

Currency Hedging: Managing cash-flow exposure

Laura Alfaro

(Harvard & CEPR & NBER)

Mauricio Calani

(Central Bank of Chile)

Liliana Varela

(LSE & CEPR)

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Background

- Use of **foreign currency** is prevalent → currency mismatches
 - Trade, capital markets, funding for banks and non-financial firms (original sin); fear of floating → systemic risk

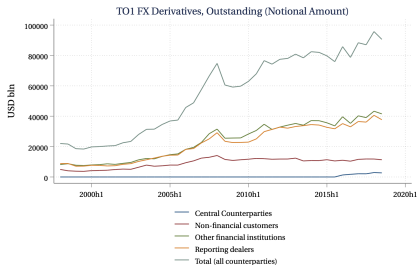
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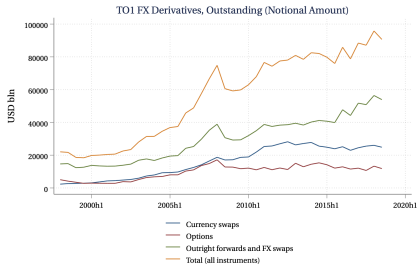
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- FX-derivative markets are among the largest and fastest-growing financial markets in the world
 - Globally: daily turnover in FX market: 70% in FX-derivatives vs 30% spot
 - EMEs: non-existent two decades ago, but last 15 years have seen impressive growth in size and scope (\$1.6T daily in April 2019, vs. < \$0.5T in spot; growth rates 60% in 2016-2019; BIS, 2019)

Growth FX derivatives market

A. By Counterparty



B. By Instrument



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- Paradoxically, growth has received less attention
 - Instrument to manage ER volatility and associated vulnerabilities
 - Data limitation

Currency Hedging: Main Questions

1. **Do firms exploit natural hedging?** (match FC payables \leftrightarrow FC receivables)
 - Literature: extreme & opposite assumptions—natural hedge or full exposure
→ Ignores the role of financial hedging
2. **Do firms fully/partially hedge their FX currency exposure?**
 - Literature: extreme assumption—*“The theoretical finance literature has then focused on analyzing why hedging can make sense while imposing the assumption that firms should fully hedge”* Froot et al. (1993)
3. **Which transactions firms use FX derivatives for?**
 - Literature: extreme assumption—firms should hedge FC debt → Ignores trade and trade financing exposures?
4. **How are FX contracts priced (across/within firms)?**
 - How does the FX derivative market price firm's hedging needs?
5. **Does FX hedging add value to the firm?**
 - How do financial conditions affect firms' FX hedging policies and outcomes?

Currency Hedging: Approach

- Unique/novel dataset with detailed firm/transaction-level data (2005-2018) for Chile linking:
 1. Foreign currency (FX) derivatives (all daily transaction, detailed contract information, 1997-)
 2. Foreign and local currency debt (monthly, census, bonds, loans, FDI, 2003-)
 3. Custom's international trade (operation, currency of invoice, census); trade credit
 4. Employment/sales;
 5. Tax IDs (create firms/corporations)
- Comprehensive: firms' joint decision on FC exposure (trade, financing) and FX hedging
- Exploit Market Supply Shock—Policy reform to pension funds regulation
 - Effects of FX Hedging on Firms' Outcomes
 - Propensity score matching exercise

Currency Hedging: Rationale and Implications

- Firms are exposed to a variety of risks: market, commercial, political, etc.
 - Risk management options: operational (payments, receivable, location, pricing, etc.); self-insurance and buffers (accumulating foreign currency assets or liabilities); financial products (derivatives). (Servaes et al. 2009; Lewis, 2018)
- **Focus:** exchange rate transaction risk, which is contractual, clearly defined and can potentially be managed using financial derivatives.

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- **Friction-less neoclassical framework:** hedging adds no value to the firm
 - Market imperfections — financial frictions, transaction costs, and convex tax schedules— volatility can be costly, conveying a role to hedging by firms. (Froot et al. 1993; Rampini and Viswanathan, 2010; Rampini et al, 2014)

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(Froot et al. 1993; Rampini and Viswanathan, 2010; Rampini et al, 2014)
- Comprehensive granular information: Transaction-level Derivative data + Broad Firm Coverage + Foreign Currency Exposure (Trade and Debt)
 - Precisely measure firms' transaction exposure and their hedging behaviour.
 - New facts regarding firm's use and effects of FX derivatives.

Currency Hedging: Main Findings

1. Natural (operational) hedging of currency risk is **quantitatively limited**
 - Timing of cash-flows.
2. Firms mostly use FX derivatives to *partially* hedge short-term financing, principally from **trade**
3. Firms hedge larger amounts of their **gross** (rather than **net**) exposure.
4. FX derivatives are priced heterogeneously
 - FX premium is higher for **smaller** firms and for **longer** maturity contracts
5. FX hedging **adds value** to the firm (higher export, import, employment)
 - A supply shock to FX market translates into lower liquidity, reduces intensive & extensive margins, raises FX premium; affects firms operations

Currency Hedging: Main Findings (Cont.)

- Firms using FX derivatives are larger—firms in trade and foreign currency borrowing: foreign currency exposure (Bernard et al, 2007; Melitz, 2003, Helpman et al. 2004, Alfaro and Chen, 2018, Salōmao and Varela, 2020; Gaubert and Itskhoki, 2022)
 - Firms engaging in international trade are not naturally hedged
 - Firms use financial derivatives to partially hedge larger amount and gross transactions
 - Higher currency volatility: higher extensive and intensive use of FX derivatives

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- Different timing operational and financial milestones— signing of a contract, production, sale, and delivery of a product or service and payments
 - Timing of day-to-day operation key to understanding exposure
 - Longer deliveries and transportation times in international transactions (In trade: Antras and Foley, 2015)

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 - Longer deliveries and transportation times in international transactions (In trade: Antras and Foley, 2015)
- Timing misalignment between FC payables and receivables and their interaction with domestic currency obligations → use financial hedges for gross transactions.
 - Costs remain in local currency (wages, taxes, etc.) → matter for cash flow management
 - Firms vulnerable to currency fluctuations associated with working capital obligations → hedging adds value to the firm
 - Firms turn FC exposure into LC

Literature: International Economics and Finance

- International Economics: vast literature focusing on currency mismatches and vulnerabilities but few papers consider firm's use of financial foreign currency hedging (theoretically, empirically: managed EXR periods; lack of data) (Itzetzi, Reinhart and Rogoff 2021; Gopinath and Itskhoki, 2021)

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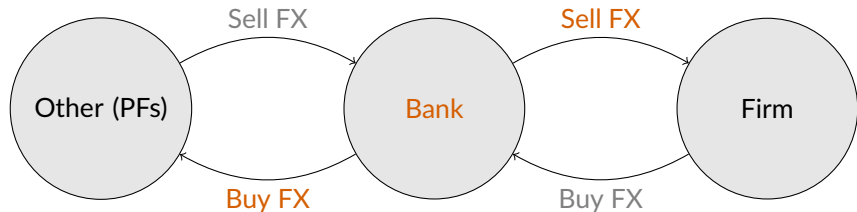
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 - Financial constraints and risk management: FXD add value (Froot et al. 1993) and limit their use (Rampini and Viswanathan 2010)
 - FX hedging affects firms' operations/real outcomes (trade, employment, leverage)

Background + Data

Chile's FX Derivatives Market: Over-The-Counter

- Options and futures are usually transacted on the Stock Exchange.
- Forwards and Swaps are transacted outside the Stock Exchange in the over-the-counter (OTC) market.
 - Forwards and Swaps are contracts with known (and fixed) maturity dates.



FX Derivatives: Transaction Level–Snapshot

A. By market

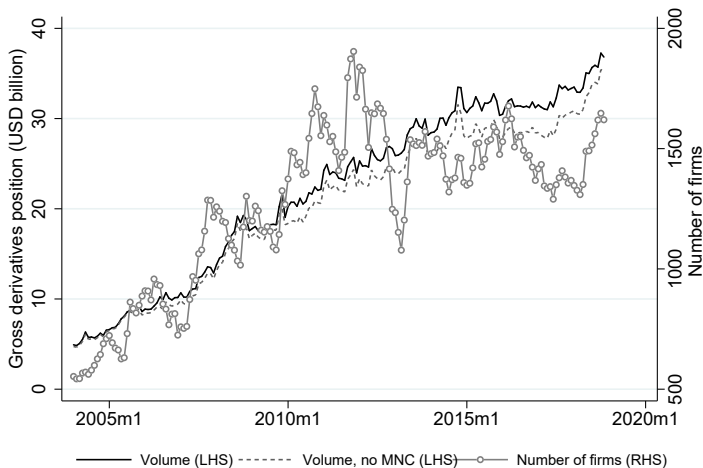
Type	All market					Real-sector				
	Obs.	Share	Notional	Maturity	Non-	Obs.	Share	Notional	Maturity	Non-
	(#)	(%)	Median (\$ 000)	Median (days)	delivery (%)	(#)	(%)	Median (\$ 000)	Median (days)	delivery (%)
	(1)	(2)	(3)	(4)	(5)	(7)	(8)	(9)	(10)	(11)
Forwards	1,518,688	80.4	5,630	71.1	83.5	639,736	88.3	1,308	90.5	65.1
Futures	2,211	0.1	1,684	43.3	96.8	356	0.0	1,728	85.6	82.6
Call options	24,974	1.3	1,436	159.2	91.6	21,414	3.0	716	164.4	91.2
Put options	15,677	0.8	1,936	167.6	93.0	13,224	1.8	852	175.1	93.6
Swaps	502	0.0	7,887	1,382.4	74.3	234	0.0	6537	1,690.6	56.8
FX swaps	271,427	14.4	1,2723	77.2	90.6	15,650	2.2	3,901	77.7	37.0
CC Swaps	55,474	2.9	6,505	1051.4	31.4	33,799	4.7	1,566	684.8	5.5
Total	1,888,953	100.0	6,584.8	103.0	83.2	724,413	100.0	1,352.6	122.2	63.0

Merge of Detailed Administrative Data, Chile (2005-18)

1. **FX-derivatives:** Daily, census, transaction-level (1997–); > 7 days
 2. **Foreign Debt:** Foreign debt: monthly, census, firm-instrument level (bonds, loans, FDI) (2003–)
 3. **Local debt:** Bank credit registry (incl. delinquency and line of credit)
 4. **Customs:** Monthly, census, operation (incl. trade credit & currency)
 5. **Firm data:** Yearly, census, firm-level (sales, sector, age and workers)
 6. **Tax ID:** Merge create firms/corporations
- Any year ~ 30,000 firms (105,000 in total), from which 1,300 (7,300 in total) use FXD
- **Chile:** 2 decades of quality data, flexible ER, no capital controls, stable macro (no domestic fueled crises)
- **The Market:** OTC, active FX derivatives market (BIS, 2019)

FX Derivatives Market: Non-Financial Firm Counter-party

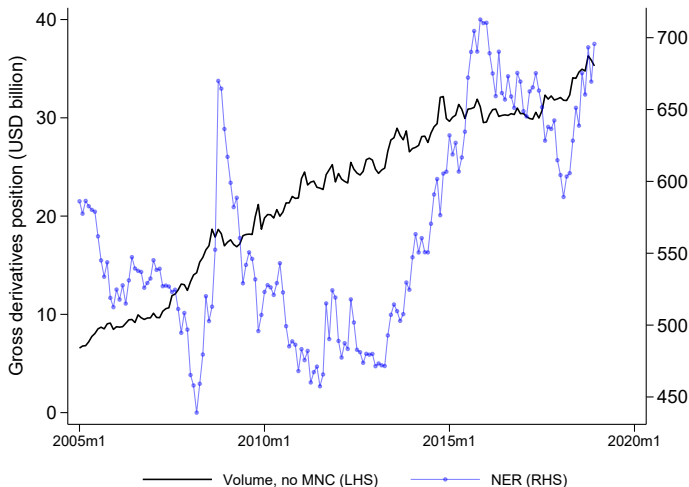
Fig: Number of firms and gross FX Derivatives positions



Gross FX-Derivatives position is the sum of long and short positions.
Volume and number of firms consider only those in the non-financial corporate sector

Non-Financial Firms FX Derivatives Market and EXR

Fig: Non-Financial Firms FX Derivative Position and Exchange rate (peso to US dollars)



FX Derivatives: Non-Financial Firms–Snapshot

- Total contracts close to 1.9 million; 725K: with one non-financial firm counter-party; forwards (88%), Non deliv. (limits default risk; BIS, 2019)

Type	Non-Financial Firms: purchases					Non-Financial Firms: sales				
	Obs.	Share	Notional Median	Maturity Median	Non-delivery	Obs.	Share	Notional Median	Maturity Median	Non-delivery
	(#)	(%)	(\$ 000)	(days)	(%)	(#)	(%)	(\$ 000)	(days)	(%)
	(1)	(2)	(3)	(4)	(5)	(7)	(8)	(9)	(10)	(11)
Forwards	452,145	89.4	1,324.2	80.9	57.5	187,591	85.8	1,270.8	113.6	83.6
Futures	299	0.1	1935.5	92.2	90.3	57	0.0	645.0	50.9	42.1
Call options	6,470	1.3	617.7	145.4	93.8	14,944	6.8	758.8	172.6	90.1
Put options	7,086	1.4	736.7	153.4	92.5	6,138	2.8	985.1	200.2	94.9
Swaps	141	0.0	7670.8	1839.6	61.7	93	0.0	4,819.1	1,464.8	49.5
FX swaps	11,810	2.3	4024.3	74.4	26.6	3,840	1.8	3,524.6	88.1	69.0
CC Swaps	27,725	5.5	1120.0	635.9	2.7	6,074	2.8	3,605.2	907.6	18.0
Total	505,676	100.0	1,360.9	113.5	54.7	218,737	100.0	1,333.5	142.2	82.3

Samples: 2005-2018

- Non-financial firms cleaned by tax ids ($\approx 105,000$)
- Exclude < 7 days (excl. 1.4% of sample)
- Dollar hedging ($> 85\%$ of sample; robustness all currencies)
- Domestic firms (90% domestic firms); robustness with MNCs
- Without and with copper (244 firms, 4,561 contracts)
- Subsets of only X, only M, trade (X & M), only debt, debt & trade
- Without and with swaps

Stylized Facts

FACT 1: Firms' Exposure to Foreign Currency Risk–Are Firms Naturally Hedging?

- Many firms have operational/ financial exposure to foreign currency (FC)
- If FC cash flows in opposing directions → Firms could *naturally hedge*
 - *Natural hedge*: operational hedging matching payables and receivables time t (different from alternatives, self-insuring/borrowing)
- What is the correlation between receivable and payables in FC due the same period?

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- What is the correlation between receivable and payables in FC due the same period?
- Consider all cash flows maturing in t for firm i , month m , industry j

$$X_{i,m}^{CF} = \alpha_0 + \alpha_1 (M_{i,m}^{CF} + FCD_{i,m}^{CF}) + \eta_i + \eta_{j,y} + \varepsilon_{i,m}$$

- $X_{i,m}^{CF}$, Cash-flow-maturing-in- t from export trade credit (log)
- $M_{i,m}^{CF}$, Cash-flow-maturing-in- t from import trade credit (log)
- $FCD_{i,m}$, Foreign currency debt (log); flows/maturities
- Firm FE; industry \times year FE; errors clustered at the firm-level

→ $\alpha = 1$, naturally hedged

Fact 1. Firms' use of natural hedging is limited: Flows maturing in the same period

Dependent variable: (log) Exports trade credit at maturity, X^{CF}							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
M^{CF}	0.027** (0.007)	0.023*** (0.005)					
$M^{CF} + FCD^{CF}$			0.015*** (0.003)				
$M^{CF} \times 1(\text{Trade Only})$				0.017* (0.008)	0.022** (0.007)	0.019*** (0.005)	0.05*** (0.012)
$M^{CF} \times 1(\text{Trade and FX})$				0.027** (0.009)	0.034*** (0.007)	0.029*** (0.006)	0.063*** (0.012)
$M^{CF} \times 1(\text{Trade and FCD})$				0.052** (0.019)	0.058** (0.020)	0.039*** (0.011)	0.079*** (0.018)
$M^{CF} \times 1(\text{Trade and FX and FCD})$				0.033* (0.013)	0.032* (0.015)	0.041*** (0.012)	0.073*** (0.020)
Observations	1,613,353	1,599,768	1,599,768	1,618,731	1,613,353	1,599,768	195,275
R^2	0.85	0.83	0.83	0.85	0.77	0.83	0.88
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry \times Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Include MNC	-	-	-	Yes	-	-	-
Include Mining	Yes	-	-	Yes	Yes	-	-
$X > 0$ and $M > 0$	-	-	-	-	-	-	Yes

Note: All variables in logs, clustered s.e. at firm level in parentheses

- Several Robustness: different t , measurements (including total X, M at t)

→ Little support for hypothesis of natural hedging quantitatively high

FACT 1: Firms' use of natural hedging is limited: Different timing and maturity of flows

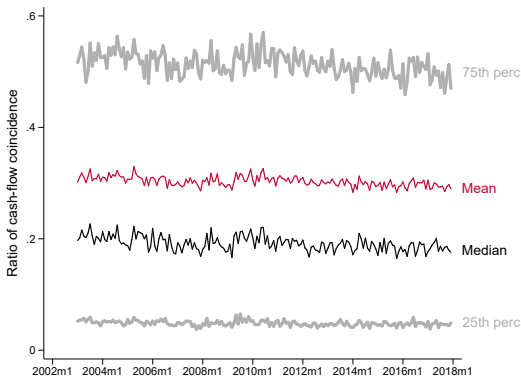
- Different maturities and timing of flows

	Maturity in days							Num. Obs.
	Mean	St. Dev.	Min	p10	Median	p90	Max	
Imports trade credit	91	58	1	30	88	180	540	1,435,762
Exports trade credit	137	94	1	21	115	267	540	433,350
Foreign currency debt	1375	1291	30	90	1099	2880	10830	10,103

- Trade credit for export is 50% longer than for imports
- FC debt has 10 times longer maturity than exports
- Financial/operational milestones: sign contract, pay contract, produce contract, deliver, receive,

→ Different timing: difficult to match the cash flows (“naturally hedge”)

Fact 1: Coincidence of Cash Flows



Note.— All series show moments of within-period distributions of the coincidence measure. Thick gray lines show the 25th and 75th percentiles, solid black line depicts the median, and the dashed black line the mean across observations within a month.

- Alternative ways to manage FC risk: operational hedge; self-insuring; external finance; financial instruments

FACT 2: Do firms fully/partially hedge their FX exposure? For which transactions firms use FX derivatives to hedge?

Table: Trade, Debt, and FX Derivatives: Summary Statistics

	Imports	Export	FC Debt
Trade Credit / Total Trade	0.78	0.82	
Forward/ Trade Credit (Unconditional, all firms)	0.50	0.35	
Forward/ Trade Credit (Conditional, Trade and $FX > 0$)	0.94	0.93	
FX long (CC Swap) / FC Debt (Unconditional, all firms)			0.14
FX long (CC Swap) / FC Debt (Conditional, FC debt > 0)			0.16

Firms mostly use FX derivatives to *partially* hedge short-term financing, principally from trade.

FACT 2: Which transactions firms use FX derivatives to hedge for?

- Contract level analysis: which operations do firms hedge? → not straightforward
- Match an FX contract i with an import/export j using: firm ID, maturity date and (coarsened) amount Iacus et al. (2012). Compare matched vs. unmatched exposures
- Regression at the *transaction* c level, for firm- i in month- m

$$A_{c,i,m} = \alpha_1 \mathbf{1}(Hedged)_c + \eta_i + \eta_m + \epsilon_{c,i,m}$$

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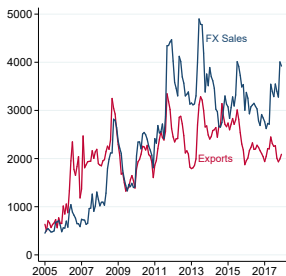
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	A. Exports trade credit (logs)			B. Imports trade credit (logs)		
	2006	2016	2005-2018	2006	2016	2005-2018
	(1)	(2)	(3)	(4)	(5)	(6)
1(Hedged)	0.765*** (0.123)	0.516*** (0.144)	0.630*** (0.110)	0.561*** (0.065)	0.545*** (0.103)	0.591*** (0.047)
Observations	14,948	6,576	213,364	15,146	8,224	196,104
R^2	0.40	0.37	0.32	0.36	0.35	0.31
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Month FE	-	-	Yes	-	-	Yes

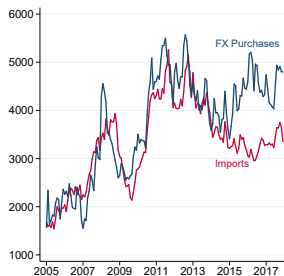
FACT 3: Extensive margin use of FXD: more likely for trade; Intensive margin: **gross**—rather than net—exposure

- A large portion of firms that both import and export, hedge imports and exports separately

(a) Exports and short FX position



(b) Imports and long FX position



Notes: Sample used in this figure excludes firms which have foreign currency debt, to avoid biasing upwards the estimation of the use of FX derivatives. Correlations between series are 0.73 for exports, and 0.84 for imports. This sample also excludes multinational corporations, and mining related companies. Results without exclusion of such firms make the results stronger.

FACT 4: FX derivatives contracts are priced differently: higher for longer contracts, smaller firms

$$FXP_{c,i,b,d} = \beta_1 A_{c,i,b,d} + \beta_2 N_{c,i,b,d} + \beta_3 D_{c,i,b,d} + \beta_4 \mathbf{X}_{i,y} + \eta_i + \eta_{b,m} + \eta_m + \varepsilon_{c,i,b,d}$$

	FX Purchases		FX Sales	
	(1)	(2)	(3)	(4)
Maturity ($N_{c,i,b,d}$)	0.425** (0.197)	0.425** (0.197)	-2.117*** (0.384)	-2.120*** (0.384)
Size (sales) ($\mathbf{X}_{i,y}$)	-0.157* (0.086)	-0.156* (0.087)	0.075 (0.132)	0.076 (0.132)
Notional amount ($A_{c,i,b,d}$)		0.014 (0.052)		-0.046 (0.067)
Delivery instrument ($D_{c,i,b,d}$)		0.158 (0.198)		-0.330 (0.336)
Observations	343,621	343,621	133,424	133,424
R Squared	0.18	0.18	0.22	0.22
Firm FE	Yes	Yes	Yes	Yes
Month FE	Yes	Yes	Yes	Yes
Bank-Month FE	Yes	Yes	Yes	Yes

Notes: S.E. clustered at the firm level. FXP in percentage points. Notional amount: amount hedged (logs) in a given contract. Maturity: days from signing of the contract to its maturity ($N_{t,f,b,i}$). Robustness: complexity, lagged delinquent debt.

Taking Stock

- Firms in international trade are prone to cash-flow currency mismatches
- Benchmark Modigliani-Miller (MM): Hedging adds no value to the firm
 - Firms do use FX derivatives: arguably motivated by market imperfections that deviate from neoclassical assumptions
 - External financing is costly

Taking Stock

- Firms in international trade are prone to cash-flow currency mismatches
- Benchmark Modigliani-Miller (MM): Hedging adds no value to the firm
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- Higher EXR volatility: more FX derivatives ▶ EXR

Additional Robustness *Coincidence, Complexity*

	Extensive Margin		Intensive Margin: Purchases (log)		Intensive Margin: Sales (log)	
	(1)	(2)	(3)	(4)	(5)	(6)
X^{TC}	0.014*** (0.004)	0.018*** (0.004)	-0.003 (0.007)	-0.002 (0.007)	0.030*** (0.009)	0.043*** (0.008)
M^{TC}	0.049*** (0.005)	0.052*** (0.005)	0.144*** (0.015)	0.154*** (0.015)	0.015* (0.008)	0.010 (0.007)
Foreign Currency Debt	-0.012*** (0.004)	-0.015*** (0.005)	-0.001 (0.011)	-0.005 (0.013)	-0.012 (0.011)	-0.015 (0.013)
Managerial constraints						
Coincidence	-0.008** (0.003)	-0.009*** (0.003)	-0.014*** (0.005)	-0.016*** (0.005)	0.005+ (0.003)	0.003 (0.004)
# Import countries	0.008*** (0.002)	0.009*** (0.002)	0.005** (0.002)	0.006** (0.002)	0.008*** (0.002)	0.008*** (0.002)
# Export countries	0.005** (0.002)	0.004** (0.002)	0.007** (0.003)	0.006* (0.003)	0.009*** (0.002)	0.009*** (0.002)
Observations	2296913	2264326	2296913	2264326	2296913	2264326
R Squared	0.53	0.53	0.65	0.65	0.53	0.54
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Year-industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Includes MNC	No	Yes	No	Yes	No	Yes
Includes mining	No	Yes	No	Yes	No	Yes

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Additional Robustness *Exchange Rate Expectations and Volatility*

	A. Extensive margin		B. Int. Margin: Sales (log)		C. Int. Margin: Purchases (log)	
<i>Baseline variables</i>						
	(1)	(2)	(3)	(4)	(5)	(6)
X ^{TC}	0.020*** (0.004)	0.020*** (0.004)	0.047*** (0.008)	0.047*** (0.008)	0.001 (0.007)	0.001 (0.007)
M ^{TC}	0.054*** (0.005)	0.054*** (0.005)	0.012* (0.007)	0.012* (0.007)	0.155*** (0.015)	0.155*** (0.015)
FCD	-0.015*** (0.005)	-0.015*** (0.005)	-0.015 (0.013)	-0.015 (0.013)	-0.005 (0.013)	-0.005 (0.013)
<i>Volatility</i>						
Expectation disp.12m (%), survey	0.051*** (0.007)	0.051*** (0.007)	0.031*** (0.006)	0.016*** (0.006)	0.017** (0.007)	0.028*** (0.007)
<i>Past and expected depreciation</i>						
E[12m depr], survey median	-0.010 (0.008)	-0.011 (0.007)	-0.183*** (0.009)	-0.112*** (0.007)	0.110*** (0.008)	0.058*** (0.008)
Depr trend past 12m		-0.001 (0.001)		0.005*** (0.000)		-0.004*** (0.000)
Observations	2264326	2264326	2264326	2264326	2264326	2264326
R Squared	0.53	0.53	0.54	0.54	0.65	0.65
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Year-industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Includes MNC	No	No	No	No	No	No
Includes mining	No	No	No	No	No	No

Taking Stock

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→ Maturity premium that is heterogeneous across firms (*Fact 4*)

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→ Maturity premium that is heterogeneous across firms (*Fact 4*)

2. But hedging is partial, selection of larger firms, for larger amounts (*Fact 2*)

→ Financial frictions also limit the use of FXD

Taking Stock: Financial Constraints

→ Financial frictions reduce firms' FX derivatives: *cross-section and time series*

	FX=1 (Firm FX derivatives)		Sales FX derivatives		Purchases FX derivatives	
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A. Financial Constraints						
X^{TC}	0.020*** (0.004)	0.019*** (0.004)	0.047*** (0.008)	0.046*** (0.008)	0.000 (0.007)	0.000 (0.007)
M^{TC}	0.054*** (0.005)	0.054*** (0.005)	0.012* (0.007)	0.012* (0.007)	0.155*** (0.015)	0.155*** (0.015)
FCD	-0.015*** (0.005)	-0.016*** (0.005)	-0.015 (0.013)	-0.015 (0.013)	-0.005 (0.013)	-0.005 (0.013)
Delinquency	-0.024*** (0.003)	-0.022*** (0.003)	-0.008** (0.003)	-0.008** (0.003)	-0.016*** (0.003)	-0.015** (0.003)
Credit line		0.011*** (0.002)		0.005** (0.002)		0.007*** (0.002)
Observations	2,264,326	2,264,326	2,264,326	2,264,326	2,264,326	2,264,326
R^2	0.53	0.53	0.54	0.54	0.65	0.65
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Year-industry FE	Yes	Yes	Yes	Yes	Yes	Yes

- Financial constraints limit the use of FX derivatives

Taking Stock

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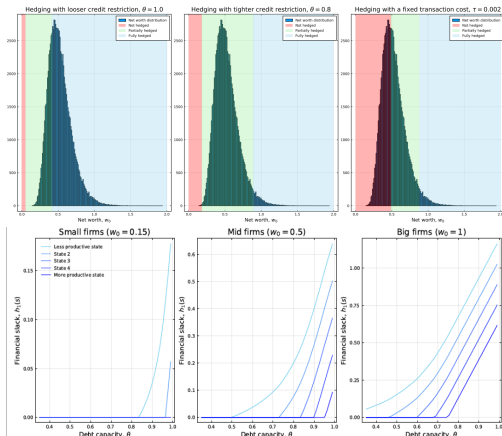
2. But hedging is partial, selection of larger firms, for larger amounts (*Fact 2*)

→ Financial frictions also limit the use of FXD

→ Suggests fixed-costs, *transaction-level* (OTC) ▶ FC Simulations ▶ Inst. Details

Capital Market Imperfections: Collateral Constraints and Transaction Costs (AC, 2022)

Hedging, Firm Size, Collateral, Transaction Costs



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- Buy asset $h_1(s)$ to hedge status s at $t = 1$. For this you must pay τ_0 in all states.

Taking Stock: Financial Constraints, cont.

- Financial constraints limit the use of FX derivatives
- Does hedging add value to the firm? Propensity Score

Does hedging add value to the firm?

- Propensity Score Matching (Rosembaum and Rubin, 1983) and Coarsened Exact Matching (Iacus et al, 2021)

$$\beta = E(Y_1 | FXD \text{ hedging} = 1, X) - E(Y_0 | FXD \text{ hedging} = 0, X) - [E(Y_0 | FXD \text{ hedging} = 1, X) - E(Y_0 | FXD \text{ hedging} = 0, X)]$$

Table: Real Effects: Matching

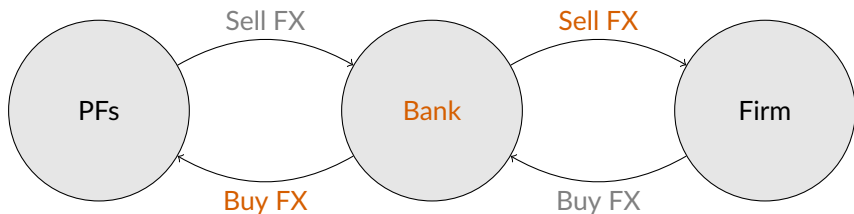
	Panel A: CEM				Panel B: PSM			
	Sales (1)	Imports (2)	Exports (3)	Total trade (4)	Sales (1)	Imports (2)	Exports (3)	Total trade (4)
ATET (2010-14)	0.083*** (0.018)	0.108*** (0.038)	0.012 (0.065)	0.115*** (0.034)	0.144*** (0.026)	0.103** (0.052)	0.184*** (0.070)	0.179*** (0.044)
Observations	17964	16159	2542	17419	55568	47413	14562	53578
ATET (2011-15)	0.129*** (0.019)	0.186*** (0.036)	0.068 (0.057)	0.222*** (0.031)	0.100*** (0.024)	0.221*** (0.060)	0.182** (0.086)	0.271*** (0.050)
Observations	17947	16539	2468	17595	58741	50200	15053	56599
ATET (2011-17)	0.127*** (0.017)	0.166*** (0.030)	0.069 (0.056)	0.190*** (0.027)	0.144*** (0.026)	0.103** (0.052)	0.184*** (0.070)	0.179*** (0.044)
Observations	21245	19819	2872	20821	55568	47413	14562	53578

Notes: Variables: Match: the number of workers, industry, available line of credit, and outstanding accounts payable and receivable (pre-treatment period).

→ Further evidence on real outcomes using an exogenous Supply Shock

Supply Shock FX Derivatives Market

- Pensions Funds and regulation: LIMIT on the share of un-hedged portfolio invested abroad
- In 2012 limits were adjusted
- Announced May 2012, approved June 2012, enforced Dec 2012.
- How did the supply shock get to firms? → Banks



Supply Shock FX Derivatives Market

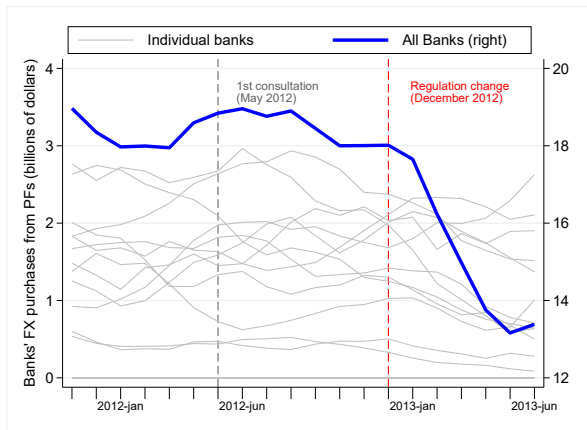


Fig: Banks' purchases of FX derivatives from Pension Funds

Supply Shock FX Derivative Market

1. Average Effects of Supply Shocks
2. Evolution of the Supply Shock: From Banks to Firms (OTC Market)
 - Supply of FX derivatives to firms
 - Price of FX derivatives: forward premium
 - Additional check: from AFPs to Banks
3. Effect of firms' hedging decisions at the intensive and extensive margins, and real/financial effects (Fact 5)

Supply Shock FX Derivatives Market: Average Effect

$$FX_{i,\tau}^{\text{Long}} = \beta_1 Post_{\tau} + \eta_i + \varepsilon_{i,\tau},$$

Purchases of FX derivatives before and after change in regulation

A: 6 month window. Before: Dec 2011-May 2012, After: Dec 2012-May 2013

	Outstanding (log)		Annual Growth (%)	
	(1)	(2)	(3)	(4)
1(Post)	-0.245**** (0.060)	-0.248*** (0.062)	-0.550*** (0.099)	-0.545*** (0.103)
Observations	660	658	616	614
R ²	0.930	0.920	0.48	0.48
Firm FE	Yes	Yes	Yes	Yes
Includes Mining and MNC	Yes	-	Yes	-

Notes: $FX_{i,\tau}^{\text{Long}}$ = log of the average outstanding FX position by firm i in period τ ; $Post_{\tau}$ = 1 Dec 2011-May 2012; Dec 2012-May 2013; Firm FE;

Fact 5. Supply Shock FX Derivatives Market: Firms' FX Hedging and Forward Premium

- Aggregate effects are important: 60% reduction of purchases of FX derivatives and 0.7pp increase in the forward premium (6 month window)

Table: Weighted average estimated supply shock

	FX-derivatives purchase (Growth Rate)	Forward Premium (pp.)
	(1)	(2)
All firms	-0.572*** (0.063)	0.705* (0.357)
Firms in international trade	-0.549*** (0.060)	0.775*** (0.179)

Fact 5. Supply Shock FX Derivatives Market: Firm Effects

- Firms—with multibanking—decreased their imports and size (employment, leverage)
 - Single-banked reduced by more
 - Consistent with hedging adding value to firms who use it
- Exporters lowered their sales of FX derivatives, deepening the initial shock

	FX sales (1)	Imports (2)	Exports (3)	Employment (4)
	Window of N=6 months			
1(Post)	-0.664** (0.324)	-0.141** (0.061)	-0.204 (0.154)	-0.029** (0.013)
Obs.	101	424	189	419
R ²	0.075	0.16	0.14	0.0024

Conclusions and Implications

- Unique census data to assess firms' use of FX derivatives:
 1. Do firms exploit “natural hedging”?
 - Natural hedging is limited (3%) → Different timing payables and receivables in foreign (and local) currency: Role for firms' use of financial hedges
 2. Do firms fully/partially hedge their FX currency exposure?
 - Hedging is partial: firms hedge cash in/out-flows separately.
 3. Which transactions firms use FX-derivatives for?
 - Larger firms (> 26% all worker) hedge larger amounts (50% higher); trade financing exposure.
→ Granularity: importance of large firms on aggregate output (Gabaix, 2011) (2) and (3) → Reduce vulnerabilities
 4. Are FX contracts priced differently across time/firms?
 - Maturity premium and heterogeneous across firms
 5. Does FX add value to the firms? How does the development of the FX derivatives market affect firms' FX hedging decisions?
 - Financial sector plays a key role: drop of 58% in purchases of FX derivatives
 - FX derivatives affect firms' real outcomes and add value to the firm
 - Market thickness/liquidity: key for mitigating risks
 - Financing and risk management decisions are intimately linked.

Currency Hedging: Managing cash-flow exposure

Laura Alfaro

(Harvard & CEPR & NBER)

Mauricio Calani

(Central Bank of Chile)

Liliana Varela

(LSE & CEPR)

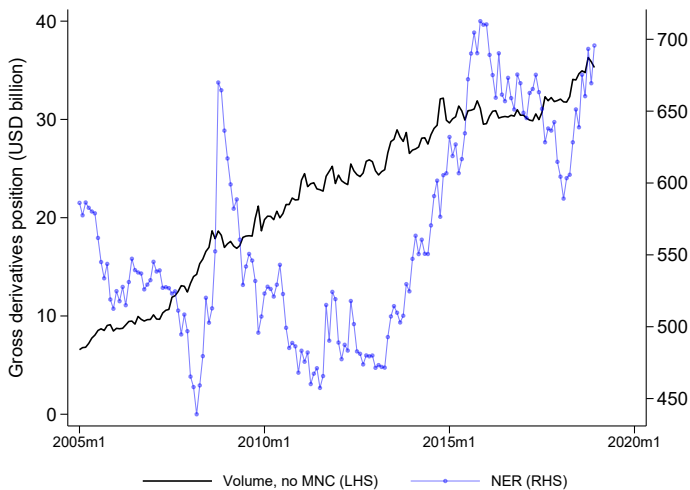
November 2022

Disclaimer: The opinions and assessments expressed in this presentation do not necessarily reflect those of the Central Bank of Chile or its Board Members.

Appendix

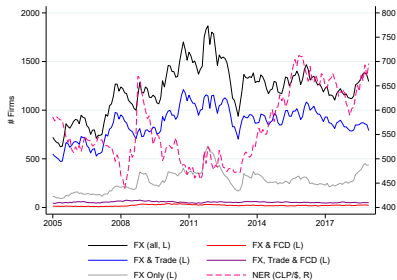
FX derivatives market—Chile

Fig: FX Derivative Position and Exchange rate (peso to US dollars)

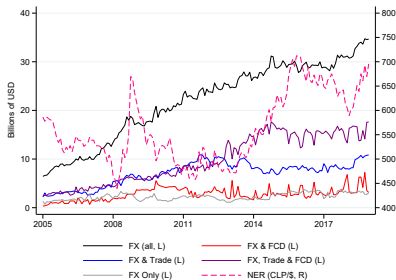


Use of FX derivatives by type of firm

(a) Number of firms



(b) Gross derivative position

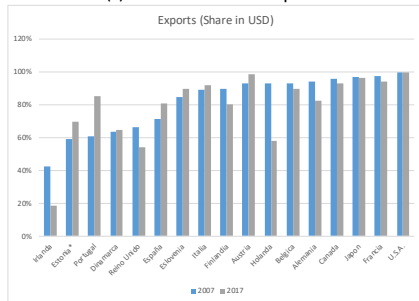


Notes: Categories of firms are mutually exclusive, except for the "(all)" category which includes all the others.

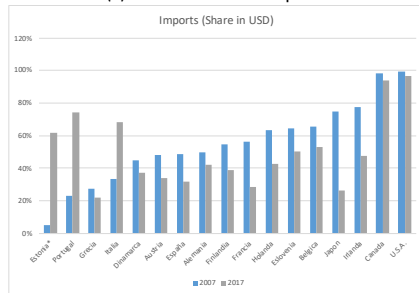
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Currency of Trade

(a) Share of USD in Exports



(b) Share of USD in Imports



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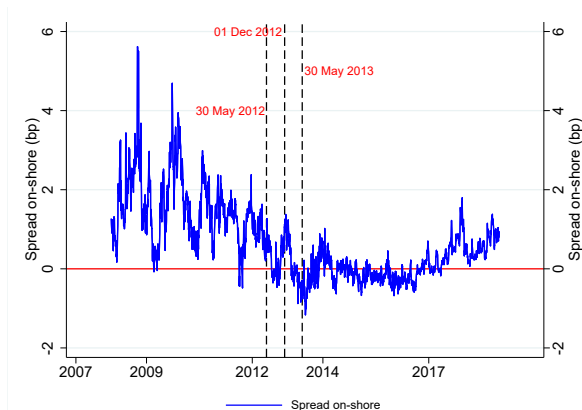
Exchange Rate and Interest Rate

Exchange Rate (CHP/USD) and Interest Rate (3 Months)



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Covered Interest Rate Parity



- $(1 + i_{t,n}^* + x_{t,n}) = (1 + i_{t,n}) * \frac{S_t}{F_{t,n}}$, where $i_{t,t+n}^*$ and $i_{t,t+n}$, n -year risk-free interest rates quoted at date t in U.S. dollars and Chilean pesos; S_t the spot exchange rate, and $F_{t,t+n}$ the n -year outright forward exchange rate signed in t ; x_t , n the measure of CIP deviation.

► [Go back Data](#)

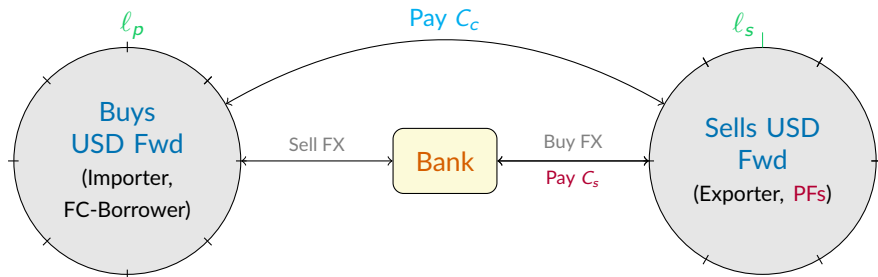
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Fact 3. *Intensive margin: robustness debt*

	(1)	(2)	(3)	(4)
M^{TC}	0.143*** (0.013)	0.135*** (0.016)	0.143*** (0.016)	0.135*** (0.016)
FCD	0.001 (0.013)		0.035* (0.022)	
X^{TC} by exp	0.012 (0.010)	0.013 (0.016)	0.002 (0.009)	0.016 (0.014)
X^{TC} by imp.	0.006 (0.006)	0.026* (0.016)	0.002 (0.067)	0.030** (0.015)
FCD, up to 6 months		0.029 (0.019)		0.033* (0.018)
FCD, 7 to 1 year		0.044* (0.023)		0.041** (0.020)
FCD, 1 years +		0.002 (0.006)		0.003 (0.006)
Observations	2520309	22857366	2121848	2306632
R^2	0.65	0.65	0.69	0.69
Firm FE	Yes	Yes	Yes	Yes
Year-Industry FE	Yes	Yes	Yes	Yes
Includes MNC	Yes	Yes	Yes	Yes
Includes Mining	Yes	Yes	Yes	Yes
Includes Swaps	-	-	Yes	Yes

Notes: Standard errors clustered at the firm level reported in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Sketch of Model-Market Thickness



- Pension funds exit the market temporarily
- Bank **evaluates** **selling** FX derivative ℓ_p , but cannot find a seller of opposite position ℓ_s
- Bank **does not sell** ℓ_s
- Firms who normally sell USD forward, know they cannot later buy, so they too stop selling → pay coordination cost C_c , market is even thinner.

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Model: Dynamic Problem–Rampini Viswanathan (2010)

$$V_t(w(s^t), s^t) = \max_{d(s^t), k(s^t), w(s^{t+1}), h(s^{t+1})} d(s^t) + \beta \mathbb{E}[V_{t+1}(w(s^{t+1}), s^{t+1}) | s^t]$$

subject to

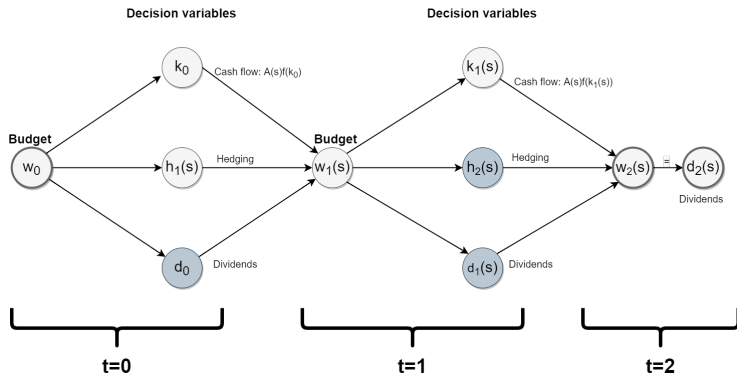
$$w(s^t) \geq d(s^t) + p k(s^t) + R^{-1} \mathbb{E}[h_{t+1} | s^t] \quad (\text{Budget})$$

$$w(s^{t+1}) \leq A(s^{t+1}) f_t(k(s^t)) + q(s^{t+1}) k(s^t) (1 - \theta) + h(s^{t+1}) \quad (\text{Net Worth})$$

$$w(s^{t+1}) > 0 \quad (\text{Positive Net Worth})$$

$$h(s^{t+1}) \equiv \theta q_{t+1}(s) k(s^t) - R b(s^{t+1}) \geq 0 \quad (\text{Credit Restriction})$$

Time Line

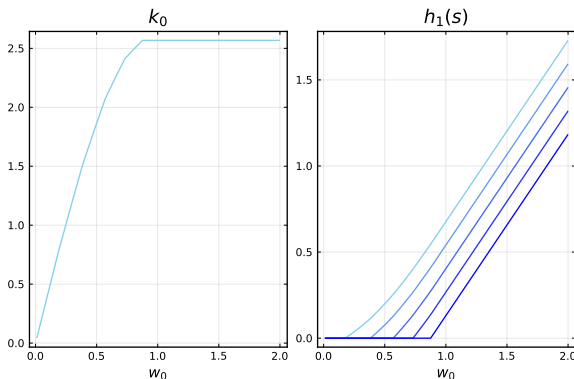


*Darker circles, set to zero (assumed in model)

Time Line

- **At $t=0$** , the firm decides how much to invest in capital and how much debt capacity to maintain for *risk management*.
 - If the firm is small, the capital is very productive, thus the firm does not hold any financial slack.
 - Due to the diminishing return to capital, at some point it is more profitable to maintain debt capacity (to cover bad states of nature) instead of investing it in additional capital.
- **At $t=1$** , due to the productivity assumption $A_2 = 1.5$, the productivity of capital is so high (exogenously, not due to k_0), that the firm will invest all of it in capital and nothing to maintain financial slack. In this way $h_2(s) = 0$ in all states.
- Therefore, the model uncertainty resolves to $t = 0$. Then the problem at $t = 1$ is trivial, since everything is invested in capital.

Results: RV(2010)

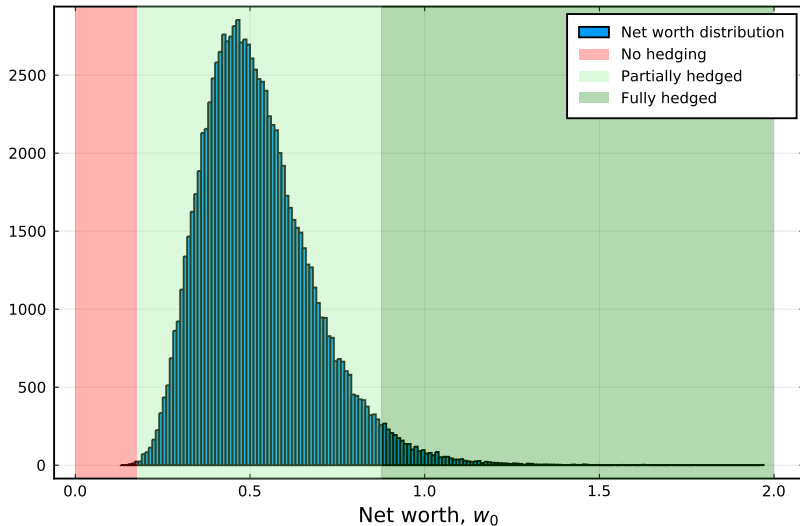


*Darker lines are more productive states according to $A_1(s)$. Left: Shows capital investment. Right: Shows how many resources have been moved to each state. For example, the low-productivity light blue line indicates how many resources were reallocated to that particular state.

Calibration

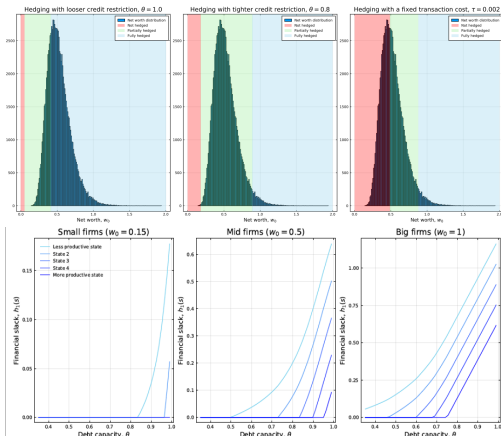
Parameter	Value	Name
$[w_0^{min}, w_0^{max}]$	$[1e-2, 3]$	Initial net worth
N_w	800	Net worth grid points
N_s	5	Number of states
$\pi_{s,s'}$	$1/N_s$	Transition probability
$q_1 = q_2$	1	Price of state contingent claim
β	0.95	Preferences
α	0.33	Technology
θ	0.8	Collateralization rate
R	$1/\beta$	Expected return
$A_1(s)$	$s/10$	Productivity $t = 1$
A_2	1.5	Productivity $t = 2$
$f(k)$	k^α	Technology

Results: RV (2010) Model



Capital Market Imperfections: Collateral Constraints and Transaction Costs (AC, 2022)

Hedging, Firm Size, Collateral, Transaction Costs



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- Buy asset $h_1(s)$ to hedge status s at $t = 1$. For this you must pay τ_0 in all states.