

Foreign Currency Borrowing and Exporter Dynamics in Emerging Markets

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Motivation

- ▶ Firms in emerging markets (EMs) rely on foreign currency (FC) debt for financing (Acharya et al., 2015; Gutierrez et al., 2021)
- ▶ Unexpected exchange rate depreciation \Rightarrow vulnerability due to FC borrowing (Kim, Tesar and Zhang, 2015; Du and Schreger, 2022)

Motivation

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- ▶ Unexpected exchange rate depreciation \Rightarrow vulnerability due to FC borrowing (Kim, Tesar and Zhang, 2015; Du and Schreger, 2022)

This paper

- ▶ Why do firms in EMs borrow in FC?
- ▶ New perspective: interaction between firms' export and currency of financing
 - ▶ Firms in EMs invoice their exports in foreign currency (Gopinath and Itskhoki, 2022)
 - ▶ Extensive and intensive correlations between export and financing currency choice
- ▶ Driving forces behind interaction and associated aggregate implications for EMs

This paper

- ▶ **Empirically:** Correlations between firms' currency choice of financing and exports
 - ▶ Indian firm-level data during 2000-2016
 - ▶ **Extensive margin correlation**
 - After start exporting, higher likelihood and intensity of FC borrowing
 - After stop exporting, lower likelihood and intensity of FC borrowing
 - ▶ **Intensive margin correlation**
 - Among exporters, the top 5% largest exporters borrow more intensively in FC

This paper

- ▶ **Theoretically:** model with heterogeneous firms, exporter dynamics, financial frictions
 - ▶ Endogenous choices of export and **currency of financing**
 - ▶ Potential channels of correlations
 - Natural hedge:** FC revenues from exports can repay FC borrowing
 - Collateral:** FC revenues can serve as better collateral for FC borrowing
 - Cost complementarity:** Exporting firms face reduced fixed costs of FC borrowing

This paper

▶ **Quantitatively:**

- ▶ Discipline model with empirical estimation + Indian financial/export variables
- ▶ **Role of each driving force** in delivering overall correlations
 - Cost complementarity: firm distribution
 - Hedging+Collateral: intensive correlations ↓ + less firms borrow in FC, esp. exporters
 - During depreciation, due to market reallocation, correlations with exports offset currency risk of FCB
- ▶ **Aggregate implications of FCB depends on correlations with exports**
 - ▶ Without FCB, output losses during depreciation would be underestimated by 22.9%
 - ▶ Compared to a model without correlations with exports, the output losses due to FCB are underestimated by 31.9%

Literature

▶ **Interaction between trade and financial friction**

Manova (2013); Feenstra et al. (2014); Leibovici (2021); Kohn et al. (2016, 2020, 2022)

▶ **Popularity of foreign currency-denominated debt in EMs**

-Carry trade (Caballero et al., 2016; Bruno and Shin, 2017; Acharya and Vij, 2020)

-Hedging from exchange rate exposure (Froot et al., 1993; Alfaro et al., 2023)

-Trade position (Harasztosi and Kátay, 2020; Jiao and Kwon, 2022)

▶ **Balance-sheet effects of foreign currency-denominated debt in EMs**

Calvo and Reinhart (2002); Kim Tesar and Zhang (2015); Du and Schreger (2022)

-New empirical evidence on the extensive margin dynamic correlations

-A heterogeneous firm model with flexible currency of financing decisions

-Quantify importance of correlations with real activities in evaluating aggregate implications of FCB

Outline

Introduction

Empirical facts

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Quantitative analysis

Conclusion

Empirical analysis

▶ **Correlations** between export v.s. currency of financing

▶ Extensive margin: exporters vs non-exporters [▶ Go](#)

▶ Intensive margin: firms with large exports vs small exports [▶ Go](#)

▶ Extensions and Robustness [▶ Go](#)

- ▶ **Prowess database:** Centre for Monitoring Indian Economy (CMIE) Pvt. Ltd.
- ▶ **Financial performance** of Indian firms: 2000-2016 [▶ Sample description over time](#)
 - ▶ Information on all listed firms and a large set of unlisted firms
 - ▶ Clean to annual frequency
- ▶ Data on **currency composition of financing** + **export activities**
 - ▶ Foreign currency borrowings: any loan taken in FC other than Indian rupees [▶ Definition](#)
- ▶ Focus on **non-financial firms**
 - ▶ Manufacturing, mining, electricity, non-financial services and construction firms

Effects of entering export market on FCB

▶ Back: contents

- ▶ Local projection with a clean control condition (Dube et al., 2023)

$$y_{i,t+h} - y_{i,t-1} = \alpha^h \Delta D_{it} + Z' \beta + \eta_t^h + e_{it}^h, \quad h = 0, 1, 2, 3, 4, 5$$

restricting sample to observations that are either

$$\left\{ \begin{array}{ll} \text{new exporters} & \Delta D_{it} = 1, \\ \text{or never exporting before (clean control)} & D_{i,t+h} = 0. \end{array} \right.$$

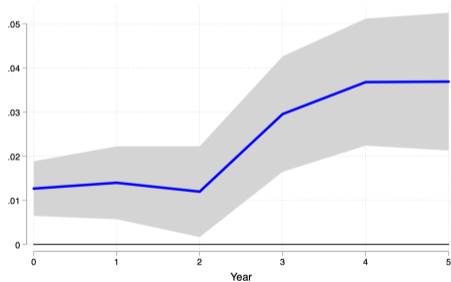
- ▶ $y_{i,t}$: indicator for financing in FC ($I_{FCB,it}$), intensity FC borrowing ($S_{FCB,it}$)
- ▶ $\Delta D_{it} = 1$: firm i first entering export market at time t
- ▶ α^h : cumulative change in dependent variable after entering export market

Results: effects of entering export market

[▶ Back: contents](#)

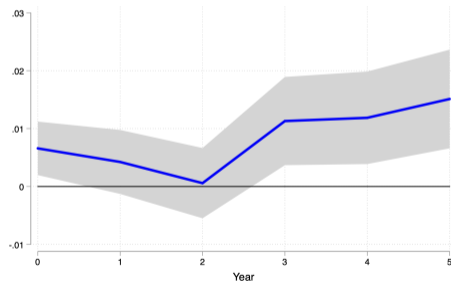
[▶ Other](#)

- ▶ After **entering** export market
 - ▶ Likelihood of financing in FC increases by 1.2-3.7pp (19%-60% of average)
 - ▶ Intensity of FCB increases by 0.1-1.5pp, conditional on ever borrowing in FC (0.8%-11.4% of average)



Note: 90% confidence bands displayed

(a) Likelihood of FCB



Note: 90% confidence bands displayed

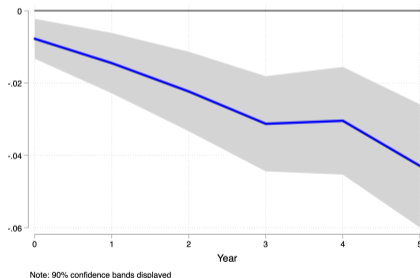
(b) Intensity of FCB

Results: effects of exiting export market

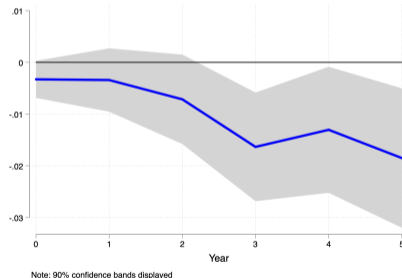
▶ [Back: contents](#)

▶ [Other](#)

- ▶ $\Delta D_{it} = 1$: firm exits export market and never export since then
- ▶ After **exiting** export market
 - ▶ Likelihood of financing in FC falls by 0.8-4.3pp (14%-68% of average)
 - ▶ Intensity of FCB falls by 0.3-1.9pp, conditional on ever borrowing in FC (3%-13% of average)



(a) Likelihood of FCB



(b) Intensity of FCB

Export intensity v.s. FCB

[▶ Back: contents](#)[▶ Quartile](#)

- ▶ Conditional on ever borrowing in FC, larger exporters borrow more intensively in FC
- ▶ Top 5% largest exporters have significantly higher intensity of FCB
- ▶ Non-linear correlation

By export intensity	Intensity of FCB
Non-exporters	0.132
$\leq p(95)$	0.128
$> p(95)$	0.199

FCB intensity = FCB/total liability; export intensity =
export / sales.

Robustness

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- ▶ Including Re-entry Exporters does not bias baseline results [▶ New entrants](#)
 - ▶ Export dynamics after first entering/exiting don't bias baseline results
- ▶ Baseline results are not driven by multinational corporations [▶ No MCNs](#)
- ▶ Sample: 1988-2016 [▶ 1988-2016](#)
 - ▶ Sample incorporating trade liberalization
- ▶ Sample: manufacturing industry [▶ Manufacturing](#)
 - ▶ Correlations are robust
 - ▶ Extensive margin of FCB is more responsive
- ▶ Extensive margin of trade: local projection following Jordà (2005) [▶ LP without clean control](#)

▶ Other tests

▶ More than hedging

Summary of empirical findings

- ▶ **Correlations** between export v.s. currency of financing
 - ▶ After entering (exiting) export market, likelihood and intensity of FCB increase (decrease)
 - ▶ Among exporters, top 5% largest exporters borrow more intensively in FC
- ▶ What are **driving forces and aggregate implications** of observed correlations?
 - ▶ A heterogenous firm model with endogenous export and currency of financing decisions
 - ▶ Potential channels for correlations
 - ▶ Allow to discipline model with data evidence

Outline

Introduction

Empirical facts

Model

Quantitative analysis

Conclusion

Set-up

- ▶ **A small open economy**
 - ▶ Heterogenous firms produce, sell to domestic + foreign
 - ▶ Borrow for investment by issuing bonds denominated in home and foreign final goods
- ▶ **Firms face both trade and financial frictions**
 - ▶ Trade frictions: fixed export cost + iceberg cost
 - ▶ Financial frictions: collateral constraints + fixed cost of FC borrowing
- ▶ Idiosyncratic productivity shock (z_{it}) + aggregate exchange rate shock (e_t)

Entrepreneurs

- ▶ A unit measure of monopolistically competitive **entrepreneurs** $j \in [0, 1]$

- ▶ Preference: $\mathbb{E}_0 \sum_{t=0}^{\infty} \beta^t \frac{c_{jt}^{1-\gamma}}{1-\gamma}$

- ▶ Produce using capital

- ▶ Sell to final goods producers y_{jt} and foreign market y_{jt}^* (may not export)

$$y_{jt} + \tau x_{jt} y_{jt}^* = A_t z_{jt} k_{jt}^\alpha$$

- ▶ Iceberg costs ($\tau > 1$)

- ▶ x_{jt} : 1 if firm j exports at time t

- ▶ Borrow in bonds denominated in both home and foreign final goods

- ▶ Entrepreneurs accumulate capital following

$$k_{j,t+1} = (1 - \delta)k_{jt} + i_{jt}$$

Entrepreneurs: financial friction

▶ Collateral constraints

$$b_{i,t+1} \leq \theta (p_{it}y_{it} + x_{it}e_t p_{it}^* y_{it}^*)$$
$$e_t b_{i,t+1}^* \leq \theta^* (p_{it}y_{it} + x_{it}e_t p_{it}^* y_{it}^*),$$

- ▶ p (p^*): price in domestic (foreign) market, denominated in home (foreign) final goods
 - ▶ $e_t = P_t^*/P_t \equiv 1/P_t$: exchange rate (exogenous)
 - ▶ EMs collateral borrowing constraints more depend on cash flows, rather than assets (Lian and Ma, 2021; Camara and Sangiácomo, 2022)
-
- ▶ **Fixed cost of financing in FC**, f^* , if borrowing in FC
 - ▶ Costly to verify firms' financial information

Entrepreneurs: trade v.s. financial costs

- ▶ If **not borrowing in FC** (in unit of domestic final good)

$$F(x_{j,t-1}, x_{jt}, b_{j,t+1}^* = 0) = \begin{cases} 0 & \text{for } x_{jt} = 0, \\ x_{j,t-1} f_1^x + (1 - x_{j,t-1}) f_0^x & \text{for } x_{jt} = 1. \end{cases}$$

- ▶ If **borrowing in FC**,

$$F(x_{j,t-1}, x_{jt}, b_{j,t+1}^* > 0) = \begin{cases} f^* & \text{for } x_{jt} = 0, \\ \zeta [f^* + x_{j,t-1} f_1^x + (1 - x_{j,t-1}) f_0^x] & \text{for } x_{jt} = 1. \end{cases}$$

- ▶ ζ : degree of cost **complementarity** between trade costs (f_0^x, f_1^x) and FC financing cost (f^*)
 - ▶ Cost of settlement using foreign currency is partly paid when invoicing trade in foreign currency

Entrepreneurs' problem

- ▶ Entrepreneurs choose consumption, borrowings, pricing plans and export status

$$V(z, k, b, b^*, x_{-1}, e) = \max_{c, p, y, p^*, y^*, k', b', b^*, x} \frac{c^{1-\gamma}}{1-\gamma} + \beta \mathbb{E}_{z', e' | z, e} V(z', k', b', b^*, x, e')$$

$$\text{s.t. } c + k' + b + eb^* = py + xep^*y^* + (1 - \delta)k + \frac{b'}{1+r} + e\frac{b^*}{1+r^*} - F(x_{-1}, x, b^*)$$

$$y + \tau xy^* = Azk^\alpha,$$

$$b' \leq \theta (py + xep^*y^*),$$

$$eb^* \leq \theta^* (py + xep^*y^*),$$

$$y = (p/P)^{-\sigma} Y = (ep)^{-\sigma} Y \quad ,$$

$$y^* = (p^*/P^*)^{-\sigma} Y^* = (p^*)^{-\sigma} Y^*$$

- ▶ Export if $V(z, k, b, b^*, x_{-1}, e)|_{x=1} \geq V(z, k, b, b^*, x_{-1}, e)|_{x=0}$

▶ Stationary Equilibrium

▶ FOCs

▶ ss

▶ Extension

Mechanisms: correlations between export and currency of financing

- ▶ **Natural hedge:** FC revenues are used to repay FC borrowing (one-to-one) ▶ Statistics

- ▶ **Collateral:** FC revenues serve as better collateral for FC borrowing

Exporters	Non-exporters
$b' \leq \theta (py + ep^*y^*)$	$b' \leq \theta py$
$b^{*'} \leq \theta^* (py/e + p^*y^*)$	$b^{*'} \leq \theta^* py/e$

- ▶ **Cost complementarity:** exporters face reduced fixed cost of FC borrowing ($\zeta < 1$)

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Quantitative analysis

- ▶ **Parameterization** to India micro- and macro data during 2000-2016
 - ▶ Identify correlations using Indian financial/export variables and empirical estimation
- ▶ **Mechanisms** ▶ Role of correlations
 - ▶ Correlations with exports mitigate currency risk of FCB during depreciation
- ▶ **Evaluate aggregate effects of FCB in EMs**
 - ▶ Compare with a model without FCB \Rightarrow aggregate impact of FCB
 - ▶ Counterfactual w/o correlations: producer currency pricing w/o cost complementarity
 - ▶ Compare the impacts of FCB between benchmark and counterfactual model

Shocks

- ▶ Productivity shock z follows AR(1)

$$\log(z_{it}) = \rho_z \log(z_{i,t-1}) + \sigma_z \varepsilon_{it}, \quad \varepsilon_{it} \sim N(0, 1), \quad (1)$$

- ▶ Exchange rate shock e follows AR(1)

$$\log(e_t) = \rho_e \log(e_{t-1}) + \sigma_e \varepsilon_t, \quad \varepsilon_t \sim N(0, 1), \quad (2)$$

Fitted parameters

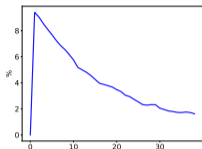
Parameter	Description	Value	Target/Source
β	Discount factor	0.88	Total leverage
σ_z	Volatility of z	0.12	Standard deviation of sales
θ	Collateral requirement of HCB	0.9	Average response of S_{FCB} after entering
θ^*	Collateral requirement of FCB	0.34	Average response of S_{FCB} after exiting
θ_k	Adjustment cost of capital	0.01	Intensity of FCB, (if with FCB and exports)
r	Interest rate of HCB	0.09	Intensity of FCB, (if with FCB)
τ	Iceberg cost	1.40	Export intensity conditional on exporting
f_0^x	Export entry cost	1.00	Export enter rate
f_1^x	Export fixed cost	0.35	Share of exporting firms
f^*	Fixed cost of FCB	0.29	Share of firms holding FCB
ζ	Cost complementarity between f^x and f^*	0.65	Share of firms both exporting and holding FCB

► Fixed parameters

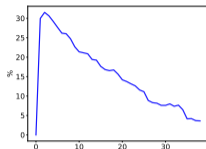
Moments in data and model: targeted moments

Targeted	Data	Model
Leverage	0.42	0.35
Std(sales)	0.33	0.30
Average response of S_{FCB} after entering	0.01	0.02
Average response of S_{FCB} after exiting	-0.01	-0.02
FCB intensity, conditional on with FCB	0.13	0.08
FCB intensity, conditional on with FCB and exports	0.11	0.08
Export intensity, conditional on exporting	0.29	0.33
Export enter rate	0.03	0.04
Share of exporting firms	0.31	0.20
Share of firms holding FCB	0.07	0.07
Share of firms both exporting and holding FCB	0.04	0.05

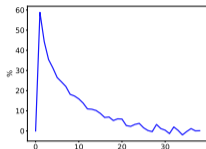
Mechanisms



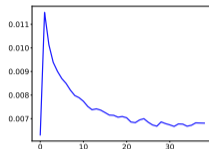
(a) Real exchange rate



(b) Export intensity



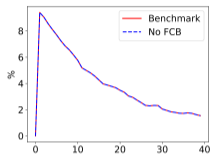
(c) FCB intensity



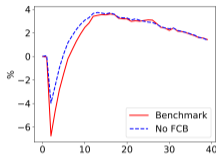
(d) b'^*/b'

- ▶ During depreciation, currency risk \uparrow + tight collateral constraint \Rightarrow less FCB
- ▶ During depreciation, exports go up \Rightarrow more FCB due to correlations
- ▶ Benchmark: correlations with exports offset negative balance sheet effects
 - ▶ Market reallocation relaxes exporters' collateral constraints of b'^* + hedging
 - ▶ More exporters enter the market

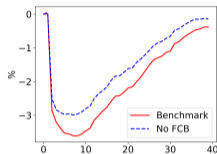
Aggregate impact of FCB



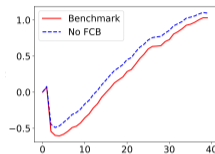
(a) e



(b) b



(c) k



(d) $y + \tau y^*$

- ▶ Trade-off of FCB
 - ▶ Benchmark: currency risk + lower cost of FCB + correlations with exports
 - ▶ No-FCB model: no currency risk, but higher borrowing cost of HCB
- ▶ Without FCB, underestimate the output and capital losses from the depreciation shock by 22.9% and 16.7%, respectively

Aggregate impact of FCB: role of correlations

- ▶ Counterfactual: PCP without cost complementarity
 - ▶ Benchmark: currency risk + lower cost of FCB + correlations with exports
- ▶ Without correlations, output and capital losses due to FCB during depreciation are underestimated by 31.9% and 25.7%, respectively

Parameters	Benchmark	No-correlations
β	0.88	0.9
θ	0.9	1.9
θ^*	0.34	0.3
r	0.09	0.07
f_1^x	0.35	0.25
f_0^x	1	1.2
f^*	0.29	0.025
ζ	0.65	1
Moments		
Std(sales)	0.30	0.33
Leverage	0.35	0.30
FCB intensity, conditional on with FCB	0.08	0.07
FCB intensity, conditional on with FCB and exports	0.08	0.06
Average response of S_{FCB} after entering	0.02	0.01
Average response of S_{FCB} after exiting	-0.02	-0.002
Share of firms holding FCB	0.07	0.04
Share of firms both exporting and holding FCB	0.05	0.03

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Conclusion

- ▶ This project provides a toolkit to empirically, theoretically, and quantitatively **identify the degree of correlations** and **evaluate the aggregate implications of FCB in EMs**

- ▶ **Why do firms in EMs borrow in FC?**
 - ▶ Hedging + collateral + cost complementarity
 - ▶ Exporters face 35% lower cost of FC borrowing
 - ▶ Without accounting for these correlations, aggregate output losses due to FCB during depreciation are underestimated by 32%

Conclusion

- ▶ This project provides a toolkit to empirically, theoretically, and quantitatively **identify the degree of correlations** and **evaluate the aggregate implications of FCB in EMs**

- ▶ **Why do firms in EMs borrow in FC?**
 - ▶ Hedging + collateral + cost complementarity
 - ▶ Exporters face 35% lower cost of FC borrowing
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Thank you!

Appendix

India: Effective Exchange Rate

- ▶ India has been operating on a managed floating exchange rate regime from March 1993, marking the start of an era of a market determined exchange rate regime of the rupee with provision for timely intervention by the central bank [▶ Back](#)
- ▶ 2020: #6 economy in GDP (current US\$); #18 in total exports; #12 in total imports

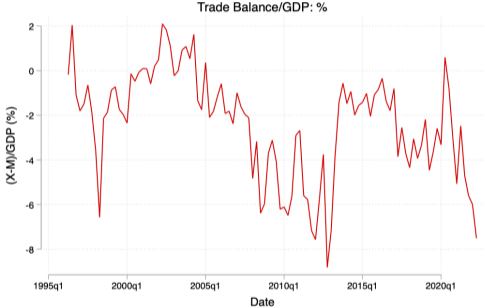


India: Exchange Rate to USD

- ▶ Depreciation towards USD over time



India: Trade vs GDP



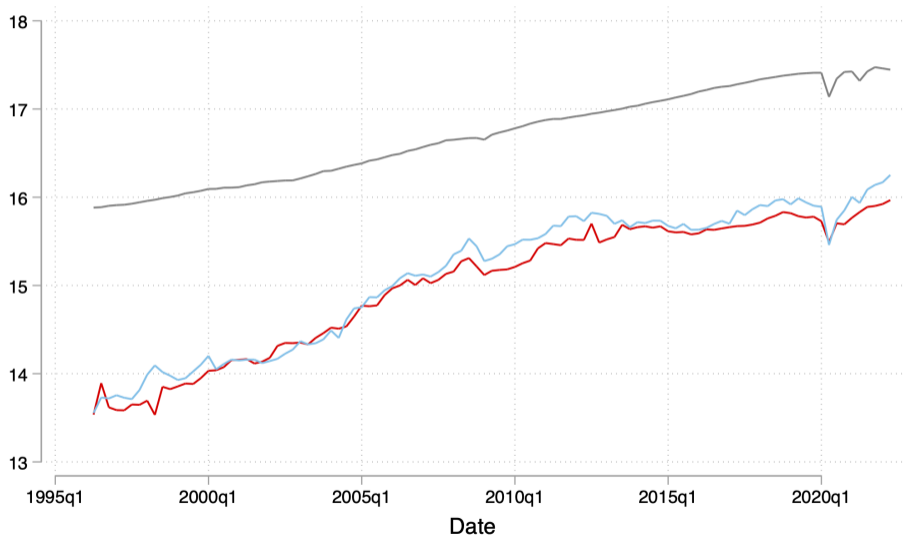
Notes: Real NA, seasonally adjusted, domestic currency, IMF IFS

India: Trade vs GDP, conti

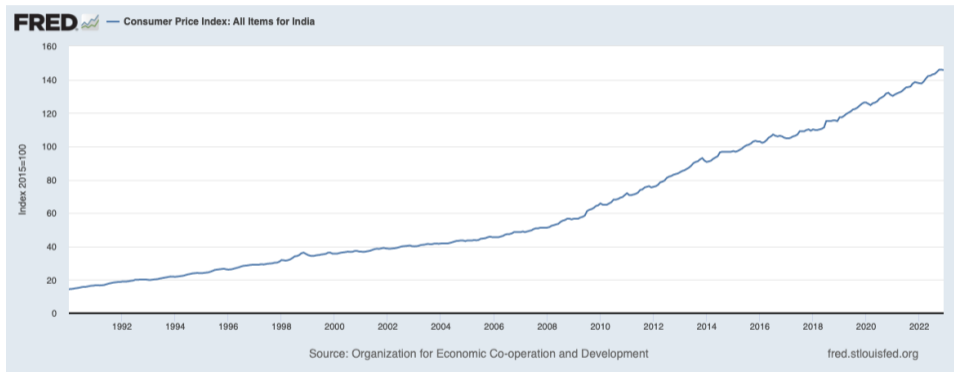


Notes: Real NA, seasonally adjusted, domestic currency, IMF IFS

India: Trade vs GDP, conti

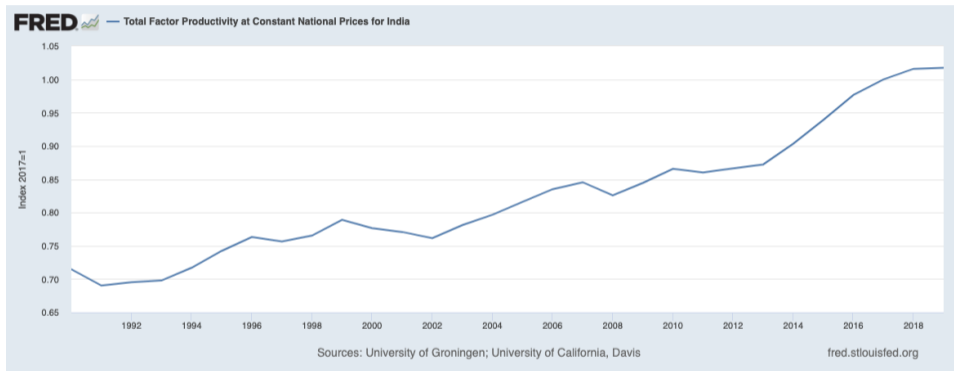


India: CPI



Notes: Consumer Price Index: All Items for India, Index 2015=100, Monthly, Not Seasonally Adjusted, FRED

India: TFP

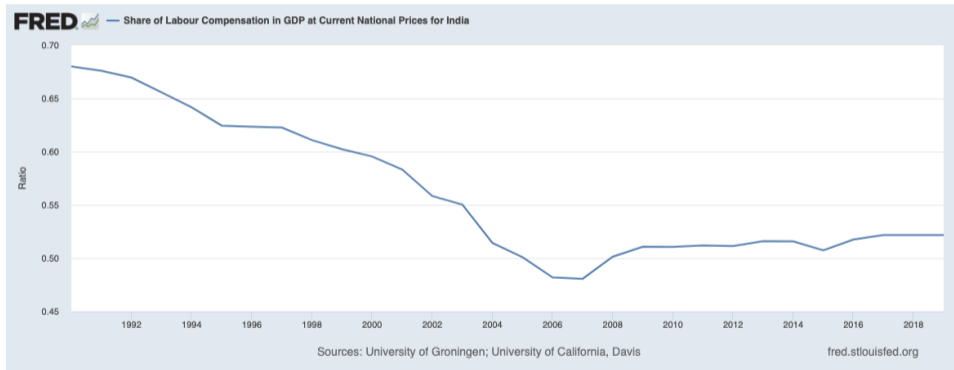


Notes: Total Factor Productivity at Constant National Prices for India, Index 2017=1, Annual, Not Seasonally

Adjusted, FRED

India: labor share

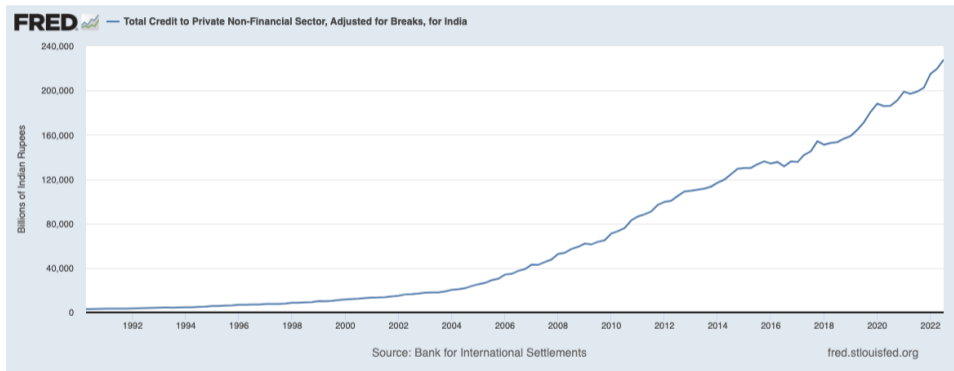
- ▶ Mean=0.574, during 1988-2016



Notes: Share of Labour Compensation in GDP at Current National Prices for India, Ratio, Annual, Not Seasonally

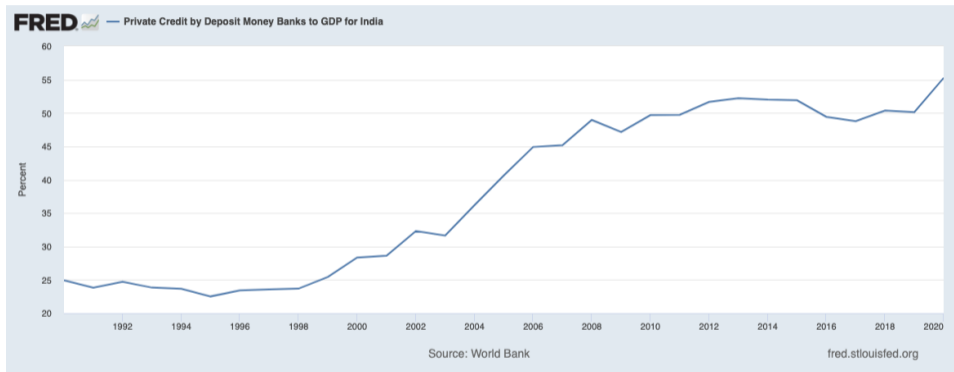
Adjusted, FRED

India: credit to private sector (level)



Notes: Total Credit to Private Non-Financial Sector, Adjusted for Breaks, for India, Billions of Indian Rupees, Quarterly, Not Seasonally Adjusted, FRED

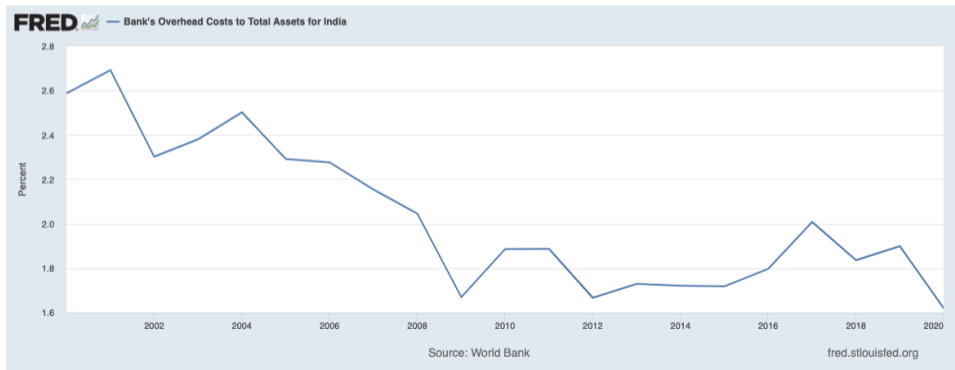
India: credit-to-GDP



Notes: Private Credit by Deposit Money Banks to GDP for India, FRED

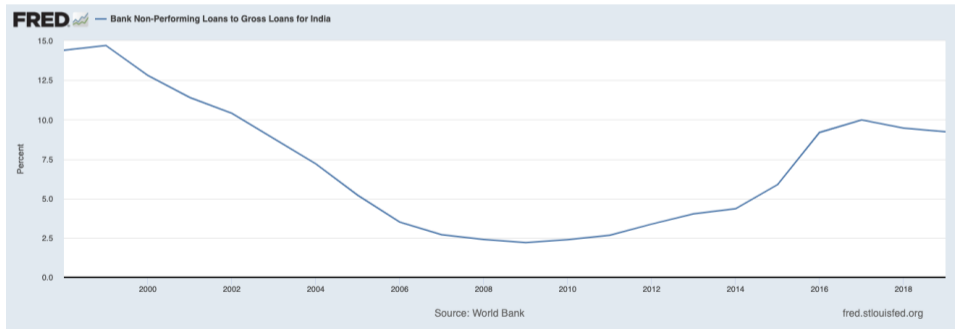
India: bank's overhead costs

- ▶ Operating expenses of a bank as a share of the value of all held assets. Total assets include total earning assets, cash and due from banks, foreclosed real estate, fixed assets, goodwill, other intangibles, current tax assets, deferred tax, discontinued operations and other assets.



India: bank non-performing Loans

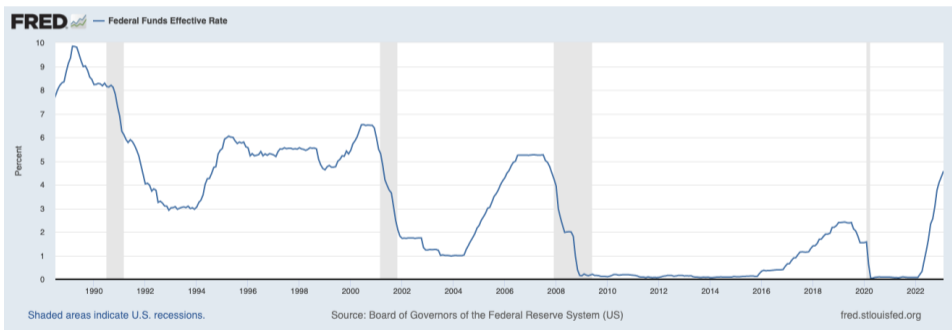
- ▶ Ratio of defaulting loans (payments of interest and principal past due by 90 days or more) to total gross loans (total value of loan portfolio). The loan amount recorded as nonperforming includes the gross value of the loan as recorded on the balance sheet, not just the amount that is overdue.



Notes: Bank Non-Performing Loans to Gross Loans for India, Percent, Annual, Not Seasonally Adjusted, FRED

U.S. federal funds effective rate

- ▶ The federal funds rate is the interest rate at which depository institutions trade federal funds (balances held at Federal Reserve Banks) with each other overnight.

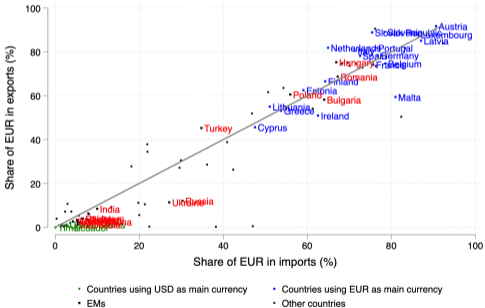
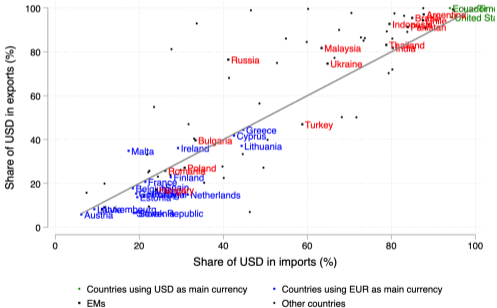


Notes: Federal Funds Effective Rate, Percent, Monthly, Not Seasonally Adjusted, FRED

Motivation: Dominant Currency in EMEs trade

► Using database from Boz et al.(2020), EMEs mainly use vehicle currencies.

► High FX exposure [▶ Back: Motivation](#)



Indian Disclosure Revise

- ▶ Since the financial year 2011-12, all companies apart from banking companies present their financial data in the revised schedule VI disclosure format of the Companies Act, 1956, which is in accordance with the IFRS requirements.
- ▶ Accordingly, a company's foreign currency borrowings are also required to be segregated into non-current and current categories. Foreign currency borrowings captures the sum of both, long term as well as short term components.
- ▶ Although data pertaining to long term and short term classification of a company's foreign currency borrowings is captured in separate fields on Prowess from 2011-12 onwards, such a segregation of data is not available prior to 2011-12.

Definition: foreign currency borrowings

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▶ [Back: data](#)

- ▶ Foreign currency borrowings in CMIE'S ProwessIQ:
any loan taken in foreign currency other than Indian rupees
- ▶ Loans taken from
 - ▶ Foreign banks, Indian banks, foreign branches of Indian banks
 - ▶ Export-Import banks
 - ▶ Multinational lending institutions: World Bank, IBRD, and the Asian Development Bank, external commercial borrowings (ECBs), global depository receipts (GDRs) and American depository receipts (ADRs)
- ▶ Also including external commercial borrowings
 - ▶ Convertible bonds, non-convertible bonds, subordinated debt
- ▶ Also including foreign suppliers' credit (capital goods, not trade credit)

Summary statistics

[▶ Back: Data](#)

	N	Mean	Std. Dev.	min	max	p25	Median	p75
$\mathcal{I}_{starter}$	235877	0.017	0.131	0	1	0	0	0
\mathcal{I}_{exiter}	235877	0.016	0.124	0	1	0	0	0
\mathcal{I}_{FCB}	235877	0.065	0.246	0	1	0	0	0
\mathcal{I}_{exp}	235877	0.306	0.461	0	1	0	0	1
Export intensity	235877	0.088	0.222	0	1	0	0	0.015
Conditional S_{FCB}	12765	0.13	0.099	0	0.369	0.046	0.109	0.199

Table: Statistics of Exports, Imports, Foreign Currency Borrowing

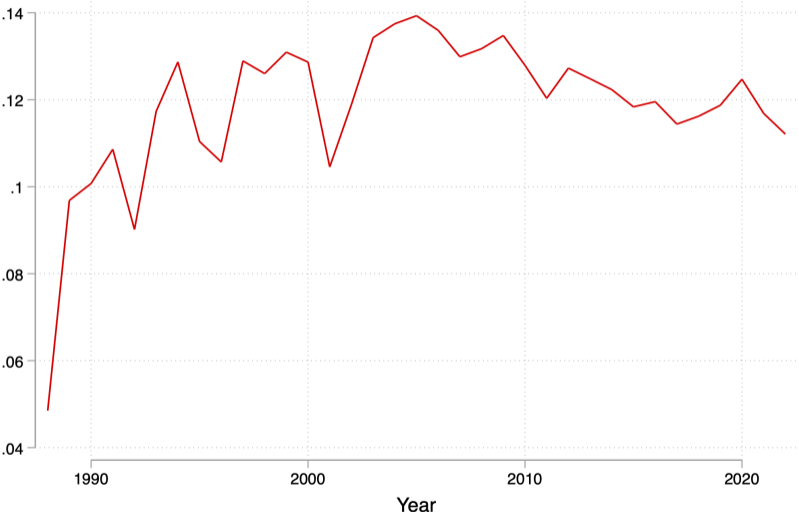
	N	Mean	SD	Min	Max	p25	Median	p75
ln(exports)	8602	1.806	2.086	-5.714	5.744	0.62	2.116	3.281
ln(imports)	8602	1.52	2.079	-5.745	5.728	0.27	1.699	3.015
ln(frqn-borr)	8602	1.427	1.788	-3.812	6.149	0.176	1.426	2.693

Sample: probability of borrowing in FC [▶ Back: data](#)



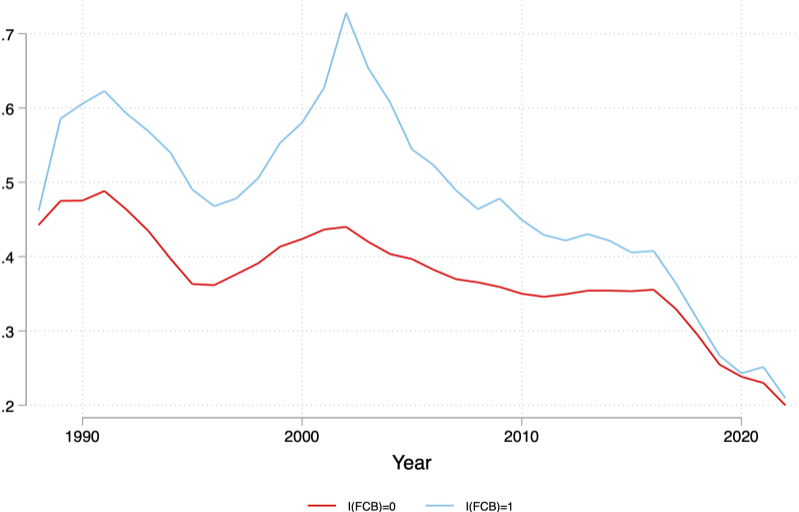
Sample: FCB intensity, conditional on with FCB

[▶ Back: data](#)



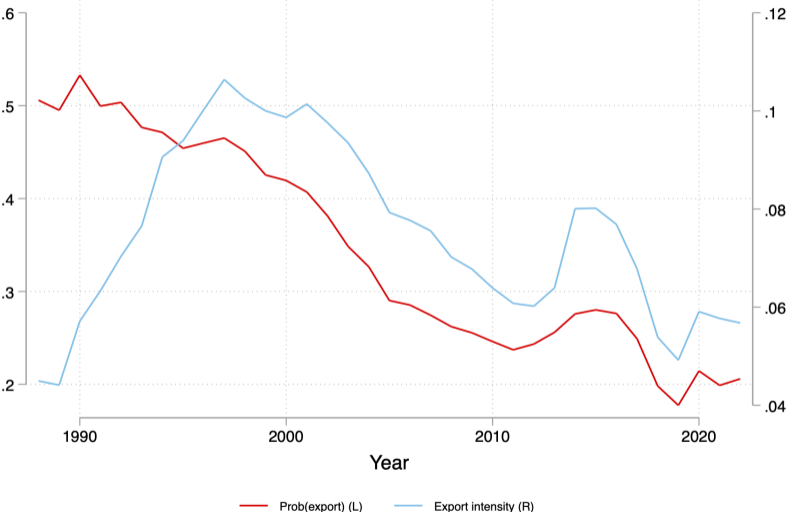
Sample: leverage

[▶ Back: data](#)



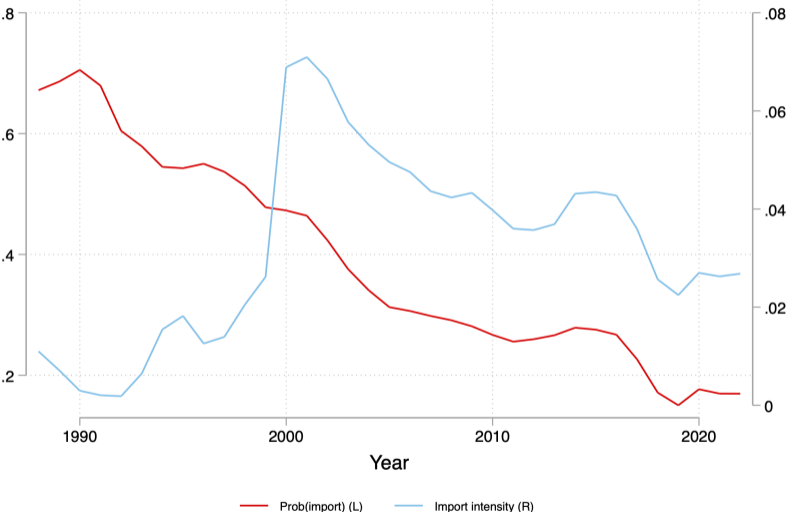
Sample: exports

[▶ Back: data](#)



Sample: import

[▶ Back: data](#)



Trade intensity v.s. FCB ▶ Back: intensive

- ▶ Firms with higher export intensity are more likely to borrow in FC
- ▶ Conditional on ever issuing FCB, firms borrow more intensively in FC

By export intensity	Prob(FCB)	FCB intensity
Non-exporters	0.032	0.132
(0,Q1)	0.109	0.123
[Q1,Q2)	0.132	0.122
[Q2,Q3)	0.163	0.121
[Q3,Q4]	0.151	0.151

FCB intensity = FCB/total liability; export intensity = export / sales.

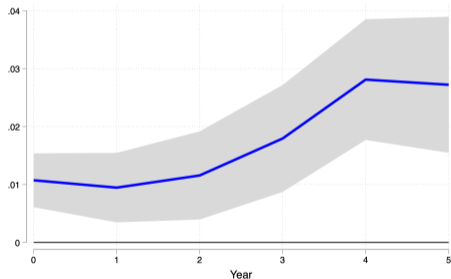
Results: effects of entering export market

▶ [Back: contents](#)

▶ [Back: robustness](#)

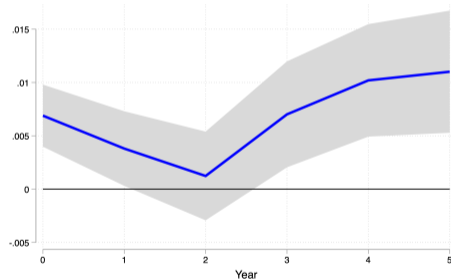
▶ After newly **entering** export market

- ▶ Likelihood of financing in FC increases by 0.9pp-3.0pp
- ▶ Intensity of FCB increases by 0.2pp-1.0pp, conditional on ever issuing FCB



Note: 90% confidence bands displayed

(a) Likelihood of FCB



Note: 90% confidence bands displayed

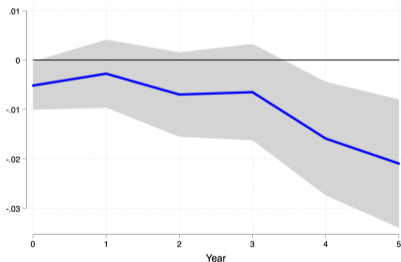
(b) Intensity of FCB

Results: effects of exiting export market

▶ [Back: contents](#)

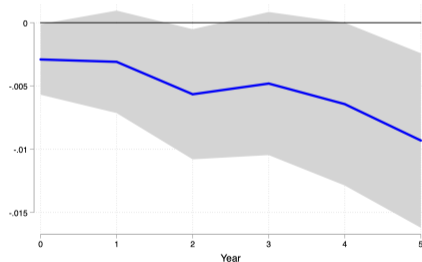
▶ [Back: robustness](#)

- ▶ $\Delta D_{it} = 1$: company exits export market and never export since then
- ▶ After **exiting** export market
 - ▶ Likelihood of financing in FC falls by 0.3pp-1.9pp
 - ▶ Intensity of FCB falls by 0.2pp-1.1pp, conditional on ever issuing FCB



Note: 90% confidence bands displayed

(a) Likelihood of FCB



Note: 90% confidence bands displayed

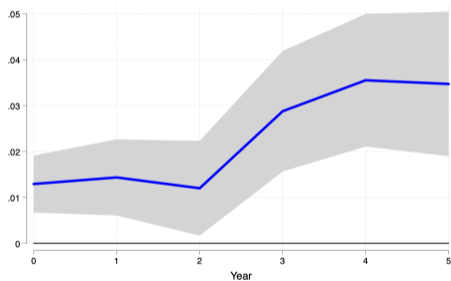
(b) Intensity of FCB

Results: after entering, No MNCs

▶ [Back: contents](#)

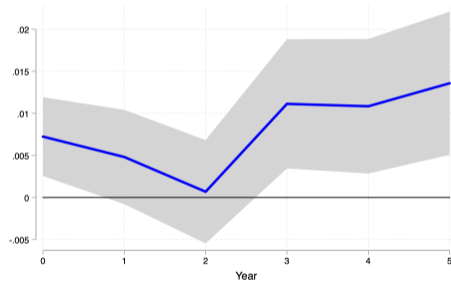
▶ [Back: robustness](#)

- ▶ MNCs are defined as firms with a foreign equity share of 10% or more
- ▶ Drop about 670 firms, about 2% of baseline sample



Note: 90% confidence bands displayed

(a) Likelihood of FCB



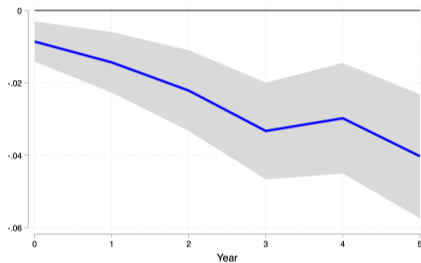
Note: 90% confidence bands displayed

(b) Intensity of FCB

Results: after exiting, No MNCs

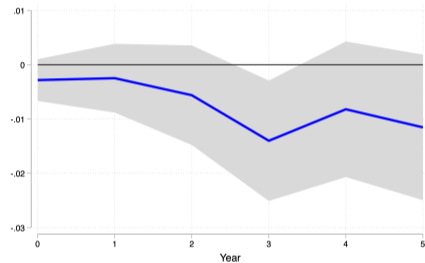
[▶ Back: contents](#)

[▶ Back: robustness](#)



Note: 90% confidence bands displayed

(a) Likelihood of FCB



Note: 90% confidence bands displayed

(b) Intensity of FCB

By export intensity	Intensity of FCB
Non-exporters	0.131
$\leq p(95)$	0.127
$> p(95)$	0.202

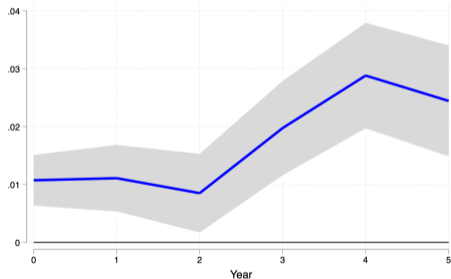
Results: effects of entering export market, 1988-2016

▶ Back: robustness

▶ After newly **entering** export market

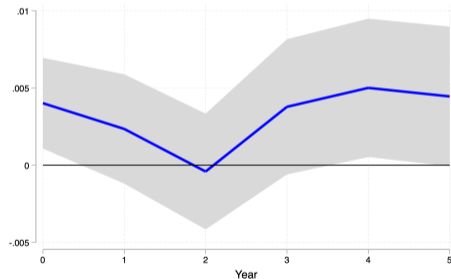
▶ Back: contents

- ▶ Likelihood of financing in FC increases by 0.9pp-2.9pp
- ▶ Intensity of FCB increases by 0pp-0.5pp, conditional on ever issuing FCB



Note: 90% confidence bands displayed

(a) Likelihood of FCB



Note: 90% confidence bands displayed

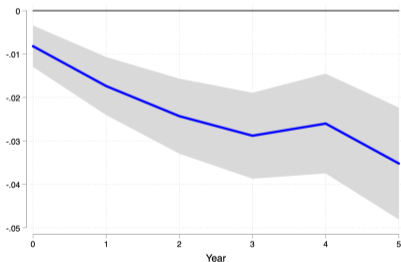
(b) Intensity of FCB

Results: effects of exiting export market, 1988-2016

[▶ Back: contents](#)

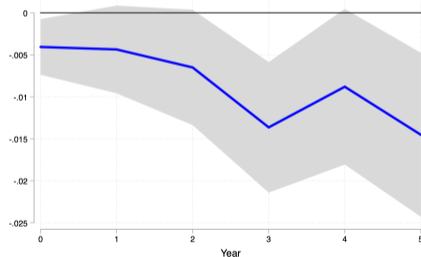
[▶ Back: robustness](#)

- ▶ $\Delta D_{it} = 1$: company exits export market and never export since then
- ▶ After **exiting** export market
 - ▶ Likelihood of financing in FC falls by 0.8pp-3.5pp
 - ▶ Intensity of FCB falls by 0.4pp-1.5pp, conditional on ever issuing FCB



Note: 90% confidence bands displayed

(a) Likelihood of FCB

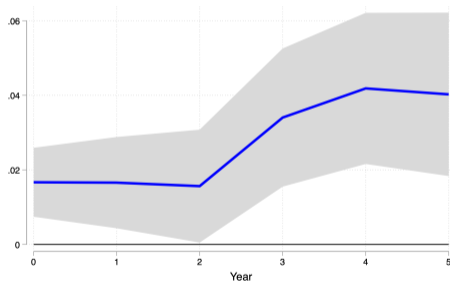


Note: 90% confidence bands displayed

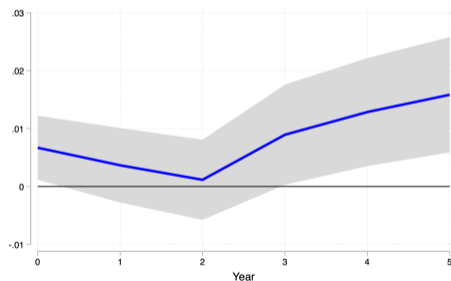
(b) Intensity of FCB

Results: effects of entering export market, manufacturing [▶ Back: robustness](#)

- ▶ After newly **entering** export market [▶ Back: contents](#)
 - ▶ Likelihood of financing in FC increases by 1.7pp-4.0pp
 - ▶ Intensity of FCB increases by 0.4pp-1.4pp, conditional on ever issuing FCB



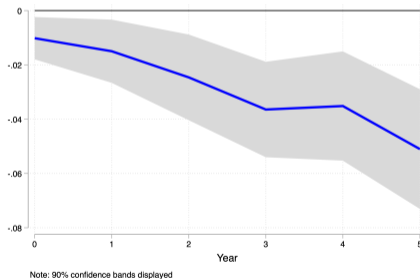
(a) Likelihood of FCB



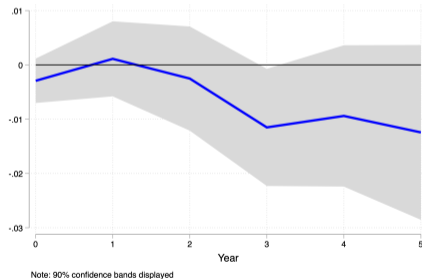
(b) Intensity of FCB

Results: effects of exiting export market, manufacturing [▶ Back: robustness](#)

- ▶ $\Delta D_{it} = 1$: company exits export market and never export since then
- ▶ After **exiting** export market [▶ Back: contents](#)
 - ▶ Likelihood of financing in FC falls by 1.3pp-5.4pp
 - ▶ Intensity of FCB falls by 0.1pp-1.4pp, conditional on ever issuing FCB



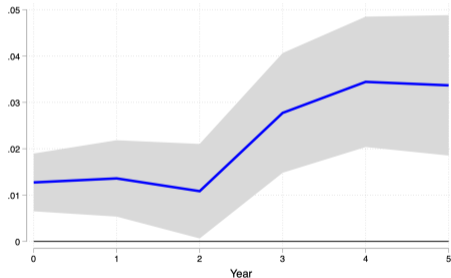
(a) Likelihood of FCB



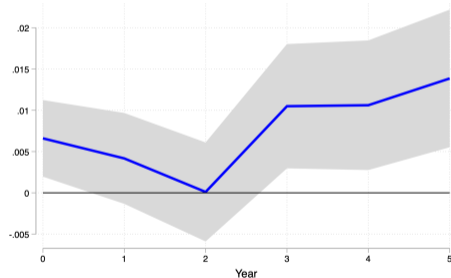
(b) Intensity of FCB

Results: local project without clean-control condition [▶ Back: robustness](#)

- ▶ After newly **entering** export market [▶ Back: contents](#)
 - ▶ Likelihood of financing in FC increases by 1.1pp-3.8pp
 - ▶ Intensity of FCB increases by 0.2pp-1.2pp, conditional on ever issuing FCB



(a) Likelihood of FCB

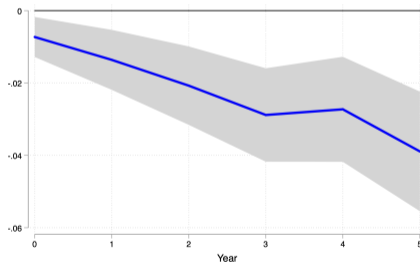


(b) Intensity of FCB

Results: local project without clean-control condition

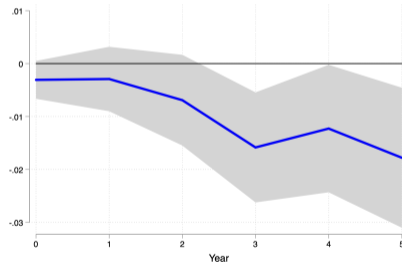
[Back: robustness](#)

- ▶ $\Delta D_{it} = 1$: company exits export market and never exports since then
- ▶ After **exiting** export market
 - ▶ Likelihood of financing in FC falls by 0.9pp-3.8pp
 - ▶ Intensity of FCB falls by 0.4pp-1.5pp, conditional on ever issuing FCB



Note: 90% confidence bands displayed

(a) Likelihood of FCB



Note: 90% confidence bands displayed

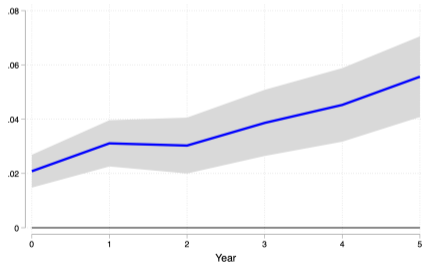
(b) Intensity of FCB

Results: effects of entering import market

[▶ Back: contents](#)

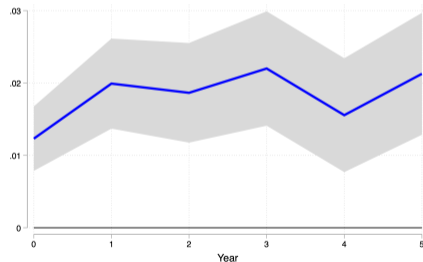
[▶ Back: export extensive margin](#)

- ▶ $\Delta D_{it} = 1$: company enters import market
- ▶ After **entering** import market
 - ▶ Likelihood of financing in FC increases by 2.1pp-6.0pp
 - ▶ Intensity of FCB increases by 1.1pp-2.2pp, conditional on ever issuing FCB



Note: 90% confidence bands displayed

(a) Likelihood of FCB



Note: 90% confidence bands displayed

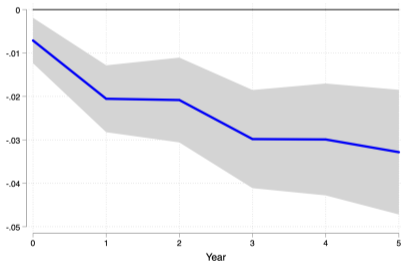
(b) Intensity of FCB

Results: effects of exiting import market

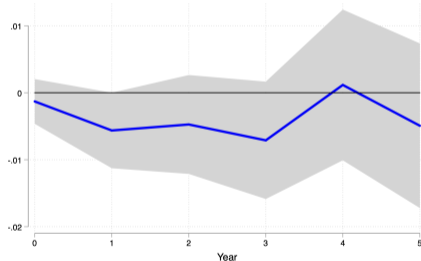
▶ [Back: contents](#)

▶ [Back: export extensive margin](#)

- ▶ $\Delta D_{it} = 1$: company exits import market and never import since then
- ▶ After **exiting** import market
 - ▶ Likelihood of financing in FC falls by 0.9pp-3.4pp



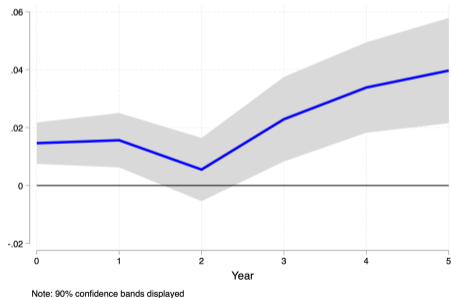
(a) Likelihood of FCB



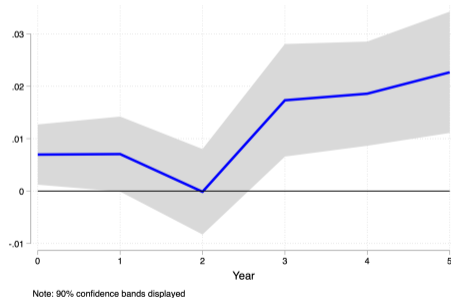
(b) Intensity of FCB

Results: drop only importers [▶ Back: robustness](#)

- ▶ Drop only-importers: 9.8% observations
- ▶ After newly **entering** export market [▶ Back: contents](#)
 - ▶ Likelihood of financing in FC increases by 0.2pp-3.7pp
 - ▶ Intensity of FCB increases by 0.2pp-1.9pp, conditional on ever issuing FCB



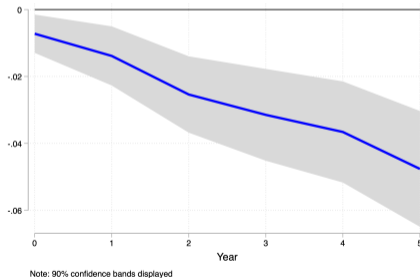
(a) Likelihood of FCB



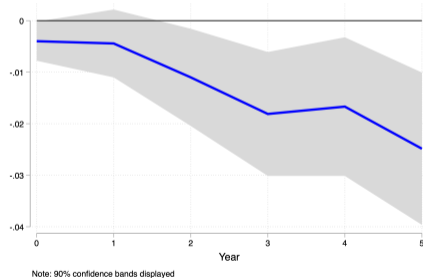
(b) Intensity of FCB

Results: drop only importers [▶ Back: robustness](#)

- ▶ $\Delta D_{it} = 1$: company exits export market and never export since then
- ▶ After **exiting** export market
 - ▶ Likelihood of financing in FC falls by 0.9pp-4.7pp
 - ▶ Intensity of FCB falls by 0.5pp-1.9pp, conditional on ever issuing FCB



(a) Likelihood of FCB



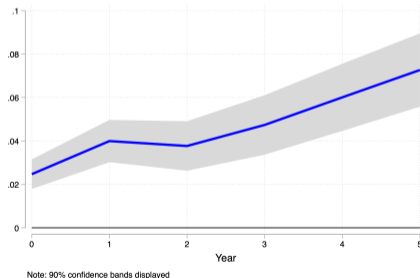
(b) Intensity of FCB

Results: drop only exporters

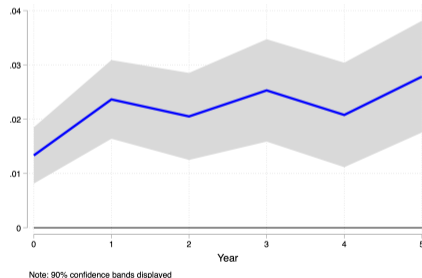
▶ [Back: contents](#)

▶ [Back: export extensive margin](#)

- ▶ Drop only-exporters: 8.1% observations
- ▶ $\Delta D_{it} = 1$: company enters import market
- ▶ After **entering** import market
 - ▶ Likelihood of financing in FC increases by 2.5pp-7.2pp
 - ▶ Intensity of FCB increases by 1.3pp-2.5pp, conditional on ever issuing FCB



(a) Likelihood of FCB



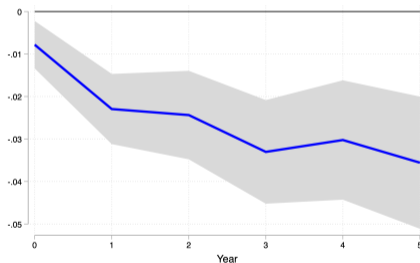
(b) Intensity of FCB

Results: drop only exporters

▶ Back: contents

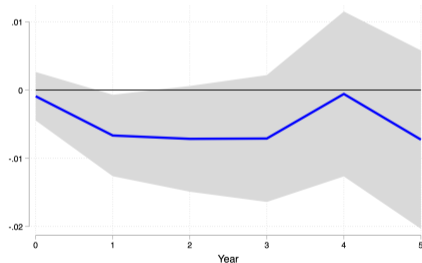
▶ Back: export extensive margin

- ▶ $\Delta D_{it} = 1$: company exits import market and never import since then
- ▶ After **exiting** import market
 - ▶ Likelihood of financing in FC falls by 1.0pp-3.7pp



Note: 90% confidence bands displayed

(a) Likelihood of FCB



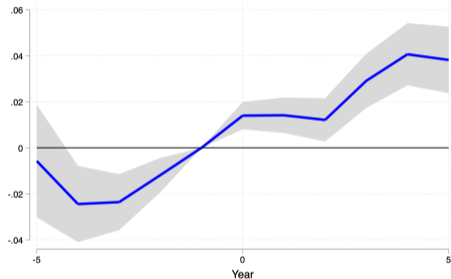
Note: 90% confidence bands displayed

(b) Intensity of FCB

Results: pre-treatment for first exporting

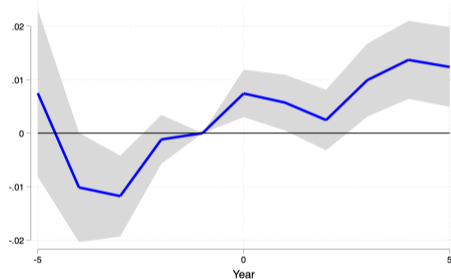
▶ Back: robustness

▶ Pre-treatment effects of first exporting is not exactly zero



Note: 90% confidence bands displayed

(a) Likelihood of FCB



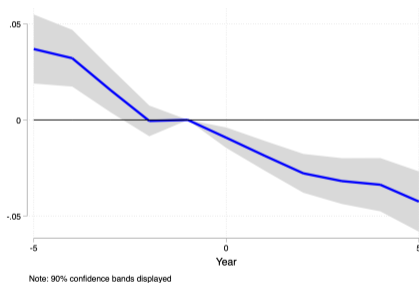
Note: 90% confidence bands displayed

(b) Intensity of FCB

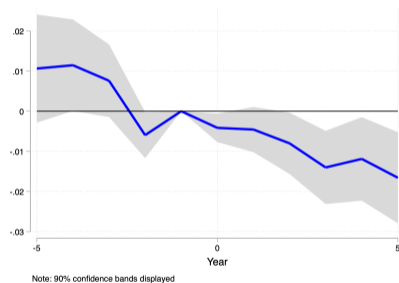
Results: pre-treatment for never exporting

▶ [Back: robustness](#)

- ▶ $\Delta D_{it} = 1$: company exits export market and never export since then
- ▶ When firms export, they are more likely to hold FCB, and borrow more intensively



(a) Likelihood of FCB



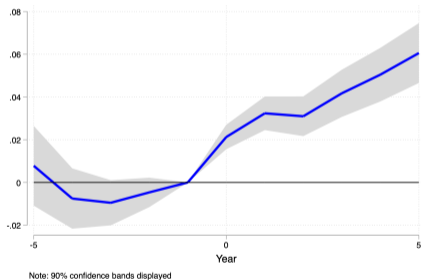
(b) Intensity of FCB

Results: pre-treatment for first importing

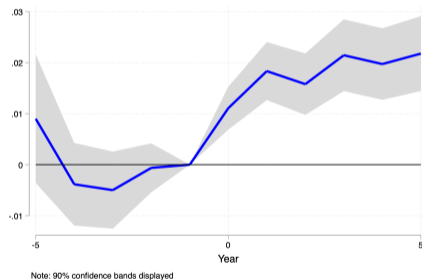
[▶ Back: contents](#)

[▶ Back: export extensive margin](#)

- ▶ $\Delta D_{it} = 1$: company enters import market
- ▶ Pre-treatment effects of first importing is almost zero



(a) Likelihood of FCB



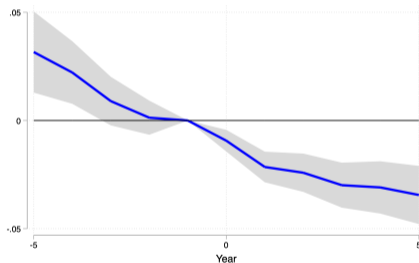
(b) Intensity of FCB

Results: pre-treatment for never importing

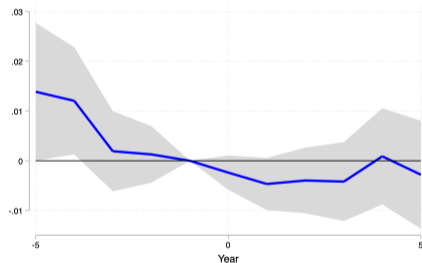
▶ [Back: contents](#)

▶ [Back: export extensive margin](#)

- ▶ $\Delta D_{it} = 1$: company exits import market and never import since then
- ▶ When firms import, they are more likely to hold FCB, and borrow more intensively



(a) Likelihood of FCB



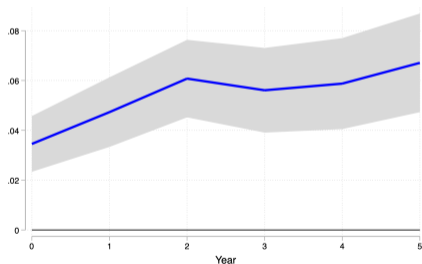
(b) Intensity of FCB

Results: first issuing FC borrowings - exports

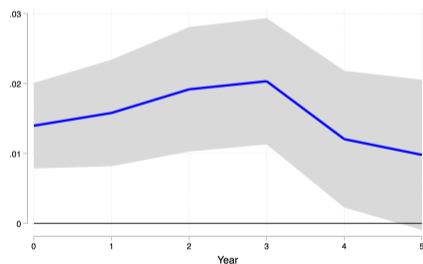
▶ [Back: contents](#)

▶ [Back: robustness](#)

- ▶ $\Delta D_{it} = 1$: firm i starts holding FCB
- ▶ After firm starts holding FCB
 - ▶ Likelihood of exporting increases by 3.5pp-6.7pp
 - ▶ Export intensity increases by 1.2pp-2.0pp, conditional on ever exporting



(a) I_{exp}

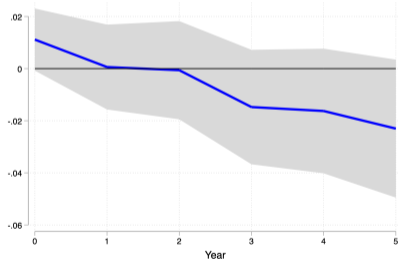


(b) S_{exp}

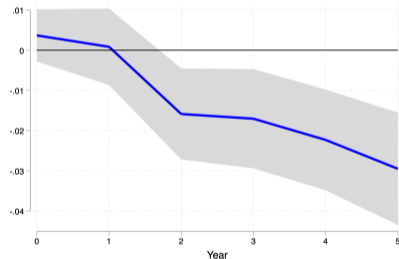
Results: deleveraging FC borrowings: exports

[▶ Back: contents](#)[▶ Back: robustness](#)

- ▶ $\Delta D_{it} = 1$: firm i stops holding FCB
- ▶ After completely deleveraging FCB
 - ▶ Likelihood of exporting falls by 3.5pp-6.7pp
 - ▶ Export intensity falls by -0.1pp-3pp, conditional on ever exporting



(a) I_{exp}

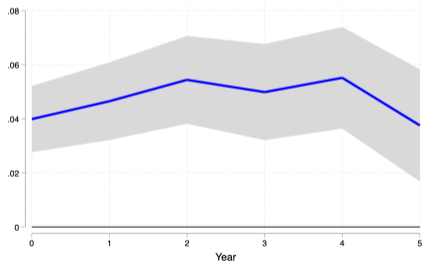


(b) S_{exp}

Results: first issuing FC borrowings - imports

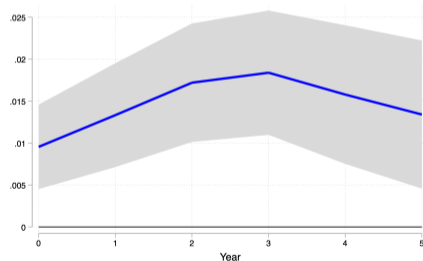
[▶ Back: contents](#)[▶ Back: robustness](#)

- ▶ $\Delta D_{it} = 1$: firm i starts holding FCB
- ▶ After firm starts holding FCB
 - ▶ Likelihood of importing increases by 3.8pp-5.5pp
 - ▶ Import intensity increases by 1.0pp-1.8pp, conditional on ever importing



Note: 90% confidence bands displayed

(a) I_{imp}



Note: 90% confidence bands displayed

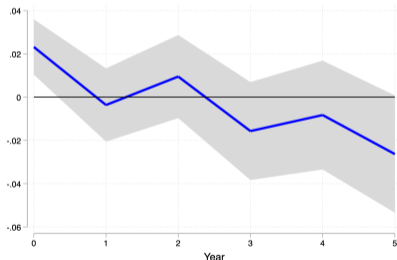
(b) S_{imp}

Results: deleveraging FC borrowings - imports

▶ [Back: contents](#)

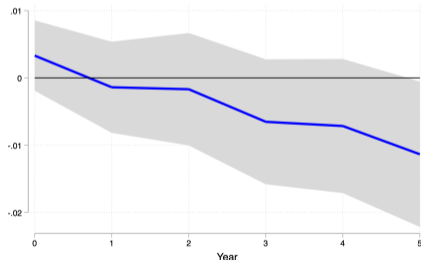
▶ [Back: robustness](#)

- ▶ $\Delta D_{it} = 1$: firm i stops holding FCB
- ▶ After completely deleveraging FCB
 - ▶ Likelihood of importing falls by 3.8pp-5.5pp
 - ▶ Import intensity falls by 0.1pp-1.1pp, conditional on ever importing



Note: 90% confidence bands displayed

(a) I_{imp}

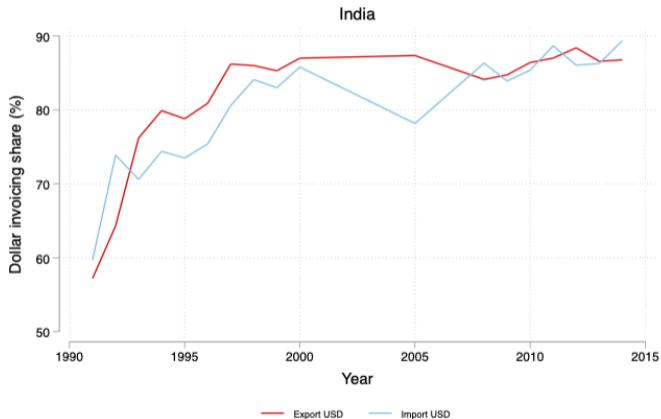


Note: 90% confidence bands displayed

(b) S_{imp}

Currency in Trade: India [▶ Back](#)

- ▶ Boz et al.(2020) Currency in Global Trade



Entrepreneurs' problem with import decisions ▶ Benchmark

- ▶ Entrepreneurs choose consumption, borrowings, pricing plans, exports and imports

$$\begin{aligned}
 V(z, k, b, b^*, x_{-1}, x_{-1}^m, e) &= \max_{c, p, y, p^*, y^*, k', b', b^{*'}, x, x^m} \frac{c^{1-\gamma}}{1-\gamma} + \beta \mathbb{E}_{e', z' | e, z} V(z', k', b', b^{*'}, x, x^m, e') \\
 \text{s.t. } c + k' + b + eb^* &= py + xep^*y^* - ep^m M + (1 - \delta)k \\
 &+ \frac{b'}{(1+r)(1+\tau_c)} + e \frac{b^{*'}}{(1+r^*)(1+\tau_c)} - F(x_{-1}, x, x_{-1}^m, x^m, b^{*'}) \\
 y + \tau xy^* &= Azk^{\alpha_k}, \quad \text{if } x^m = 0 \\
 y + \tau xy^* &= Azk^{\alpha_k} M^{\alpha_M}, \quad \text{if } x^m = 1 \\
 y &= (ep)^{-\sigma} Y, \quad y^* = (p^*)^{-\sigma} Y^*, \\
 b' &\leq \theta (py + xep^*y^* - ep^m M), \\
 eb^{*'} &\leq \theta^* (py + xep^*y^* - ep^m M),
 \end{aligned}$$

- ▶ Interaction between import and financial frictions ($x^m = 0, M = 0$: benchmark)
- ▶ FC payment towards imports + fixed cost of importers + collateral constraints

Entrepreneurs' problem: steady states [▶ Back](#)

- ▶ Entrepreneurs choose export status, pricing plans
- ▶ No borrowings, no shocks (mean of e and z)
- ▶ $Y = Y^* = 1$

$$V(z, k, x_{-1}, e) = \max_{c, p, y, p^*, y^*, k', b^*, x} \frac{c^{1-\gamma}}{1-\gamma} + \beta \mathbb{E}_{e'} \mathbb{E}_{z'|z} V(z', k', x, e')$$

$$\text{s.t. } c + k' = py + xep^*y^* + (1 - \delta)k - F(x_{-1}, x, b^*)$$

$$y + x\tau y^* = Azk^\alpha,$$

$$y = (p/P)^{-\sigma} Y = (ep)^{-\sigma} Y \quad y^* = (p^*)^{-\sigma} Y^*$$

Rewrite entrepreneurs' problem [▶ Back](#)

- ▶ Entrepreneurs choose export status, pricing plans

$$V(z, k, x_{-1}, e) = \max_{c, y, y^*, k', x} \frac{c^{1-\gamma}}{1-\gamma} + \beta \mathbb{E}_{e'|e} \mathbb{E}_{z'|z} V(z', k', x, e')$$

s.t.

$$[\lambda_1] \quad c + k' = \frac{y^{1-\frac{1}{\sigma}}}{e(Y)^{-\frac{1}{\sigma}}} + xe \frac{(y^*)^{1-\frac{1}{\sigma}}}{(Y^*)^{-\frac{1}{\sigma}}} + (1-\delta)k - F(x_{-1}, x, b^*)$$

$$[\lambda_2] \quad y + m\tau y^* = Azk^\alpha,$$

FOC: $x = 1$ (same for $x_{-1} = 0, 1$) [▶ Back](#)

▶ FOCs are same for $x_{-1} = 0, 1$, but the value function varies due to sunk cost

$$[c]: c^{-\gamma} = \lambda_1,$$

$$[y]: \frac{1 - \frac{1}{\sigma}}{e} \left(\frac{y}{Y}\right)^{-\frac{1}{\sigma}} \lambda_1 = \lambda_2,$$

$$[y^*]: e \left(1 - \frac{1}{\sigma}\right) \left(\frac{y^*}{Y^*}\right)^{-\frac{1}{\sigma}} \lambda_1 = \lambda_2 \tau,$$

$$[k']: \beta EV_{k'} = \lambda_1 \Rightarrow \beta E \left[\lambda'_1 (1 - \delta) + \lambda'_2 \alpha A' z' (k')^{\alpha-1} \right] = \lambda_1,$$

▶ Fixed market share allocation

$$y + \tau y^* = Azk^\alpha$$

$$\tau = e^2 \left(\frac{y^*/y}{Y^*/Y}\right)^{-\frac{1}{\sigma}} \Rightarrow \frac{y^*}{y} = \left(\frac{\tau}{e^2}\right)^{-\sigma} \cdot \frac{Y^*}{Y}$$

FOC: $x = 1$ (same for $x_{-1} = 0, 1$): steady status [▶ Back](#)

▶ Export intensity

$$\begin{aligned}\frac{ep^*y^*}{py + ep^*y^*} &= 1 - \frac{py}{py + ep^*y^*} = 1 - \frac{(y)^{1-\frac{1}{\sigma}}/e(Y)^{-\frac{1}{\sigma}}}{(y)^{1-\frac{1}{\sigma}}/e(Y)^{-\frac{1}{\sigma}} + e\frac{(y^*)^{1-\frac{1}{\sigma}}}{(Y^*)^{-\frac{1}{\sigma}}}} \\ &= 1 - \frac{1}{1 + e^2 \cdot (Y)^{-\frac{1}{\sigma}} \cdot \frac{(y^*/y)^{1-\frac{1}{\sigma}}}{(Y^*)^{-\frac{1}{\sigma}}}} = 1 - \frac{1}{1 + e^2 \frac{(y^*/y)^{1-\frac{1}{\sigma}}}{(Y^*/Y)^{-\frac{1}{\sigma}}}} \\ &= 1 - \frac{1}{1 + \tau \cdot \frac{y^*}{y}} \quad \left(\tau = e^2 \left(\frac{y^*/y}{Y^*/Y} \right)^{-\frac{1}{\sigma}} \right)\end{aligned}$$

▶ Domestic sales

$$y = \frac{Azk^\alpha}{\left(\frac{\tau}{e^2}\right)^{-\sigma} \frac{Y^*}{Y} \tau + 1} \quad (3)$$

FOC: $x = 1$ (same for $x_{-1} = 0, 1$): steady status [▶ Back](#)

▶ Steady states: $\lambda_1 = \lambda'_1$

$$\lambda_1 = \beta E \left[(1 - \delta)\lambda'_1 + \alpha A' z' (k')^{\alpha-1} \cdot \frac{1 - \frac{1}{\sigma}}{e'} \left(\frac{y'}{Y'} \right)^{-\frac{1}{\sigma}} \lambda'_1 \right]$$
$$\Rightarrow 1 = \beta E \left[(1 - \delta) + \frac{1 - \frac{1}{\sigma}}{e} \left(\frac{y'}{Y'} \right)^{-\frac{1}{\sigma}} \alpha A' z' (k')^{\alpha-1} \right]$$

▶ Solve k^{ss1} from ($y' = y, k' = k$)

$$\frac{\frac{1}{\beta} - (1 - \delta)}{1 - \frac{1}{\sigma}} \bar{e} \frac{1}{\alpha \bar{A} \bar{z}} = \left(\frac{\bar{A} \bar{z} / Y}{\left(\frac{\tau}{e^2} \right)^{-\sigma} \frac{Y^*}{Y} \tau + 1} \right)^{-\frac{1}{\sigma}} k^{-\frac{\alpha}{\sigma} + \alpha - 1}$$

Rewrite entrepreneurs' problem: $x = 0$ [▶ Back](#)

- ▶ Entrepreneurs choose export status, pricing plans

$$V(z, k, x_{-1}, e) = \max_{c, y, k'} \frac{c^{1-\gamma}}{1-\gamma} + \beta \mathbb{E}_{e'|e} \mathbb{E}_{z'|z} V(z', k', 0, e')$$

s.t.

$$[\lambda_1] \quad c + k' = \frac{y^{1-\frac{1}{\sigma}}}{e(Y)^{-\frac{1}{\sigma}}} + (1-\delta)k - F(x_{-1}, x, b^*)$$

$$[\lambda_2] \quad y = Azk^\alpha,$$

FOC: $x = 0$ (same for $x_{-1} = 0, 1$): steady status [▶ Back](#)

- ▶ Domestic sales

$$y = Azk^\alpha \quad (4)$$

- ▶ Steady states: $\lambda_1 = \lambda'_1$

$$\lambda_1 = \beta E \left[(1 - \delta)\lambda'_1 + \alpha A' z' (k')^{\alpha-1} \cdot \frac{1 - \frac{1}{\sigma}}{e'} \left(\frac{y'}{Y'} \right)^{-\frac{1}{\sigma}} \lambda'_1 \right]$$
$$\Rightarrow 1 = \beta E \left[(1 - \delta) + \frac{1 - \frac{1}{\sigma}}{e} \left(\frac{y'}{Y'} \right)^{-\frac{1}{\sigma}} \alpha A' z' (k')^{\alpha-1} \right]$$

- ▶ Solve k^{ss0} from ($y' = y, k' = k$)

$$\frac{\frac{1}{\beta} - (1 - \delta)}{1 - \frac{1}{\sigma}} \bar{e} \frac{1}{\alpha \bar{A} \bar{z}} = (\bar{A} \bar{z} / Y)^{-\frac{1}{\sigma}} k^{-\frac{\alpha}{\sigma} + \alpha - 1}$$

- ▶ Let $\mathcal{S} := \mathcal{Z} \times \mathcal{K} \times \mathcal{B} \times \mathcal{B}^* \times \mathcal{X} \times \mathcal{E}$ denote the state space of entrepreneurs, where $\mathcal{Z} = \mathbb{R}^+$, $\mathcal{K} = \mathbb{R}^+$, $\mathcal{B} = \mathbb{R}_0^+$, $\mathcal{B}^* = \mathbb{R}_0^+$, $\mathcal{X} = \{0, 1\}$ and $\mathcal{E} = \mathbb{R}^+$ denote the set of possible values of productivity, capital stock, bonds denominated in home good, bonds denominated in foreign good, trade status in the previous period and **exogenous real exchange rate shock**, respectively. Denote $s \in \mathcal{S}$ be an element of the state space.
- ▶ Assume that aggregate variables A_t , r_t , and r_t^* are constant. A recursive stationary competitive equilibrium consists of policy functions $\{c, p, y, p^*, y^*, k', b', b^*, x\}$, a value function V , and a measure $\phi : \mathcal{S} \rightarrow [0, 1]$, s.t. policy and value functions solve the entrepreneurs' problem;

FOC: $x = 1$ (same for $x_{-1} = 0, 1$) [▶ Back](#)

▶ FOCs are same for $x_{-1} = 0, 1$, but the value function varies due to sunk cost

$$[c] : c^{-\gamma} = \lambda_1,$$

$$[y] : \frac{1}{e} \left(1 - \frac{1}{\sigma}\right) \left(\frac{y}{Y}\right)^{-\frac{1}{\sigma}} (\lambda_1 + \lambda_3\theta + \lambda_4\theta^*) = \lambda_2,$$

$$[y^*] : e \left(1 - \frac{1}{\sigma}\right) \left(\frac{y^*}{Y^*}\right)^{-\frac{1}{\sigma}} (\lambda_1 + \lambda_3\theta + \lambda_4\theta^*) = \lambda_2\tau,$$

$$[k'] : \beta EV_{k'} = \lambda_1 \Rightarrow \beta E \left[\lambda'_1(1 - \delta) + \lambda'_2\alpha Az' (k')^{\alpha-1} \right] = \lambda_1,$$

$$[b'] : \beta EV_{b'} + \lambda_1 \frac{1}{1+r} - \lambda_3 = 0 \Rightarrow \beta E(-\lambda'_1) + \lambda_1 \frac{1}{1+r} - \lambda_3 = 0,$$

$$[b^*] : \beta EV_{b^*} + \lambda_1 e \frac{1}{1+r^*} - \lambda_4 e = 0 \Rightarrow \beta E(-e'\lambda'_1) + \lambda_1 e \frac{1}{1+r^*} - \lambda_4 e = 0.$$

System equations: $x = 1$ [▶ Back](#)

▶ Given A, e, Y, Y^*, r, r^*, z , unknown: $y, y^*, c, k', b, b^*, \lambda_3, \lambda_4$

$$\tau = e^2 \left(\frac{y^*/y}{Y^*/Y} \right)^{-\frac{1}{\sigma}} \quad (5)$$

$$c^{-\gamma} = \beta E \left[(1 - \delta) (c')^{-\gamma} + \alpha A z' (k')^{\alpha-1} \frac{1 - \frac{1}{\sigma}}{e'} \left(\frac{y'}{Y'} \right)^{-\frac{1}{\sigma}} \left[(c')^{-\gamma} + \lambda_3' \theta + \lambda_4' \theta^* \right] \right], \quad (6)$$

$$c^{-\gamma} = \beta(1 + r)E (c')^{-\gamma} + (1 + r)\lambda_3, \quad (7)$$

$$c^{-\gamma} = \beta(1 + r^*)E \left(\frac{e'}{e} (c')^{-\gamma} \right) + (1 + r^*)\lambda_4, \quad (8)$$

$$c + k' - \frac{b'}{1 + r} - e \frac{b^*'}{1 + r^*} = \frac{y^{1 - \frac{1}{\sigma}}}{e(Y)^{-\frac{1}{\sigma}}} + e \frac{(y^*)^{1 - \frac{1}{\sigma}}}{(Y^*)^{-\frac{1}{\sigma}}} + (1 - \delta)k - b - eb^* - F \quad (9)$$

$$y + \tau xy^* = Azk^\alpha, \quad (10)$$

$$b' \leq \theta \left(\frac{y^{1 - \frac{1}{\sigma}}}{e(Y)^{-\frac{1}{\sigma}}} + e \frac{(y^*)^{1 - \frac{1}{\sigma}}}{(Y^*)^{-\frac{1}{\sigma}}} \right), \quad (11)$$

$$eb^* \leq \theta^* \left(\frac{y^{1 - \frac{1}{\sigma}}}{e(Y)^{-\frac{1}{\sigma}}} + e \frac{(y^*)^{1 - \frac{1}{\sigma}}}{(Y^*)^{-\frac{1}{\sigma}}} \right). \quad (12)$$

Rewrite entrepreneurs' problem, $x = 0$ ▶ Back

$$\blacktriangleright py = \frac{1}{e} \frac{y^{1-\frac{1}{\sigma}}}{Y^{-\frac{1}{\sigma}}},$$

$$V(z, k, b, b^*, x_{-1}, e) = \max_{c, y, y^*, k', b', b^{*'}} \frac{c^{1-\gamma}}{1-\gamma} + \beta \mathbb{E}_{z', e'} V(z', k', b', b^{*'}, 0, e')$$

s.t.

$$[\lambda_1] \quad c + k' - \frac{b'}{1+r} - e \frac{b^{*'}}{1+r^*} = \frac{y^{1-\frac{1}{\sigma}}}{e(Y)^{-\frac{1}{\sigma}}} + (1-\delta)k - b - eb^* - F$$

$$[\lambda_2] \quad y = Azk^\alpha,$$

$$[\lambda_3] \quad b' \leq \theta \frac{y^{1-\frac{1}{\sigma}}}{e(Y)^{-\frac{1}{\sigma}}},$$

$$[\lambda_4] \quad eb^{*'} \leq \theta^* \frac{y^{1-\frac{1}{\sigma}}}{e(Y)^{-\frac{1}{\sigma}}}.$$

FOC: $x = 0$ (same for $x_{-1} = 0, 1$) [▶ Back](#)

- ▶ FOCs are same for $m_{-1} = 0, 1$, but the value function varies due to sunk cost

$$[c] : c^{-\gamma} = \lambda_1,$$

$$[y] : \frac{1 - \frac{1}{\sigma}}{e} \left(\frac{y}{Y}\right)^{-\frac{1}{\sigma}} [\lambda_1 + \lambda_3\theta + \lambda_4\theta^*] = \lambda_2,$$

$$[k'] : \beta EV_{k'} = \lambda_1 \Rightarrow \beta E \left[\lambda'_1(1 - \delta) + \lambda'_2\alpha Az' (k')^{\alpha-1} \right] = \lambda_1,$$

$$[b'] : \beta EV_{b'} + \lambda_1 \frac{1}{1+r} - \lambda_3 = 0 \Rightarrow \beta E(-\lambda'_1) + \lambda_1 \frac{1}{1+r} - \lambda_3 = 0,$$

$$[b^{*'}] : \beta EV_{b^{*'}} + \lambda_1 e \frac{1}{1+r^*} - \lambda_4 e = 0 \Rightarrow \beta E(-\lambda'_1 e') + \lambda_1 e \frac{1}{1+r^*} - \lambda_4 e = 0.$$

System equations: $x = 0$ [▶ Back](#)

▶ Given A, e, Y, Y^*, r, r^*, z unknown: $y, c, k', b', b^*, \lambda_2, \lambda_3, \lambda_4$

$$\frac{1 - \frac{1}{\sigma}}{e} \left(\frac{y}{Y} \right)^{-\frac{1}{\sigma}} [c^{-\gamma} + \lambda_3 \theta + \lambda_4 \theta^*] = \lambda_2,$$

$$c^{-\gamma} = \beta E \left[(1 - \delta) (c')^{-\gamma} + \alpha A' z' (k')^{\alpha-1} \frac{1 - \frac{1}{\sigma}}{e'} \left(\frac{y'}{Y'} \right)^{-\frac{1}{\sigma}} [(c')^{-\gamma} + \lambda_3' \theta + \lambda_4' \theta^*] \right],$$

$$c^{-\gamma} = \beta(1+r)E(c')^{-\gamma} + (1+r)\lambda_3,$$

$$c^{-\gamma} = \beta E \left[(1+r^*) (c')^{-\gamma} \frac{e'}{e} + \frac{1}{\beta} (1+r^*) \lambda_4 \right]$$

$$c + k' - \frac{b'}{1+r} - e \frac{b^*'}{1+r^*} = \frac{y^{1-\frac{1}{\sigma}}}{e(Y)^{-\frac{1}{\sigma}}} + (1-\delta)k - b - eb^* - F$$

$$y = Azk^\alpha,$$

$$b' \leq \theta \frac{y^{1-\frac{1}{\sigma}}}{e(Y)^{-\frac{1}{\sigma}}},$$

$$eb^* \leq \theta^* \frac{y^{1-\frac{1}{\sigma}}}{e(Y)^{-\frac{1}{\sigma}}}$$

Statistics of Exports, Imports, Foreign Currency Borrowing [▶ Back](#)

	N	Mean	SD	Min	Max	p25	Median	p75
ln(exports)	8602	1.806	2.086	-5.714	5.744	0.62	2.116	3.281
ln(imports)	8602	1.52	2.079	-5.745	5.728	0.27	1.699	3.015
ln(frgn-borr)	8602	1.427	1.788	-3.812	6.149	0.176	1.426	2.693

Fixed parameters

Parameter	Description	Value	Target/Source
γ	Coefficient of relative risk aversion	2	[?]
α	Income share of capital	0.33	[?]
δ	Depreciation of capital	0.1	[?]
σ	Demand elasticity	3	[?]
r^*	Interest rate of foreign currency borrowing	2.696%	Inflation-adjusted U.S. lending rate from World Bank
ρ_e	Persistence of exchange rate shock	0.943	Persistence of Indian rupees to U.S. dollar real exchange rate
σ_e	Volatility of exchange rate shock	0.084	Volatility of Indian rupees to U.S. dollar real exchange rate
ρ_z	Persistence of firm productivity shock	0.95	[?]

► Fitted parameters

Reduce state space ▶ Back: moments

▶ $B = b + eb^*$

$$V(z, k, B, x_{-1}, e) = \max_{c, p, y, p^*, y^*, k', b', b^*, x} \frac{c^{1-\gamma}}{1-\gamma} + \beta \mathbb{E}_{z', e' | z, e} V(z', k', B', x, e')$$

$$\text{s.t. } c + k' + B = py + xep^*y^* + (1 - \delta)k + \frac{b'}{1+r} + e\frac{b^*'}{1+r^*} - F(x_{-1}, x, b^*')$$

$$y + \tau xy^* = Azk^\alpha,$$

$$b' \leq \theta (py + xep^*y^*),$$

$$eb^* \leq \theta^* (py + xep^*y^*),$$

$$y = (p/P)^{-\sigma} Y = (ep)^{-\sigma} Y \quad y^* = (p^*)^{-\sigma} Y^*$$

Algorithm: value function iteration ▶ Back: moments

- ▶ 1. Set parameters and construct grid points for state variables $(z, k, b, b^*, x_{-1}, e)$, then total bond B are given as;

$$B = b + e * b$$

where the grid points of B is set as

$$B \in [B_{min}, B_{max}],$$

$$B_{max} = b_{max} + e_{max} * b_{max}^*,$$

$$B_{min} = b_{min} + e_{max} * b_{min}^*,$$

with $nB \ll nb * ne * nb^*$.

- ▶ 2. Formulate an initial guess for the expected value function $G^0(z, k, b', b^{*'}, x, e)$ and choose a stopping criterion $tol > 0$

Algorithm: value function iteration, conti.

▶ Back: moments

- ▶ 3. For each state (z, k, B, x_{-1}, e) , compute consumption and update value function for each k', b', b'^*
 - ▶ (a) If $x = 1$, we can get y, y^* by solving

$$y + \tau y^* = Azk^\alpha,$$
$$\tau = e^2 \left(\frac{y^*/y}{Y^*/Y} \right)^{-\frac{1}{\sigma}},$$

and update value function if $b' \leq \theta(py + ep^*y^*)$ and $eb'^* \leq \theta^*(py + ep^*y^*)$

$$c + k' + B = py + ep^*y^* + (1 - \delta)k + \frac{b'}{1 + r} + e \frac{b'^*}{1 + r^*} - F(x_{-1}, x, b'^*),$$
$$V^1(z, k, B, x_{-1}, e) = \frac{c^{1-\gamma}}{1-\gamma} + \beta G^0(z, k', b', b'^*, 1, e).$$

Algorithm: value function iteration, conti. ▶ Back: moments

- ▶ 3. For each state (z, k, B, x_{-1}, e) , compute consumption and update value function for each k', b', b'^*

- ▶ (b) If $x = 0$,

$$y = Azk^\alpha,$$

and update value function if $b' \leq \theta py$, and $eb^{*'} \leq \theta^* py$,

$$c + k' + B = py + (1 - \delta)k + \frac{b'}{1 + r} + e \frac{b^{*'}}{1 + r^*} - F(x_{-1}, x, b^{*'}),$$

$$V^0(z, k, B, x_{-1}, e) = \frac{c^{1-\gamma}}{1-\gamma} + \beta G^0(z, k', b', b^{*'}, 0, e).$$

- ▶ (c) Store the maximum as the updated value function $V(z, k, B, x_{-1}, e)$. Store the location of the maximizer, as the policy vector

$$V(z, k, B, x_{-1}, e) = \max_{x \in \{0,1\}} \{V^1(z, k, B, x_{-1}, e), V^0(z, k, B, x_{-1}, e)\}$$

Algorithm: value function iteration, conti. ▶ Back: moments

- ▶ 4. Update expected value function for each grid point in the state space (For example, $b(ib)$ refers to the ib -th grid of b .)

- ▶ (a) If $B(iB_j) \leq b(ib') + e(ie')b^*(ib^*) \leq B(iB_{j+1})$

$$\begin{aligned} & G(iz, ik', ib', ib^*, ix, ie) \\ &= \sum_{iz', ie'} \pi_t(iz' | iz) \pi_e(ie' | ie) V(iz', ik', b(ib') + e(ie')b^*(ib^*), ie') \\ &= \sum_{iz', ie'} \pi_t(iz' | iz) \pi_e(ie' | ie) [\omega V(iz', ik', iB_j, ix, ie') + (1 - \omega)V(iz', ik', iB_{j+1}, ix, ie')] \end{aligned}$$

where

$$\omega = \frac{B(iB_{j+1}) - [b(ib') + e(ie')b^*(ib^*)]}{B(iB_{j+1}) - B(iB_j)}$$

Algorithm: value function iteration, conti. ▶ Back: moments

- ▶ 4. Update expected value function for each grid point in the state space (For example, $b(ib)$ refers to the ib -th grid of b .)

- ▶ (b) If $B(iB_j)$ is not well defined,

$$V(iz', ik', b(ib') + e(ie') b^*(ib^*), ix, ie') = V(iz', ik', iB_{j+1}, ix, ie')$$

- ▶ (c) If $B(iB_{j+1})$ is not well defined,

$$V(iz', ik', b(ib') + e(ie') b^*(ib^*), ix, ie') = V(iz', ik', iB_j, ix, ie')$$

- ▶ 5. If the distance of value function and its previous value is less than the tolerance level, done. Otherwise, update the value function and go back to 3.

Moments in data and model: untargeted moments [▶ Back](#)

Untargeted	Data	Model
Share of export starters	0.02	0.01
Share of export starters	0.02	0.01
Mean(S_{FCB})	0.006	0.006
Mean(export intensity)	0.08	0.06
Average response of I_{FCB} after entering	0.02	0.28
Average response of I_{FCB} after exiting	-0.02	-0.24

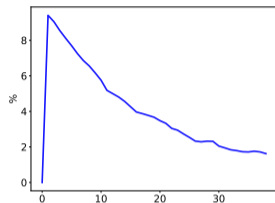
[▶ Algorithm](#)

Moments in data and model: untargeted moments [▶ Back](#)

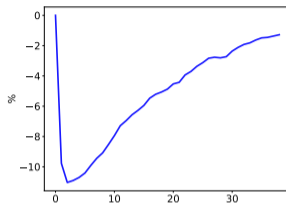
	Intensity of FCB	
	data	model
Non-exporters	0.132	0.06
$\leq p(95)$	0.128	0.08
$> p(95)$	0.199	0.10

Mechanism: complementarity between trade and financing

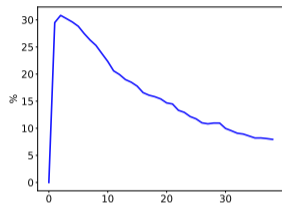
▶ [Back: mechanism](#)



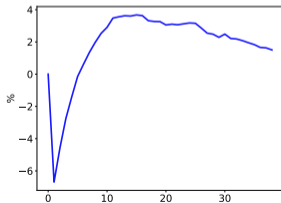
(a) Real exchange rate



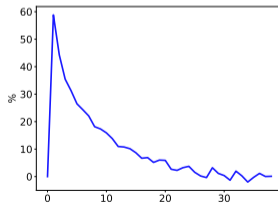
(b) Domestic sales



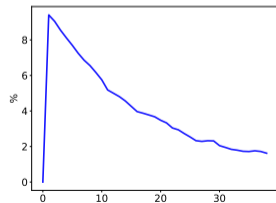
(c) Foreign sales



(d) HC borrowings



(e) FCB intensity



(f) b'^*/b'

Role of correlations

- ▶ $\zeta = 1$: no extensive margin correlation (cost complementarity)
- ▶ Producer currency pricing (PCP): no intensive margin correlation (hedging and collateral)

	Benchmark	No-cost-complementarity	PCP
All sample			
Leverage	0.35	0.32	0.25
Share of firms holding FCB (%)	7.37	0	2.71
FCB intensity, conditional on with FCB (%)	7.69	0	3.32
Share of exporting firms (%)	19.2	19.2	20.5
Export intensity, conditional on exporting (%)	33.37	33.37	9.50
Share of firms both exporting and holding FCB (%)	5.43	0	2.31
Average response of I_{FCB} after entering	0.28	0	0.18
Average response of S_{FCB} after entering	0.02	.	0.006
Average response of I_{FCB} after exiting	-0.24	0	-0.05
Average response of S_{FCB} after exiting	-0.02	.	-0.002
Exporters			
Leverage	0.48	0.43	0.29
Share of firms holding FCB (%)	39.7	0	12.2
FCB intensity, conditional on with FCB (%)	8.4	0	3.5