Outliers | 2000∼2019 panel | 2000∼2019 panel: Appreciation vs. Depreciation

Local Projection: Dynamic Responses of Monthly PPI

$$\frac{p_{i,1997m9+h} - p_{i,1997m9}}{p_{i,1997m9}} = \beta_h + \beta_{1,h} \text{ST FC}_{i,96} + \beta_{2,h} \text{LT FC}_{i,96} + \beta_{3,h} X_{i,96} + \epsilon_{i,h}$$





Quarterly LT FC Debt

Empirics: Takeaway

During **a large devaluation** in Korea in 1997,

1. Firms with high ST FC debt exposure $\Downarrow$ sales growth, $\Downarrow$ networth growth and $\Downarrow$ markup growth

2. Industries with high ST FC debt exposure $\Uparrow$ their prices more

Model

Model Overview

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- Firms face two types of **financial** frictions: working capital constraints and collateral-based leverage constraints ▸ Working Capital ▸ Leverage
- We assume that the economy is in the stationary equilibrium before **one-time unexpected** real exchange rate depreciation.
- We analyze the **transition dynamics** of industry price for each of 156 industries ▸ Transition

Model Mechanism

- Firm j's optimal pricing decision is

$$p_{j,t} = \mu_{j,t} mc_{j,t} \qquad \underbrace{(1 + \eta_{2,j,t})}_{\uparrow \text{ tighter working capital constraints}}$$

- Balance sheet deterioration has an effect on price by

(i) Investment adjustment

Balance sheet deterioration $\Rightarrow$ $\downarrow$ Investment $(k_{j,t+1})$ $\Rightarrow$ $\downarrow$ productivity $\Rightarrow$ $\uparrow$ $mc_{j,t+1}$

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Balance sheet deterioration $\Rightarrow$ $\downarrow$ Liquid Assets $(a_{j,t+1})$ $\Rightarrow$ $\uparrow$ $\eta_{2,j,t+1}$

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Balance sheet deterioration $\Rightarrow \downarrow$ Liquid Assets $(a_{j,t+1}) \Rightarrow \uparrow \eta_{2,j,t+1}$

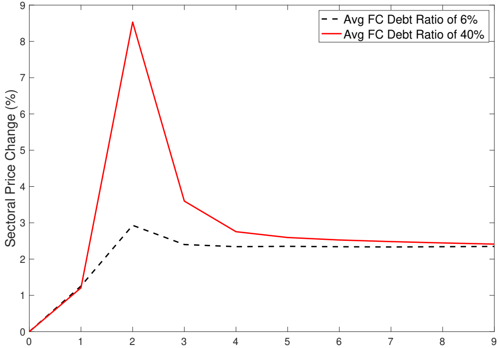
- **Strategic Complementarity** allows additional channel via the adjustment of $\mu_{j,t+1}$

▸ Policy function of k' ▸ Policy function of η_2' ▸ Policy function of a' ▸ Policy function of p" ▸ Policy function of μ"

Quantitative Analysis

Industry-Level Analysis

- Industry price dynamics upon **unexpected** large depreciation at period 1
- Industries with imported input share $= 0.1$



▸ Parameters

Model: Industry-Level Analysis

- Marginal Effect of FC Short-term Debt Ratio on Price Changes in Crisis (Data vs. Model)

$$\Delta p_{I,0-2} = \beta_0 + \beta_1 \text{ ST FC}_{I,0} + \beta_2 \text{ Imported Input Share}_I + \epsilon_I$$

	Data	Model
ST FC	0.5685	0.1637
	(0.2038)	
Imported Input Share	0.2830	0.2223
	(0.1656)	
R^2	0.4316	0.9800
N	156	156

- The model can explain more than 20% of the variation in price changes across industries.
- The dynamics of firm-level variables are aligned with data patterns:
  ▸ Firm-level Regression: Price ▸ Firm-level Regression: Markups

Quantitative Size of the Balance Sheet Channel (Industry-level Direct + Indirect effect)

- Compare the baseline results with counterfactual outcomes where the imported input price stays constant upon a depreciation shock.

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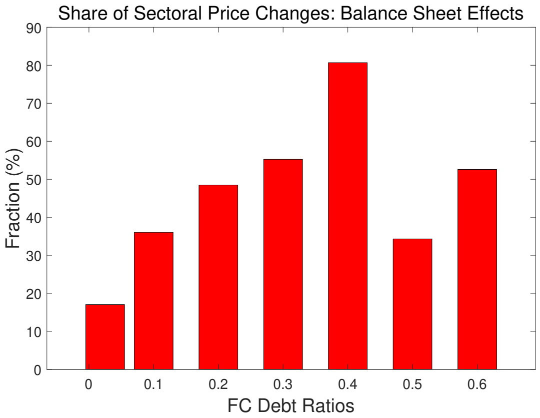
- Across FC debt share deciles, the balance sheet channel explains a substantial share of the simulated **industry-level** price changes. ▸ Firm-level Price Changes ▸ GE Effect ▸ GE Effect Share



Conclusion

- We find empirically that **industries with higher foreign currency debt increased their prices more** during the large devaluation period.
- With the model-generated data, we decompose the **two distinct channels of exchange rate pass-through – balance sheet channel and imported input channel** and show that both are significant contributors to the firm-level price dynamics during the crisis.
- Our empirical analysis and our quantitative analysis reveal that it is important, albeit overlooked, to incorporate **the balance sheet effect** when analyzing how **the exchange rate affects domestic prices**, especially for *emerging economies with dollarized liability*.

Thank you! :)

Motivation: Cross-Country

- Realized PPI change vs. Imported input implied PPI change

	Crisis Year	Δ Import Price Index	Imported Input Share (%)	Δ MC Due to Import Price Changes Implied PPI Changes via Imported Input*	Δ PPI (%)
Brazil	1999	64.08	6.0	3.84	33.0
Mexico	1994	165.39	13.2	21.87	47.11
Korea	1997	40.37	14.6	6.05	16.46
Thailand	1997	20.09	22.0	4.43	17.89
Argentina	2002	169.87	6.1	10.39	122.22

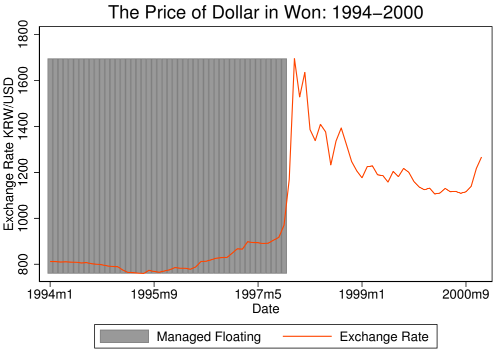
The country sample is identical to Burstein, Eichenbaum and Rebelo (2005).

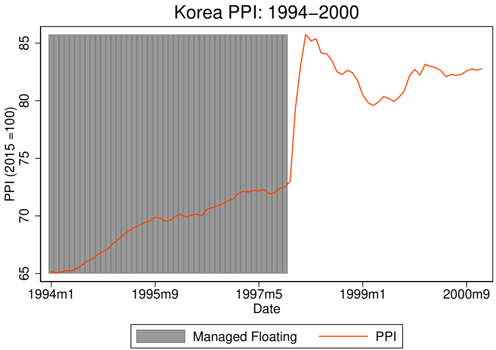
The imported input share is $\frac{\text{imported intermediate input}}{\text{total input}}$

We assume a complete exchange rate pass-through.

Back

Depreciation of Korean Won After Floating





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Summary Statistics

	1993	1994	1995	1996	1997	1998
Number of firms	1862	2204	2718	3111	3620	3994
Fraction of firms with FC debt (%)	59.7	57.5	52.8	51.9	50.6	44.0
Fraction of firms with FC short-term debt (%)	52.0	47.7	42.7	41.9	39.8	35.4
Mean FC share of short-term debt (%)	8.4	7.0	6.3	6.7	7.6	7.0
Mean FC share of long-term debt (%)	19.8	20.2	18.1	19.0	22.2	18.8
Mean FC share of short-term debt (%) given positive holding	16.2	14.6	14.7	16.0	19.0	19.8
Mean FC share of long-term debt (%) given positive holding	35.4	37.9	36.8	40.4	48.6	47.0
Mean FC short-term debt to total debt (%)	4.8	3.9	3.7	3.7	4.0	3.8
Mean FC long-term debt to total debt (%)	7.8	7.4	6.6	7.0	9.6	7.7
Mean FC short-term debt to total debt (%) given positive holding	9.6	8.7	9.6	10.1	11.7	12.7
Mean FC long-term debt to total debt (%) given positive holding	15.0	15.0	15.4	17.3	24.3	23.0

Note: Short-term debt is the amount of debt due within one year.

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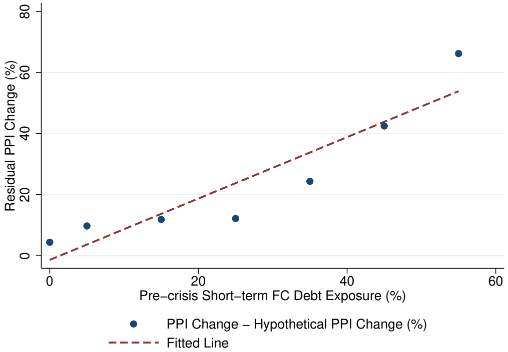
Another Measure of FC Debt Exposure: Short-term FC Debt to Total Debt Ratios

- $\underbrace{\text{Unexplained PPI changes}}_{\text{Realized PPI changes - Implied PPI Changes via Imported Input Channel}}$ and Pre-crisis Short-term FC debt exposure



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Summary Statistics (weighted by sales)

	1993	1994	1995	1996	1997	1998
Number of firms	1862	2204	2718	3111	3620	3994
Fraction of firms with FC debt (%)	89.3	88.7	88.5	90.2	89.1	87.7
Fraction of firms with FC short-term debt (%)	86.8	85.7	85.0	87.1	85.7	84.1
Mean FC share of short-term debt (%)	22.0	21.4	21.3	22.5	24.8	26.0
Mean FC share of long-term debt (%)	36.0	40.4	40.6	43.2	48.6	45.8
Mean FC share of short-term debt (%) given positive holding	25.4	25.0	25.0	25.9	29.0	31.0
Mean FC share of long-term debt (%) given positive holding	41.1	46.4	46.9	50.0	57.7	55.7
Mean FC short-term debt to total debt(%)	12.8	11.6	12.1	13.5	14.6	15.7
Mean FC long-term debt to total debt (%)	13.8	15.7	17.1	16.7	19.8	18.9
Mean FC short-term debt to total debt (%) given positive holding	15.0	13.9	14.4	15.9	17.9	19.3
Mean FC long-term debt to total debt (%) given positive holding	16.1	18.5	20.2	19.8	24.2	23.9

Note: Short-term debt is the amount of debt due within one year.

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Correlation between ST FC Debt Ratio and Firm Size

All Sample	
	Correlation with ST FC Debt Ratio
Export to Sales Ratio	0.1283
Log of Real Sales	0.3342

Firm with Positive ST FC Debt: Intensive Margin	
	Correlation with ST FC Debt Ratio
Export to Sales Ratio	0.0528
Log of Real Sales	0.1218

Back

Correlation between ST FC Debt Ratio and LT FC Debt Ratio in 1996

Firm-Level

	ST FC Debt Ratio
LT FC Debt Ratio	0.3683

Industry-Level

	ST FC Debt Ratio
LT FC Debt Ratio	0.4038

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Industry Price Dynamics and Short-term FC Debt Ratio

- Another Definition of Currency Composition:

  ST FC Debt to Total Debt Ratios & LT FC Debt to Total Debt Ratios

	(1)	(2)	(3)	(4)	(5)
ST FC	0.8978***	0.9008***	0.7497***	0.7598***	0.6780***
	(0.1951)	(0.2025)	(0.1597)	(0.2293)	(0.2099)
LT FC		-0.0319	-0.0943	-0.4331	-0.4063
		(0.2922)	(0.2991)	(0.3141)	(0.3288)
Rauch Dummy					0.0176
					(0.0486)
Imported Input Share					0.2549
					(0.1927)
Degree of Price Stickiness					0.0194
					(0.0231)
Broad Industry FE	No	No	Yes	Yes	Yes
Average Firm-level characteristics	No	No	No	Yes	Yes
Adjusted R^2	0.1411	0.1356	0.4131	0.4452	0.4457
N	156	156	156	156	156

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Industry Price Dynamics and Short-term FC Debt Ratio: w/o Outliers

	(1)	(2)	(3)
ST FC	0.6338***	0.6722***	0.5376**
	(0.2239)	(0.2441)	(0.2278)
LT FC	-0.1564	-0.2245*	-0.2221
	(0.1219)	(0.1349)	(0.1368)
Rauch Dummy			0.0070
			(0.0441)
Imported Input Share			0.3095*
			(0.1698)
Degree of Price Stickiness			0.0352**
			(0.0170)
Broad Industry FE	Yes	Yes	Yes
Average Firm-level characteristics	No	Yes	Yes
Adjusted R^2	0.3519	0.3750	0.3899
N	154	154	154

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Domestic Firms Only

	(1)	(2)	(3)
ST FC	0.5862***	0.5808***	0.5602***
	(0.1386)	(0.1672)	(0.1587)
LT FC	-0.1370*	-0.1319*	-0.1336*
	(0.0794)	(0.0784)	(0.0778)
Rauch Dummy			0.0164
			(0.0477)
Imported Input Share			0.2298
			(0.1888)
Degree of Price Stickiness			0.0268*
			(0.0159)
Broad Industry FE	Yes	Yes	Yes
Average Firm-level characteristics	No	Yes	Yes
Adjusted R^2	0.4157	0.4373	0.4365
N	155	155	155

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Industry Price Dynamics and Short-term FC Debt Ratio, Pre-crisis Period

$$\Delta p_{i,93-95} = \beta_0 + \beta_1 \text{ ST FC}_{i,93} + \beta_2 \text{LT FC}_{i,93} + \beta_3 \text{X}_{i,93} + \epsilon_i$$

	(1)	(2)	(3)	(4)	(5)
ST FC	0.1228	0.0967	-0.0480	-0.2587	-0.2671
	(0.1325)	(0.1130)	(0.1552)	(0.2197)	(0.2176)
LT FC		0.0403	-0.0217	-0.0250	-0.0130
		(0.0690)	(0.0979)	(0.0958)	(0.0953)
Rauch Dummy					0.0109
					(0.0519)
Imported Input Share					0.1285
					(0.1104)
Degree of Price Stickiness					-0.0276**
					(0.0126)
Broad Industry FE	No	No	Yes	Yes	Yes
Average Firm-level characteristics	No	No	No	Yes	Yes
Adjusted R^2	0.0015	-0.0036	0.2476	0.2818	0.2760
N	151	151	151	151	151

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Industry Price Dynamics and Short-term FC Debt Ratio, Pre-crisis Period: w/o Outliers

$$\Delta p_{i,93-95} = \beta_0 + \beta_1 \text{ ST FC}_{i,93} + \beta_2 \text{LT FC}_{i,93} + \beta_3 \text{X}_{i,93} + \epsilon_i$$

	(1)	(2)	(3)
ST FC	0.0121	-0.0621	-0.0739
	(0.1453)	(0.1552)	(0.1570)
LT FC	0.0322	0.0248	0.0364
	(0.0769)	(0.0786)	(0.0788)
Rauch Dummy			0.0450
			(0.0407)
Imported Input Share			0.0576
			(0.0936)
Degree of Price Stickiness			-0.0261***
			(0.0080)
Broad Industry FE	Yes	Yes	Yes
Average Firm-level characteristics	No	Yes	Yes
Adjusted R^2	0.2924	0.2848	0.2917
N	149	149	149

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Industry Price Dynamics and Short-term FC Debt Ratio (Panel: 2000 $\sim$ 2019)

$$\Delta p_{i,t} = \beta_i + \beta_t + \beta_1 \text{ ST FC}_{i,t-1} + \beta_2 \text{LT FC}_{i,t-1} + \beta_3 \Delta e_t \times \text{ST FC}_{i,t-1} + \beta_4 \Delta e_t \times \text{LT FC}_{i,t-1} + \beta_5 \text{X}_{i,t-1} + \epsilon_{i,t}$$

	(1)	(2)
ST FC	0.0112	0.0164
	(0.0263)	(0.0277)
LT FC	-0.0178	-0.0179
	(0.0166)	(0.0173)
$\Delta e_t \times$ ST FC	0.4460***	0.5911***
	(0.1709)	(0.1907)
$\Delta e_t \times$ LT FC	0.1952	0.1894
	(0.2434)	(0.2576)
Industry FE	Yes	Yes
Year FE	Yes	Yes
$\text{X}_{i,t-1}$	Yes	Yes
$\Delta e_t \times \text{X}_{i,t-1}$	No	Yes
Adjusted R^2	0.2299	0.2376
N	3680	3472

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Industry Price Dynamics and Short-term FC Debt Ratio (Panel: 2000 $\sim$ 2019)

$$\Delta p_{i,t} = \beta_i + \beta_t + \beta_1 \text{ ST FC}_{i,t-1} + \beta_2 \text{LT FC}_{i,t-1} + \beta_3 \Delta e_t \times \text{ST FC}_{i,t-1} + \beta_4 \Delta e_t \times \text{LT FC}_{i,t-1} + \beta_5 \text{X}_{i,t-1} + \epsilon_{i,t}$$

FX: KRW price of USD	Periods with $dFX < 0$	Periods with $dFX > 0$
	(1)	(2)
ST FC	-0.0447	-0.0094
	(0.0337)	(0.0309)
LT FC	-0.0215	0.0111
	(0.0247)	(0.0231)
ST FC $\times$dFX	-0.1408	0.8456***
	(0.5084)	(0.2353)
LT FC $\times$dFX	0.3100	0.0219
	(0.3205)	(0.4324)
Industry FE	Yes	Yes
Year FE	Yes	Yes
Adjusted R^2	0.2184	0.2719
N	1636	1662

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Pre- and Post-Crisis Price Dynamics and Short-term FC Debt Ratio in 1996

$$\Delta p_{I,t} = \beta_{0,t} + \beta_{1,t} \text{ST FC}_{I,1996} + \epsilon_I, \quad t = 1993, ..., 1998, ..., 2000$$

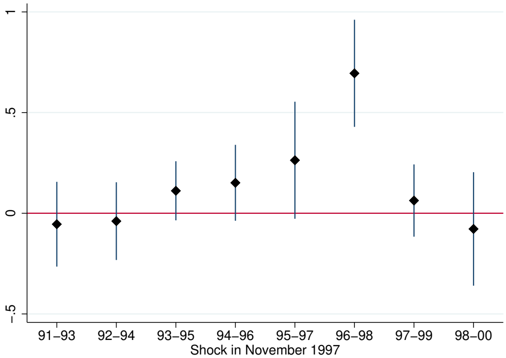

Figure 1: Treatment vs. Control Groups: Pre- and Post-crisis

▸ w/o Outliers ▸ Back

Pre- and Post-Crisis Price Dynamics and Short-term FC Debt Ratio in 1996

$$\Delta p_{I,t} = \beta_{0,t} + \beta_{1,t}\text{ST FC}_{I,1996} + \epsilon_I, \quad t = 1993, ..., 1998, ..., 2000$$

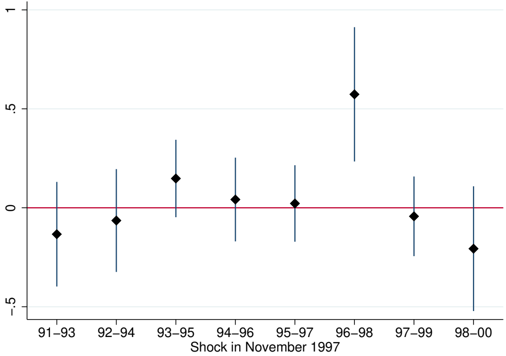

Figure 2: Treatment vs. Control Groups: Pre- and Post-crisis

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Controlling the Effect of Firm Exits

	(1)	(2)	(3)
ST FC	0.5685***	0.6437***	0.5531***
	(0.2038)	(0.2173)	(0.2060)
LT FC	-0.1846	-0.1920	-0.1830
	(0.1365)	(0.1346)	(0.1363)
Log Change of # of Firms		1.0001**	1.0207*
		(0.4832)	(0.5382)
Rauch Dummy	0.0075		-0.0020
	(0.0447)		(0.0465)
Imported Input Share	0.2830*		0.2728
	(0.1656)		(0.1675)
Degree of Price Stickiness	0.0317*		0.0327*
	(0.0168)		(0.0167)
Broad Industry FE	Yes	Yes	Yes
Average Firm-level characteristics	Yes	Yes	Yes
Adjusted R^2	0.4513	0.4440	0.4515
N	156	156	156

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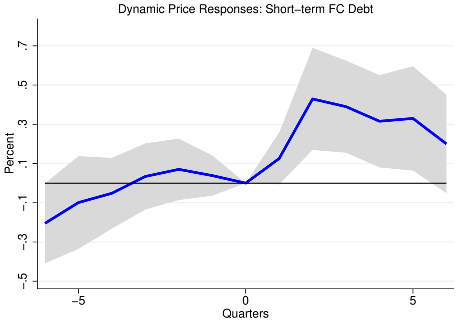
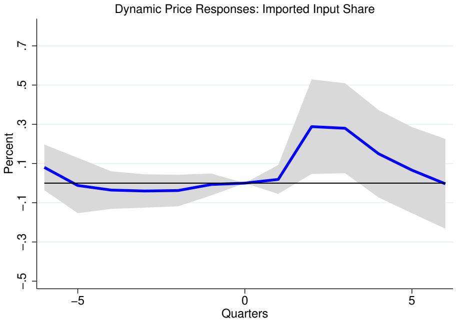
Local Projection: Dynamic Responses of Quarterly PPI

$$\frac{p_{i,1997Q3+h} - p_{i,1997Q3}}{p_{i,1997Q3}} = \beta_h + \beta_{1,h}\text{ST FC}_{i,96} + \beta_{2,h}\text{LT FC}_{i,96} + \beta_{3,h}X_{i,96} + \epsilon_{i,h}$$





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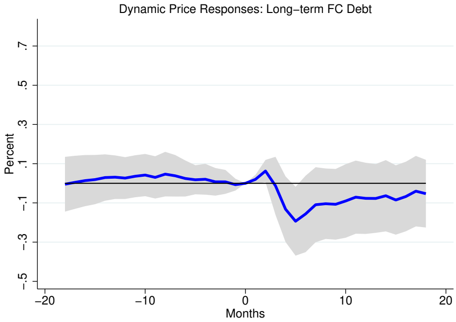
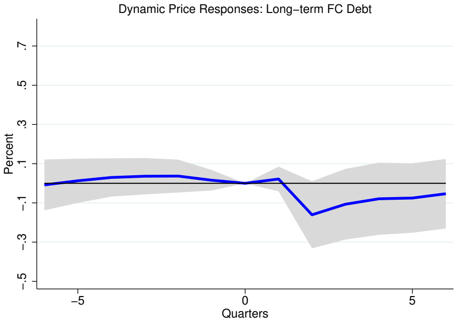
Local Projection: Dynamic Effects of LT FC Debt





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Mark-up Measure: De Locker and Warzynski (2011)

- Assume that producer j is a cost minimizer:

$$\min \quad C_{jt} = \sum_{v=1}^{n} \underbrace{p_{jt}^{v} x_{jt}^{v}}_{\text{variable input costs}} + \underbrace{r_{jt} k_{jt}}_{\text{cost of capital}} + \lambda_{jt}(Q_{jt} - \underbrace{F(x_{jt}^{1}, \ldots, x_{jt}^{n}, k_{jt})}_{\text{production function}})$$

- FOC w.r.t a variable input x_{jt}^{v} :

$$\underbrace{\frac{\partial F(.)}{\partial x_{jt}^{i}} \frac{x_{jt}^{v}}{Q_{jt}}}_{\text{output elasticity:}\theta_{jt}^{v}} = \frac{1}{\lambda_{jt}} \frac{p_{jt}^{v} x_{jt}^{v}}{q_{jt}} \quad \text{where} \quad \lambda_{jt} = \frac{\partial C_{jt}}{\partial Q_{jt}}$$

- Hence, mark-up is:

$$\mu_{jt} = \frac{P_{jt}}{\lambda_{jt}} = \theta_{jt}^{v} \times \frac{P_{jt} Q_{jt}}{p_{jt}^{v} x_{jt}^{v}}$$

- Change in mark-up, assuming the output elasticity is constant over time:

$$\Delta log \mu_{jt} = \Delta log \frac{P_{jt} Q_{jt}}{p_{jt}^{v} x_{jt}^{v}}$$

back

Empirics: Firm-Level Analysis

- Firms with high foreign currency debt exposure have lower investment growth, lower labor productivity growth and lower employment growth during the crisis.

	Capital Growth	Output/Worker Growth	Total Wage Growth	Employment
ST FC	-6.7368*	-7.3622*	-6.2982***	-4.0366**
	(3.5560)	(3.8988)	(1.4304)	(1.9167)
LT FC	-2.5349	1.5337	0.0878	-0.1654
	(2.1571)	(3.1031)	(1.2826)	(1.1898)
ST FC x Size	0.2592*	0.2960*	0.2492***	0.1600**
	(0.1409)	(0.1527)	(0.0568)	(0.0751)
LT FC x Size	0.1055	-0.0487	-0.0016	0.0155
	(0.0866)	(0.1241)	(0.0510)	(0.0479)
Adjusted R^2	0.0297	0.0546	0.0978	0.0869
N	2753	3045	2203	3169

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Empirics: Firm-Level Analysis

- Cross products of other firm-level variables and size are controlled.

	Sales Growth	Net Worth Growth	Markup Growth
ST FC	-7.8202**	-1.4387*	-0.9201***
	(3.1157)	(0.8026)	(0.2156)
LT FC	2.4760	0.2830	0.1825
	(2.2803)	(0.6609)	(0.1704)
ST FC x Size	0.3191***	0.0576*	0.0360***
	(0.1225)	(0.0321)	(0.0086)
LT FC x Size	-0.0881	-0.0106	-0.0069
	(0.0909)	(0.0267)	(0.0069)
Adjusted R^2	0.1724	0.0642	0.0425
N	3169	3169	3167

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Empirics: Firm-Level Analysis, Figures

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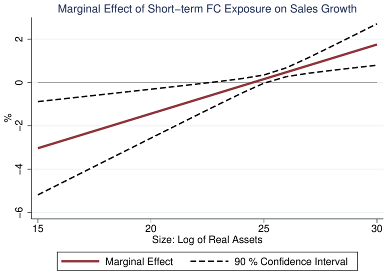

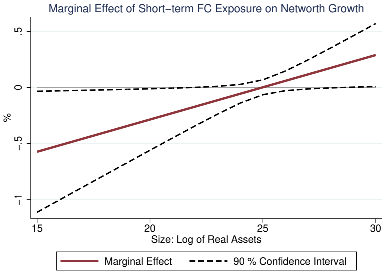

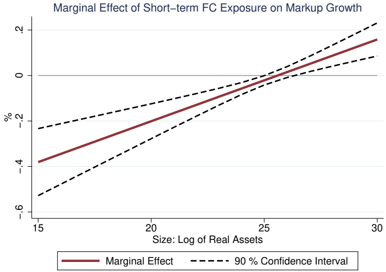

Firm-Level Investigation: Different Definitions of Currency Composition of Corporate Debt

- Another Definition of Currency Composition:

  ST FC Debt to Total Debt Ratios & LT FC Debt to Total Debt Ratios

	(1) Net Worth Growth	(2) Sales Growth	(3) Markup Growth
ST FC	-3.0536***	-17.3937***	-1.1959***
	(0.8893)	(3.1444)	(0.3311)
LT FC	-0.7602	1.3482	0.2109
	(0.8793)	(3.6418)	(0.3465)
ST FC x Size	0.1197***	0.6992***	0.0469***
	(0.0354)	(0.1235)	(0.0131)
LT FC x Size	0.0349	-0.0240	-0.0078
	(0.0358)	(0.1445)	(0.0141)
Adjusted R^2	0.0469	0.1326	0.0425
N	3154	3154	3152

Back

Preferences: Kimball-CES Structure

- Each industry I faces an exogenous CES demand, where the demand for industry I's composite goods is given by:

$$Y_I = \frac{P_I}{\bar{P}}^{-\nu} \bar{Y}$$

- Each industry I is populated by a continuum of entrepreneurs indexed by $j(I)$.

- **Intermediate goods,** y_j, are produced by entrepreneurs j, aggregated into industry I's composite goods by the Kimball (1995) aggregation.

- Following Gopinath and Itskhoki (2010), we assume functional forms and the demand for an intermediate good produced by an entrepreneur j is:

$$y_j = \left(1 - \epsilon \ln(\frac{p_j}{P_I})\right)^{\sigma/\epsilon} Y_I, \quad p_j = \exp\left(\frac{1}{\epsilon}\left(1 - (\frac{y_j}{Y_I})^{\epsilon/\sigma}\right)\right) P_I$$

Back

Technology: Entrepreneurs-Production

- Produces differentiated goods with domestic inputs n, foreign inputs x and capital k:

$$y = zk^{\alpha}x^{\kappa}n^{1-\alpha-\kappa}$$

- Need to save in liquid assets to pay a certain faction $(\frac{1}{\theta_a})$ of production costs before profits are realized:

$$wn + \xi^{\omega}x \leq \theta_a a$$

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- ξ is the real exchange rate, the price of foreign final goods in units of domestic final goods
  - **expect** $\frac{\xi_t}{\xi_{t-1}} = 1$ **for all** t

Technology: Entrepreneurs-Production

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- Need to save in liquid assets to pay a certain faction $(\frac{1}{\theta_a})$ of production costs before profits are realized:

$$wn + \xi^{\omega}x \leq \theta_a a$$

- ξ is the real exchange rate, the price of foreign final goods in units of domestic final goods
  - **expect** $\frac{\xi_t}{\xi_{t-1}} = 1$ **for all** t
- Invests in physical capital used in production and as a collateral:

$$k' = (1-\delta)k + i$$

- Investment also subject to convex adjustment costs:

$$\Phi(k, k')$$

Back

Financial mkt: Entrepreneurs-Debt

- Chooses to issue debt $d'/(1+r)$ (in units of domestic final goods) and allocates **exogenously**:

Financial mkt: Entrepreneurs-Debt

- Chooses to issue debt $d'/(1+r)$ (in units of domestic final goods) and allocates **exogenously**:
  - $(1-\lambda)\frac{d'}{1+r}$ to debt denominated in domestic final goods

Financial mkt: Entrepreneurs-Debt

- Chooses to issue debt $d'/(1+r)$ (in units of domestic final goods) and allocates **exogenously**:
  - $(1-\lambda)\frac{d'}{1+r}$ to debt denominated in domestic final goods
  - $\lambda\frac{d'}{1+r}$ to debt denominated in foreign final goods (in units of domestic goods)

    $\iff \lambda\frac{d'}{1+r}\frac{1}{\xi}$ to debt denominated in foreign final goods (in units of foreign goods)

Financial mkt: Entrepreneurs-Debt

- Chooses to issue debt $d'/(1+r)$ (in units of domestic final goods) and allocates **exogenously**:
  - $(1-\lambda)\frac{d'}{1+r}$ to debt denominated in domestic final goods
  - $\lambda\frac{d'}{1+r}$ to debt denominated in foreign final goods (in units of domestic goods)

    $\iff$ $\lambda\frac{d'}{1+r}\frac{1}{\xi}$ to debt denominated in foreign final goods (in units of foreign goods)
- In the beginning of next period, need to pay back in units of domestic goods

$$d'(1-\lambda) + \left(d'\lambda\frac{\xi'}{\xi}\right)$$

Financial mkt: Entrepreneurs-Debt

- Chooses to issue debt $d'/(1+r)$ (in units of domestic final goods) and allocates **exogenously**:
  - $(1-\lambda)\frac{d'}{1+r}$ to debt denominated in domestic final goods
  - $\lambda\frac{d'}{1+r}$ to debt denominated in foreign final goods (in units of domestic goods)

  $\iff \lambda\frac{d'}{1+r}\frac{1}{\xi}$ to debt denominated in foreign final goods (in units of foreign goods)
- In the beginning of next period, need to pay back in units of domestic goods

$$d'(1-\lambda) + \left(d'\lambda\frac{\xi'}{\xi}\right)$$

- Face borrowing constraints:

$$\frac{d'}{1+r} \leq \theta_k k'$$

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Model: Recursive Firm Problem

$$v(k,d,a,z;\lambda,\kappa,\xi) = \max_{c\geq 0, d', k', a', n, x, p} \frac{c^{1-\gamma}}{1-\gamma} + \beta E_{z'}[v(k',d',a',z';\lambda,\kappa,\xi')]$$

$$s.t. \quad c + k' - (1-\delta)k + \Phi(k,k') + a' + d\big((1-\lambda) + \lambda \underbrace{\frac{\xi}{\xi_{-1}}}_{=1}\big) = \underbrace{py - wn - \xi^{\omega}x}_{\pi(k,z)} + a + \frac{d'}{1+r}$$

$$\frac{1}{1+r}d' \leq \theta_k k' \quad \{\eta_1\}, \quad wn + \xi^{\omega}x \leq \theta_a a \quad \{\eta_2\},$$

where

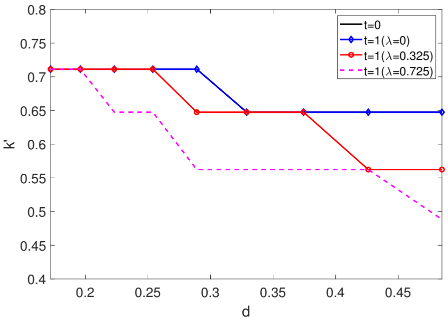
$$(i)\ y = \left(1 - \epsilon \ln(\frac{p}{P_I})\right)^{\sigma/\epsilon} P_I^{-\nu}$$

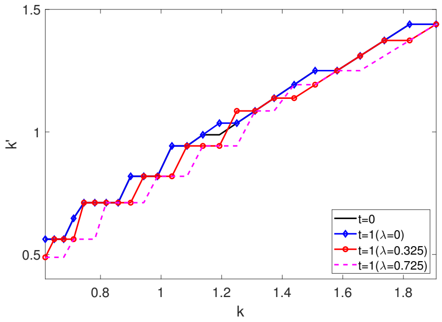
$$(ii)\ y = zk^{\alpha}x^{\kappa}n^{1-\alpha-\kappa}, \quad (iii)\ \Phi(k,k') = \frac{\phi}{2}\left(\frac{k'-(1-\delta)k}{k}\right)^2 k$$

Back

Policy Function of k': (i) Investment adjustment

- With high enough debt d, the borrowing constraint starts binding, lowering investment k'
- With lower k, next-period capital $k' \downarrow$
- With higher FC debt λ, investment $k' \downarrow$



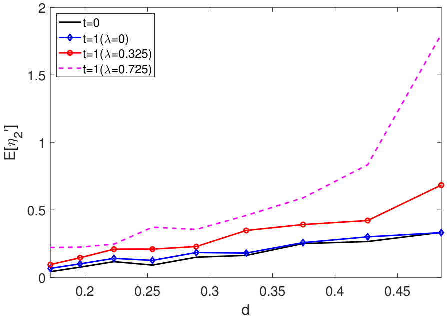


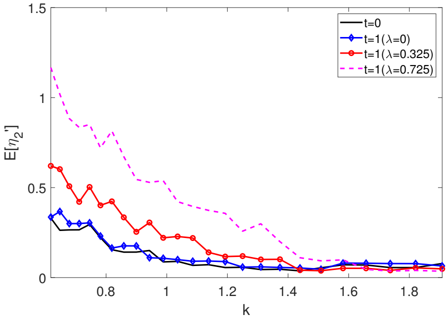
back

Policy Function of η_2: (ii) Working-capital channel

$$\beta r E_{z'|z}[(c')^{-\gamma}] + \underbrace{\eta_1}_{\text{more binding collateral constraints } \uparrow} = \beta \theta_a E_{z'|z}[\eta_2']$$

- The working capital constraints are more binding $\eta_2 \uparrow$ with lower k, higher d and higher λ





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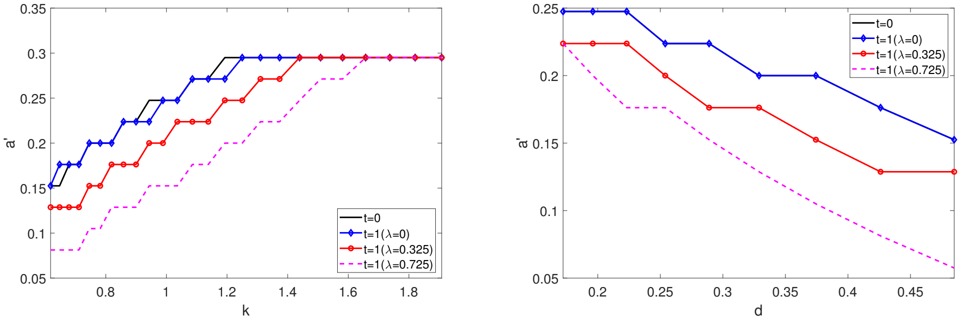
Policy Function of a': (ii) Working-capital channel



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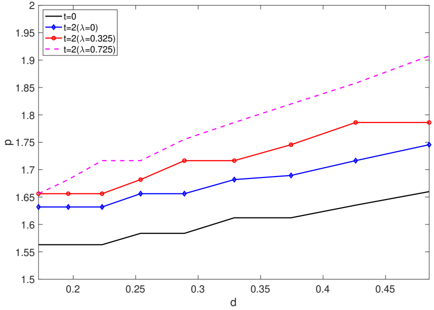
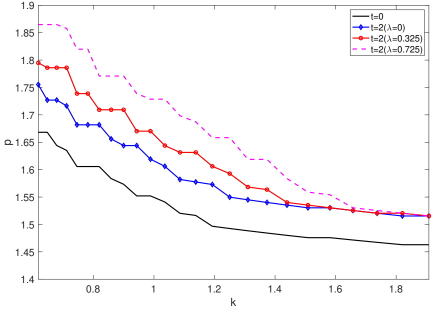
Policy Function of p'' Against d and k

- Firms charge higher $p \uparrow$ with lower k, higher d and higher λ.
- Strategic complementarity pushing up the policy function even with zero FC debt λ.





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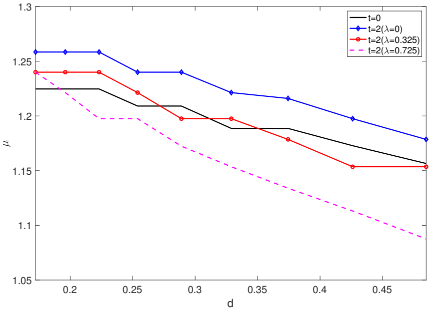
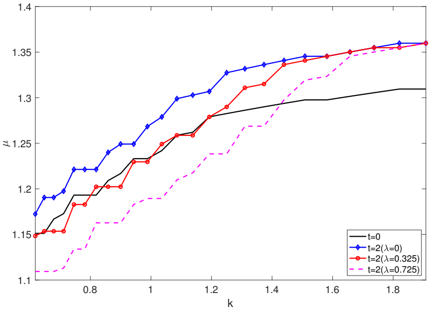
Policy Function of μ''

- Firms lower their markups $\mu \downarrow$ with lower k, higher d and higher λ upon $\uparrow$ effective MC
  - Relatively better off firms with higher k and lower d increase their markups $\mu \uparrow$.
- Strategic complementarity pushing up the policy function even with zero FC debt λ.





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Transition: MIT Shock

- Each industry with its specific firm-level distribution of λ and the imported input share κ has different stationary equilibrium and different transition dynamics upon **one time unexpected depreciation** of the real exchange rate.
  - period 0 : stationary equilibrium (SS)
  - period 1 : unexpected depreciation of real exchange rate (MIT shock)

    $\Rightarrow$ k' and a' change

    $\ldots$
  - period ∞: new stationary equilibrium (SS)
- We investigate the transition dynamics when ξ goes up from 1 to 2.1 in the first period and stays there afterwards for each of 156 industries

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Calibrated Parameters

Predetermined			
Parameter	**Value**	**Description**	**Data Source**
γ	2.0	Relative risk aversion	Standard
δ	0.1	Depreciation rate of physical capital	Standard
ν	2.0	Elasticity of substitution across sectors	Standard
σ	5.0	Elasticity of substitution within a sector	Gopinath and Itskhoki (2010)
ϵ	6.0	Super elasticity of demand	Gopinath and Itskhoki (2010)
ϕ	0.9569	Physical capital adjustment cost	Gilchrist and Sim (2007)
ω	0.353	Avg degree of ERPT to import prices	Estimated from data
r	0.08	Interest rate	Bank of Korea
ρ_z	0.9106	AR coefficient of z	Estimated
σ_z	0.0986	STD of z	Estimated
λ_m	$\in [0, 0.975]$	Distribution of FC debt share	Estimated from KIS data
π_m^I	$\in [0, 1]$	Distribution of FC debt share	Estimated from KIS data
κ_I	$\in [0, 1]$	Industry-level imported input share	Estimated from Korean Input-Output table in 1995
Calibrated			
Parameter	**Value**	**Description**	**Targeted Moments**
β	0.9090	Time discount factor	Mean of Debt to Sales Ratio (0.708)
θ_k	0.7444	Fraction of capital as a collateral	Std of Debt to Sales Ratio (0.291)
θ_a	1.2431	Fraction of working capital	Mean of Cash to Sales ratio (0.471)

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Firm-level Regression: Price Changes

$$\Delta p_j = \beta_0 + \beta_1 \text{ST FC}_j + \beta_2 \text{Imported Input Share}_I + \beta_3 \Delta P_I + \beta_4 1_{\text{Unconstrained},j} + \beta_5 \text{ST FC}_j \times 1_{\text{Unconstrained},j} + \epsilon_j$$

$$\Delta p_j = \beta_0 + \beta_1 \text{ST FC}_j + \beta_2 \text{Imported Input Share}_I + \beta_3 \Delta P_I + \beta_4 \log(k_j) + \beta_5 \text{ST FC}_j \times \log(k_j)$$
$$+ \alpha \log(X_j) + \gamma \text{ST FC}_j \times \log(X_j) + \epsilon_j$$

Firm-level Regression: Price Changes

$$\Delta p_j = \beta_0 + \beta_1 \text{ST FC}_j + \beta_2 \text{Imported Input Share}_I + \beta_3 \Delta P_I + \beta_4 1_{\text{Unconstrained},j} + \beta_5 \text{ST FC}_j \times 1_{\text{Unconstrained},j} + \epsilon_j$$

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$$+ \alpha \log(X_j) + \gamma \text{ST FC}_j \times \log(X_j) + \epsilon_j$$

	Price Changes		
	(1)	(2)	(3)
ST FC_j	0.0532	0.0583	0.1190
$\text{Imported Input Share}_I$	0.0647	0.0691	0.0754
ΔP_I	0.7043	0.6997	0.6954
$1_{\text{Unconstrained},j} \times \text{ST FC}_j$		-0.0415	
$log(k_j) \times \text{ST FC}_j$			-0.0136

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Firm-level Regression: Markup Changes

$$\Delta\mu_j = \beta_0 + \beta_1 \text{ST FC}_j + \beta_2 \text{Imported Input Share}_I + \beta_3 \Delta P_I + \beta_4 1_{\text{Unconstrained},j} + \beta_5 \text{ST FC}_j \times 1_{\text{Unconstrained},j} + \epsilon_j$$

$$\Delta\mu_j = \beta_0 + \beta_1 \text{ST FC}_j + \beta_2 \text{Imported Input Share}_I + \beta_3 \Delta P_I + \beta_4 \log(k_j) + \beta_5 \text{ST FC}_j \times \log(k_j)$$
$$+ \alpha \log(X_j) + \gamma \text{ST FC}_j \times \log(X_j) + \epsilon_j$$

	Markup Changes		
	(1)	(2)	(3)
ST FC_j	-0.0774	-0.0852	-0.1728
Imported Input Share_I	-0.0940	-0.1013	-0.1025
ΔP_I	0.4395	0.4469	0.4468
$1_{\text{Unconstrained},j} \times$ ST FC_j		0.0628	
$log(k_j) \times$ ST FC_j			0.0315

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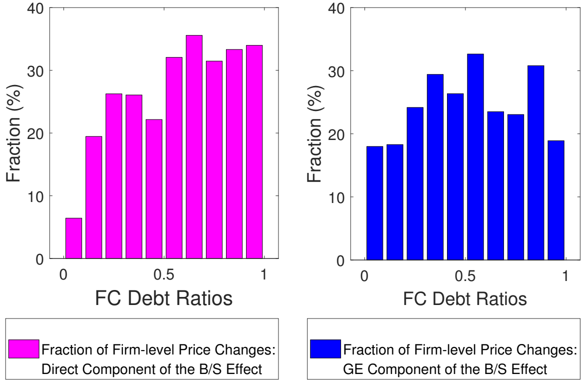
Quantitative Size of the Balance Sheet Channel (Firm-level Direct + GE effect)

- Δp_j in the counter-factual economy over Δp_j in the baseline economy
- Across FC debt share deciles, the balance sheet channel explains a substantial share of the simulated **firm-level** price changes Back

Quantitative Size of the Balance Sheet Channel (Firm-level Direct vs. GE effect)

- Direct effect of FC debt: $\hat{\beta}_1 \text{ST FC}_j$
  $\Delta p_j = \beta_0 + \beta_1 \text{ST FC}_j + \beta_2 \text{Imported Input Share}_I + \beta_3 \Delta P_I + \epsilon_j$

- GE effect $= \Delta p_j$ in the counter-factual economy - Direct effect Back



Quantitative Size of the Balance Sheet Channel (Firm-level Direct vs. GE effect)

- Direct effect of FC debt: $\hat{\beta}_1 \text{ST FC}_j$
  $\Delta p_j = \beta_0 + \beta_1 \text{ST FC}_j + \beta_2 \text{Imported Input Share}_I + \beta_3 \Delta P_I + \epsilon_j$

- GE effect $= \Delta p_j$ in the counter-factual economy - Direct effect Back