Foreign Currency Borrowings and Trade Exposure in Emerging Markets*

Chang Liu†
University of Rochester

November 2023
Click for latest version

Abstract

Capital control policies are widely used in emerging markets to mitigate financial vulnerabilities. This paper studies the impact of capital control policies in emerging markets, taking into account a newfound complementarity between trade and currency for financing, both empirically and theoretically. I find that capital control policies are more costly than suggested by the literature, as these policies materially disrupt exporters' ability to access low-cost foreign currency financing due to this complementarity. Using Indian firm-level data, I first document a positive correlation between trade and currency for financing, along both extensive and intensive margins, and term it as "complementarity between trade and financing". Disciplined by this complementarity, I develop a model where entrepreneurs make simultaneous and endogenous choices of trade and currency for financing. In the model, foreign currency revenues generated from exports can directly repay or serve as collateral for foreign currency borrowings. Moreover, firms engaged in exporting partially mitigate the settlement costs associated with foreign currency borrowings. The calibrated model indicates that, without accounting for this complementarity, I would underestimate the impact of capital control policies by 61% of the misallocation and 27% of the output losses.

Keywords: Foreign Currency Borrowings, Trade Exposure, Capital Control Policy

JEL classification: F4, F34, F38

---

*First draft: March 2023. Thank Yan Bai, George Alessandria, Narayana Kocherlakota, Paulo Barelli, Mark Bils, Corina Boar, Gaston Chaumont, Hamid Firooz, Srihari Govindan, Rafael Guntin, Juan Carlos Hatchondo, Lisa Kahn, Marios Karabarbounis, Annie Lee, Yang Lu, Marcos Mac Mullen, Gabriel Mihalache, Matias Moretti, Ronni Pavan, Christopher Sleet, Xiaomei Sui, Kegon Tan, Tiago Tavares, Soo Kyung Woo, Nese Yildiz, and participants at several seminars and conferences for helpful comments and feedback.

†Email: changliu@rochester.edu or changliu863@gmail.com; Address: Department of Economics, University of Rochester, 280 Hutchison Road, P.O. Box 270156, Rochester, NY 14627, USA. Please refer to Chang's personal website for more information.

1 Introduction

Capital control policies have become widely used as a macroprudential policy tool in emerging markets. One of the key objectives in implementing these policies is to curb the substantial reliance of the private sector on external borrowings denominated in foreign currency, which exposes private sector to greater vulnerability to global shocks and has been identified as a contributing factor to several emerging market crises (Kim et al., 2015; Kalemli-Ozcan et al., 2016)[1]. This paper aims to study the impact of capital control policies in emerging markets, with a particular focus on the interaction between trade and currency for financing decisions within the private sector.

This paper makes three contributions. First, I provide novel empirical micro-evidence on the correlation between firms' trade activities and their choices of currency for financing, along both extensive and intensive margins. Second, I provide a theoretical foundation for this correlation by extending a quantitative model that incorporates endogenous export decisions with simultaneous and endogenous decisions on currency for financing. Finally, the calibrated model demonstrates that capital control policies in emerging markets are more costly. Those policies limit exporting firms' access to low-cost foreign currency financing due to the complementarity, which in turn leads to aggregate output losses.

This paper starts by empirically documenting the relationship between firms' trade activities and their choice of currency for financing in emerging markets. Using micro-level data from India, the empirical analysis reveals a positive correlation between firms' foreign currency borrowings and trade, along both the extensive and intensive margins of trade and financing. Specifically, upon first entering the export market, firms are more likely to engage in foreign currency borrowings, and intensity of foreign currency borrowings goes up. Conversely, when firms exit the export market, their likelihood of borrowing in foreign currency decreases, and firms shift their overall borrowings towards borrowings denominated in the home currency. Moreover, when examining the trade intensive margin, firms highly involved in international trade exhibit a greater tendency to finance in foreign currency and

[1] It's well-documented in the literature that non-financial corporations in emerging markets heavily rely on foreign currency-denominated debt for financing (Acharya et al., 2015; Gutierrez et al., 2021).

have a higher intensity of foreign currency borrowings. I refer to these observed correlations between trade and financing, along both extensive and intensive margins, as the complementarity between trade and the choice of currency for financing.

Since exporting firms are more likely to finance in foreign currency, the implementation of capital control policies that restrict the use of foreign currency financing could be costly. To evaluate the significance of these associated aggregate losses, I develop a theoretical model following Kohn et al. (2020), where risk-averse entrepreneurs simultaneously determine their trade and currency choices for financing. These entrepreneurs choose their consumption, pricing strategies in both domestic and foreign market (in the case of exports), and borrowing arrangements including the choice of currency for financing and borrowing intensity. Entrepreneurs face cash flow-based collateral constraints, and exogenous demands from both domestic and foreign markets. In this model, bonds denominated in foreign final good exhibit lower borrowing costs compared to bonds denominated in home final good. However, bonds denominated in foreign final good are exposed to currency risk stemming from exogenous exchange rate shocks.

The model can replicate the observed complementarity between trade and currency choice of financing mainly through three channels. First, entrepreneurs can directly utilize their foreign currency revenues to repay foreign currency borrowings, a mechanism commonly referred to as the *natural hedge channel*. Second, exporting firms can leverage their foreign currency revenues as *collateral* to access additional financing in foreign currency. This strategy is particularly attractive due to the exogenous interest rate differentials between home and foreign currency borrowings. Third, firms actively engaged in international trade mainly invoice their transactions in dominant currencies, such as the U.S. dollar and euro. Consequently, these firms have already accounted for the costs associated with foreign currency payment. When they opt for foreign currency borrowings, these firms can complementarily reduce their fixed financing costs associated with foreign currency settlement, thereby establishing what I term the *cost complementarity channel*.

I first calibrate the model to match the key moments of India during 2000-2016, as well as the estimated correlation coefficients obtained in the empirical analysis. These moments primarily reflect firms' choices on trade and currency for financing. In this calibration, I can endogenously pin down the key parameters that quantify

the overall degree of complementarity. Using the calibrated model, I illustrate how trade and currency choices for financing interact in the benchmark model, by plotting firms' impulse response functions to an exchange rate depreciation shock. When a depreciation occurs, more firms enter the export market, and the average export intensity increases, resulting in more foreign currency borrowings as a response to the depreciation shock.

Using the calibrated model as a laboratory, I further discuss the effects of capital control policies in emerging markets. I first compare the benchmark model against models with different levels of capital control tax, thus capturing the long-run effects of these policies across different stationary equilibria. A higher capital control tax has the effect of deleveraging the entire economy, and depressing the complementarity between trade and financing. As a result, exporters have limited access to low-cost foreign currency financing. Moreover, I investigate the dynamic effects of capital control tax along a transition path. I introduce a one-unit increase in the capital control tax to the benchmark economy. A 1pp higher capital control tax is found to be associated with a 0.48pp increase in misallocation, measured as the standard deviation of the marginal revenue product of capital relative to the world interest rate. It also results in a 0.83pp reduction in aggregate output along the transition path.

Without considering the degree of complementarity between trade and currency of financing, I would underestimate the cost of capital control policies in emerging markets. To emphasize the role of complementarity when accessing the impact of capital control policies, I draw comparisons between the benchmark model and three reference models. First, by comparing the benchmark model with a reference model that disables the *cost complementarity channel*, I find that, without accurately quantifying the degree of cost complementarity, there is a potential to overestimate the negative effects of capital control policies. This overestimation results in a 35% increase in misallocation and a 36% rise in output losses. Secondly, I present the reference model that replaces the cash flow-based collateral constraints with the asset-based collateral constraints, where foreign currency revenues cannot serve as collateral for foreign currency borrowings. In the absence of the*collateral constraints* channel, there is a risk of underestimating misallocation by 25% and output losses by 27%. Thirdly, I explore the reference model in which entrepreneurs price their products in the foreign market using the home final good, disabling both the *natural hedge channel* and the collateral channel simultaneously. In comparison to the benchmark model, a 1-unit increase in

capital control tax in this reference model results in 61% lower misallocation and 27% lower output losses.

Related literature. This paper links firms' trade with currency choice of financing, and evaluate the effects of capital control policies in the emerging markets when considering the complementarity between trade and currency of financing. This paper contributes to the following strands of literature.

First, this paper contributes to a large strand of literature that connects international trade and financial friction, as discussed in prior works (Feenstra et al., 2014; Leibovici, 2021; Kohn et al., 2022). Some existing research has explored the empirical relationship between financing and international trade (Beck, 2003; Greenaway et al., 2007; Bellone et al., 2010; Minetti and Zhu, 2011). This paper distinguishes itself by centering on the concept of currency margins in both trade and financing. In particular, as emerging markets are more likely to use dominant currency to invoice their trade, they are inclined to borrowing in foreign currency. Besides, there are extensive theoretical and quantitative literature studying the role of financial frictions in international trade (Manova, 2013; Kohn et al., 2016, 2020). My theoretical framework extends the model presented in Kohn et al. (2020), and departs by allowing firms flexibility in choosing currency for financing and determining the intensity of home/foreign currency borrowings. These joint decisions allow for examining how the interaction between trade and financial friction reshapes the evaluation of capital control policies in emerging markets.

Second, this paper is related to the literature discussing the popularity of foreign currency-denominated debt in emerging markets. Borrowers in emerging markets are more likely to borrow in dollars when there is carry trade motive (Caballero et al., 2016; Bruno and Shin, 2017; Huang et al., 2018; Acharya and Vij, 2020); hedging from exchange rate exposure motive (Froot et al., 1993; Gelos, 2003; Salomao and Varela, 2022); or some other motives, such as taxes, costs of financial distress, managerial risk aversion, credit supply in dollar (Smith and Stulz, 1985; Jeanne, 2000; Keloharju and Niskanen, 2001; Maggiori et al., 2020; Gutierrez et al., 2021). In this literature, previous studies that discuss the relationship between currency for financing and trade (Kedia and Mozumdar, 2003; Harasztosi and Kátay, 2020; Jiao and Kwon, 2022) have primarily focused on empirical facts on the relationship between export shares

and the fraction of debts in foreign currency along the intensive margin. The main departure of this paper is that the empirical findings shed light on the complementarity between trade and currency for financing along both extensive and intensive dimensions of trade and financing. Moreover, I introduce trade related channels in explaining micro-level financing decisions, besides the interest rate differential and exchange rate exposure motives.

Third, this paper also relates to a large branch of literature on "original sin" in international finance, where they focus on the negative balance sheet effects of foreign currency denominated liability, both empirically and theoretically. Foreign currency borrowings expose private sector to higher currency risk and make these firms more vulnerable when there is an exchange rate depreciation (Calvo and Reinhart, 2002; Kim et al., 2015; Du and Schreger, 2022; Jiao and Kwon, 2022; Kim and Lee, 2023). Besides the currency risks, this paper brings new thoughts from the trade perspective, and document that firms' currency choice for financing is complementary to firms' trade. The complementarity would change the previous understanding in the effects of foreign currency borrowings on emerging markets and provide insights on capital control policies in emerging economies.

Lastly, another strand of literature closely related to this paper investigates the effects of capital control policies on firm dynamics and their implied aggregate implications (Forbes, 2007; Alfaro et al., 2017; Andreasen et al., 2019, 2023). My paper contributes to the literature by focusing on how these policies affect firms' choice of currency for financing. This margin, the currency denomination of debt, is less discussed in this strand of literature. The complementarity between trade and currency for financing provides a micro-foundation for understanding how capital control policies reshape the private economy.

Road map. This paper proceeds as follows. Section 2 introduces firm-level evidence that explores the relationship between trade and the choice of currency for financing. In Section 3, I outline the baseline model, which incorporates simultaneous and endogenous choices of both trade and currency for financing. Section 4 calibrates the model, highlights the main mechanisms of the benchmark model, evaluates the impact of capital control policies in emerging markets, and emphasize the critical role of complementarity in evaluating these policies. Section 5 concludes.

2 Evidence on trade and currency of financing

This section examines the relationship between trade and the choice of currency for financing, using an Indian firm-level database. Section 2.1 provides an overview of the baseline Indian firm-level sample and presents key statistics of the sample. In Section 2.2, I present evidence on how firms' choice of currency for financing is complementary to firms' trade activities. Specifically, 2.2.1 shows how changes in firms' trade status are associated with firms' choice of currency for financing (extensive margin of trade). Section 2.2.2 shows how trade intensity is linked with the intensity of foreign currency borrowings (intensive margin of trade). Section 2.3 offers various robustness checks to validate the baseline results.

2.1 Data

The empirical analysis mainly use the Indian firm-level data from the Center for Monitoring of Indian Economy (CMIE) Prowess database. This comprehensive dataset includes information related to both listed firms and a broader range of unlisted Indian firms, spanning the period from 1988 to 2023. The baseline sample restricts to non-financial companies that in manufacturing, mining, electricity, non-financial services and construction industries.

The baseline sample is at annual frequency, ranging from 2000 to 2016. This CMIE Prowess database releases 3 vintages for each calendar year, namely March, September, and December vintages. The firm-level information mainly comes from firms' annual report, prospectus or interim financials. The annual firm-level sample mainly uses the information from the March vintages. Because most companies in the sample report their financial information in their annual report. What's more, the vintages updated after 2017 enlarge with many small and non-exporting firms, so that I restrict the baseline sample to observations before 2017. More details about data cleaning can be found in Appendix A.1.

Firm-level variables. This database contains rich data about firms' currency composition of financing, trade activities (both exports and imports) as well as other rich balance-sheet information. More specifically, the core variables used in the baseline

empirical analysis contain firms' foreign currency borrowings, total export earnings, total liabilities, total sales, total assets, and some other firm-level variables.

Foreign currency borrowings are defined as any loans taken in foreign currency other than Indian rupees, including external commercial borrowings, such as convertible bonds, non-convertible bonds and subordinated debt, as well as foreign suppliers' credit obtained for capital goods [2]. I focus on both extensive and intensive margin of holding foreign currency borrowings, namely firms' likelihood and intensity of holding foreign currency borrowings ($\mathcal{I}_{FCB}$ and S_{FCB}).

In the baseline empirical analysis, I mainly use an indicator for firms' first entering the export market ($\mathcal{I}_{first-exp}$), an indicator for firms' exiting the export market ($\mathcal{I}_{never-exp}$), as well as export intensity that is defined as the ratio of export sales to total sales. I also define size, leverage and fixed asset turnover ratio (FAT) as standard in literature. Table 1 shows the summary statistics for the main variables. Appendix A.2 shows more details on variable construction.

Table 1: Summary statistics

	N	Mean	Std. Dev.	min	max	p25	Median	p75
$I_{first-exp}$	233757	.018	.132	0	1	0	0	0
$I_{never-exp}$	233757	.016	.124	0	1	0	0	0
I_{FCB}	233757	.063	.243	0	1	0	0	0
Export intensity	233757	.084	.212	0	1	0	0	.014
Size	233757	1.668	2.05	-4.906	6.478	.358	1.729	3.084
Leverage	233757	.767	.757	.006	8.576	.376	.657	.926
Log(total liability)	233757	1.021	2.299	-5.991	6.066	-.366	1.215	2.617
S_{FCB}	12135	.128	.096	0	.354	.046	.108	.196

Notes: Statistics are calculated using the baseline firm-level data from CMIE Prowess database, ranging from 2000 to 2016. The baseline sample is restricted to the observations with available data on currency of financing, export intensity and firm-level control variables. Statistics of S_{FCB} are reported using observations ever holding foreign currency borrowings. More details are listed in Appendix A.2.

2.2 Correlation between trade & foreign currency borrowings

This section presents the evidence on how firm currency of financing is related to firm trade, using Indian firm-level sample. Specifically, section 2.2.1 discusses the effects of changes in trade status on dynamics of foreign currency borrowings. Section 2.2.2

[2] Appendix A.3 presents more details on definitions and dynamics of foreign currency borrowings.

focuses on the correlation between trade intensity and intensity of foreign currency borrowings.

2.2.1 Trade extensive margin

This section focuses on how firm trade status affects firms' decisions on currency of financing. Specifically, this section discusses how firms' currency of financing decisions evolve after firms' first entering and exiting the export market.

Fact 1. After first entering export market,
(i) firms' likelihood of financing in foreign currency increases by 1.2pp-3.8pp;
(ii) intensity of foreign currency borrowings increases by 0.2pp-1.4pp, conditional on firm ever borrowing in foreign currency.

Following Dube et al. (2023), I estimate a local projection with a clean control condition, which is given as

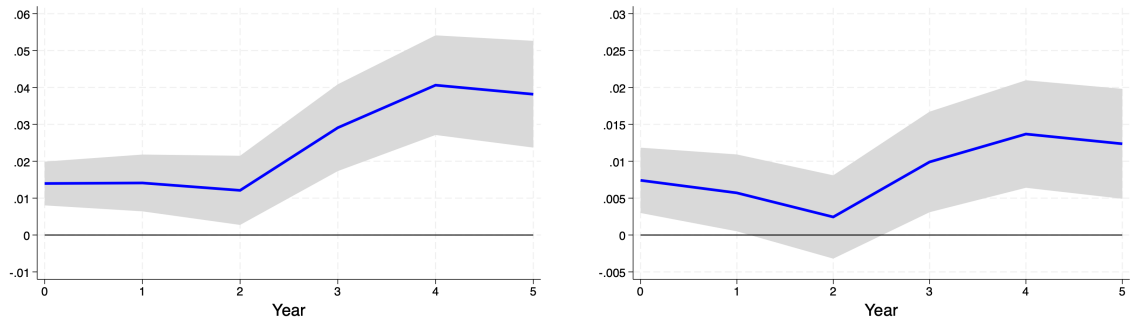
$$y_{i,t+h} - y_{i,t-1} = \alpha^h \Delta D_{it} + Z'_{i,t-1}\beta + \eta_t^h + e_{it}^h,$$

restricting sample to observations that are either

$$\begin{cases} \text{new exporters:} & \Delta D_{it} = 1, \\ \text{or clean control:} & D_{i,t+h} = 0. \end{cases}$$

where $y_{i,t}$ could be either an indicator that takes value 1 if firm i borrows in foreign currency I_{FCB}, or the share of foreign currency borrowings in their overall borrowings S_{FCB}. The indicator $\Delta D_{it} = 1$ means that firm i newly enters the export market at time t. Clean control units refer to the observations that have never exported before. I focus on the effects at horizon $h = 0, 1, 2, 3, 4, 5$ after firm i first entering the export market. Controls $Z_{i,t1}$ includes firm size (log of total assets), log of total liability, total leverage, fixed asset turnover ratio, and industry fixed effects. The time fixed effects η_t^h control for potential time trend. The error term at each horizon h is denoted by e_{it}^h. The key parameter of interest α^h for each horizon h captures the cumulative change in dependent variable after firm i first entering the export market.

Clean control condition corrects the "negative weights" bias discussed in the literature (De Chaisemartin and d'Haultfoeuille, 2020; Goodman-Bacon, 2021; Callaway and Sant'Anna, 2021), by ruling out previously treated observations (exporters) in the sample. There is a growing literature discussing problems arising from staggered treatment adoption with dynamic and heterogeneous treatment effects. If I define a group t as a given group of firms that enter export market at same time t, heterogeneous treatment effects refer to the situation where the treatment effects differ across groups $\alpha^h|_{t_0} \neq \alpha^h|_{t_1}$ for at least some horizon h and some pair of groups $t_0 \neq t_1$. α^h actually captures the weighted average estimation of the treatment effects across different group. In traditional local projection method, the previously treated observations (exporters) are still used as controls for newly-treated observations (new exporters), and these "unclean comparisons" are the source of the "negative weights" bias. That is to say, those previously treated observations act as if they were untreated, although they might in fact be experiencing dynamic treatment effects. Due to dynamic and heterogeneous treatment effects, positive group-specific treatment effects could enter the estimated coefficient α^h with a negative weight.



(a) I_{FCB} (b) S_{FCB}

Figure 1: Response of foreign currency borrowings to first entering export market

Notes: The left panel shows the responses of extensive margin of foreign currency borrowings. The right panel plots the response of foreign currency borrowings intensity, conditional on firms ever financing in foreign currency. 90% confidence bands displayed.

Figure 1 depicts the cumulative responses to firms' first entering the export market. The left panel plots how probability of holding foreign currency borrowings changes h years after firm i entering export market (extensive margin of financing in foreign currency). After firms firm enter the export market at time t, they are 1.2-3.8pp more likely to hold foreign currency borrowings in the following 5 years. On the

other hand, there are more foreign currency borrowings in their overall borrowings, as shown in the right panel of Figure 1 (intensive margin of financing in foreign currency). Compared to the average intensity of foreign currency borrowings (13%) in the baseline sample, the intensity of foreign currency borrowings increases by 0.2-1.4pp after entering the export market.

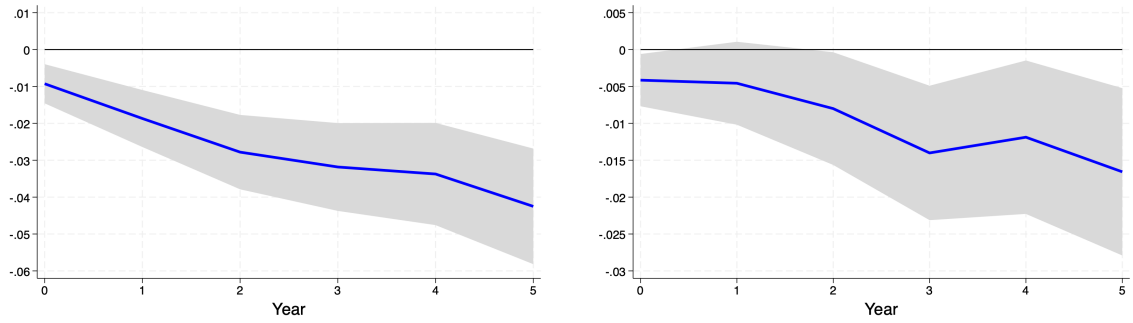
Fact 2. After exiting the export market,
(i) likelihood of financing in foreign currency falls by 0.9-4.3pp;
(ii) intensity of foreign currency borrowings falls by 0.4-1.7pp, conditional on firm ever borrowing in foreign currency.

To estimate the effects of firms' exiting the export market, I replace the treatment $\Delta D_{it} = 1$ with an alternative indicator that takes the value 1 if firm i permanently exits the export market in the baseline sample. Figure 2 shows the corresponding cumulative responses to firms' exiting export market. The left panel shows that the likelihood of holding foreign currency borrowings goes down by 0.9-4.3pp, indicating that firms gradually deleverage their foreign currency borrowings after exiting the export market. For the intensive margin of foreign currency borrowings, there are less foreign currency borrowings in their overall borrowings, as shown in the right panel of Figure 2. The foreign currency borrowings intensity falls by 0.4-1.7pp after exiting the export market.

After firms change their export status, their currency of financing decisions are quite responsive, along both extensive and intensive margins of foreign currency borrowings. This correlation between trade and currency of financing is also significant for intensity margin of trade. In next section, I present the correlation between export intensity and intensity of foreign currency borrowings.

2.2.2 Trade intensive margin

Besides the effects of firm trade status on firms' decisions on currency of financing, this section would continue to discuss the relationship between trade intensity and intensity of foreign currency borrowings, by restricting the sample to firms ever holding positive amount of foreign currency borrowings.



(a) I_{FCB} (b) S_{FCB}

Figure 2: Response of foreign currency borrowings to exiting export market

Notes: The left panel shows the responses of extensive margin of foreign currency borrowings. The right panel plots the response of foreign currency borrowings intensity, conditional on firms ever financing in foreign currency. 90% confidence bands displayed.

Fact 3: firms with higher export intensity are more likely to borrow in foreign currency; Conditional on ever financing in foreign currency, firms with higher export intensity borrow more intensively in foreign currency.

Table 2 shows the correlation between export intensity and currency of financing behaviours, by grouping firms based on their export intensity. The export intensity is defined as the ratio of export sales to total sales. The first row refers to non-exporters. The following four groups correspond to observations falling into each quartile of export intensity. Firms with higher export intensity are more likely to borrow in foreign currency. Conditional on ever financing in foreign currency, firms with higher export intensity borrow more intensively in foreign currency.

2.3 Robustness

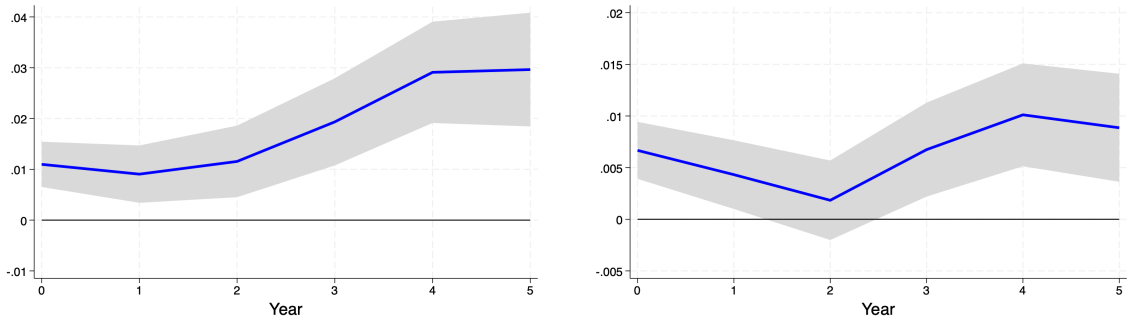
This section summarizes some robustness checks to the baseline empirical results. Firstly, I show the baseline results are robust when considering the export dynamics after first entering the export market. Secondly, the baseline results remain robust to a manufacturing sample. Lastly, this section summarizes other robustness checks to solve some potential concerns.

Table 2: Correlation between intensities of export and foreign currency borrowings

By export intensity	Prob(FCB)	S_{FCB}
Non-exporters	0.030	0.127
(0,Q1)	0.115	0.119
[Q1,Q2)	0.136	0.119
[Q2,Q3)	0.166	0.117
[Q3,Q4]	0.143	0.145

Notes: S_{FCB} refers to the intensity of foreign currency borrowings, which is measured as the ratio of foreign currency borrowings to total liability. Export intensity is defined as the ratio of export sales to total sales.

Export dynamics after first entering export market. There are concerns that firms exiting and re-entering the export market would bias the baseline estimation. Instead of using first entering the export market as the main indicator, I replace the ΔD_{it} with an indicator that takes value 1 if firm i enters the export market. That is to say, $\Delta D_{it} = 1$ includes firms' re-entering the export market.

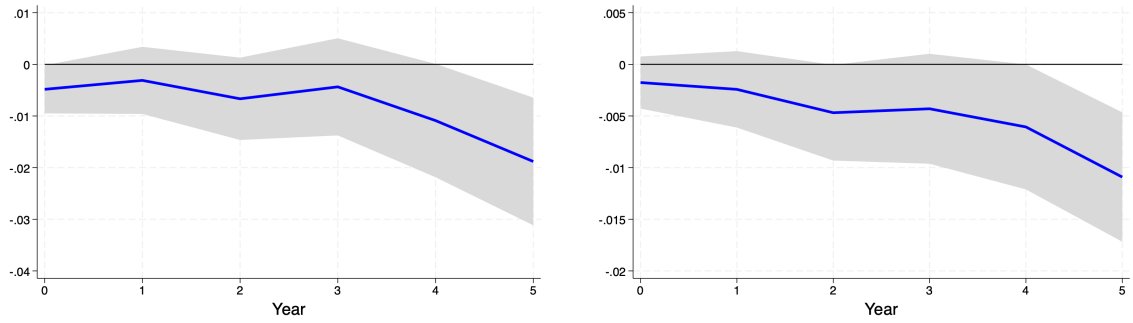


(a) I_{FCB} (b) S_{FCB}

Figure 3: Response of foreign currency borrowings to entering export market

Notes: The left panel shows the responses of extensive margin of foreign currency borrowings. The right panel plots the response of foreign currency borrowings intensity, conditional on firms ever financing in foreign currency. 90% confidence bands displayed.

When taking the firm dynamics after first entering the export market into consideration, the results are robust to the baseline results. Likelihood of financing in foreign currency increases by 1.2-3.8pp. Intensity of foreign currency borrowings increases by 0.4-1.0pp, conditional on firms' ever borrowing in foreign currency. That is to say, firms re-entering the export market won't significantly bias the baseline results.



(a) I_{FCB} (b) S_{FCB}

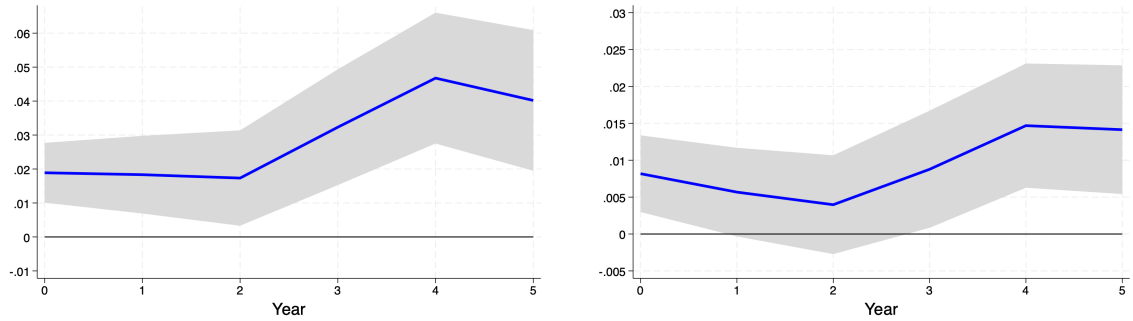
Figure 4: Response of foreign currency borrowings to exiting export market

Notes: The left panel shows the responses of extensive margin of foreign currency borrowings. The right panel plots the response of foreign currency borrowings intensity, conditional on firms ever financing in foreign currency. 90% confidence bands displayed.

Similarly, if I replace the treatment ΔD_{it} with an indicator that takes 1 if company exits export market, Figure 4 shows that the baseline results remain robust. Now, $\Delta D_{it} = 1$ includes each time firm exiting the export market. I can observe that likelihood of financing in foreign currency falls by 0.4-1.4pp, after exiting the export market. Intensity of foreign currency borrowings falls by 0.2-0.9pp, conditional on firms' ever borrowing in foreign currency. Therefore, firm dynamics cannot bias the main conclusion of the baseline empirical part.

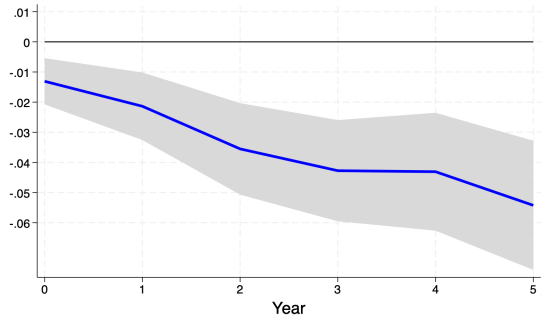
Sample of only manufacturing industry. The baseline sample incorporates manufacturing, mining, electricity, non-financial services and construction firms. In this section, I restrict the baseline sample to just manufacturing firms, which are relatively more tradable than firms in other industries.

The results are shown in Figure 5. After firms' first entering the export market, likelihood of financing in foreign currency increases by 1.7-4.0pp. Intensity of foreign currency borrowings increases by 0.4-1.4pp, conditional on firms' ever financing in foreign currency. After firms' exiting the export market, they are less likely to finance in foreign currency, with the probability going down by 1.3-5.4pp. The intensity of foreign currency borrowings falls by 0.1-1.4pp, conditional on firms' ever borrowing in foreign currency. Using the manufacturing sample, the extensive margin of foreign currency borrowings is more responsive to changes in trade status.

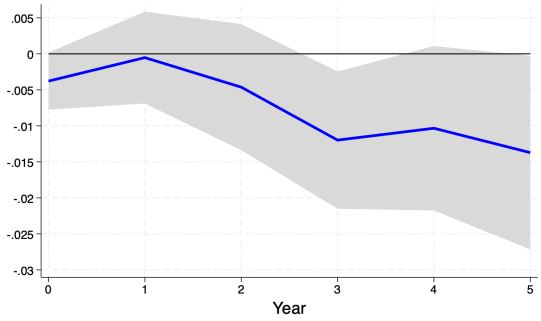


(a) I_{FCB} after first entering

(b) S_{FCB} after first entering



(c) I_{FCB} after exiting



(d) S_{FCB} after exiting

Figure 5: Responses of foreign currency borrowings using manufacturing sample

Notes: Panel (a) shows the responses of extensive margin of foreign currency borrowings to firms' first entering the export market. Panel (b) plots the response of foreign currency borrowings intensity to firms' first entering the export market, conditional on firms ever financing in foreign currency. Panel (c) shows the responses of extensive margin of foreign currency borrowings to firms' exiting the export market. Panel (d) plots the response of foreign currency borrowings intensity to firms' exiting the export market, conditional on firms ever financing in foreign currency. 90% confidence bands displayed.

Other robustness checks Alternatively, I redo the baseline empirical exercises using a sample from 1988 to 2016, which includes the trade liberalization period of India in the 1990s. The complementarity between foreign currency financing and export is robust to this longer sample. More details are available in Appendix B.1.

Instead of apply the clean control condition, I estimate a conventional local projection specification following Jordà (2005). The baseline correlation between changes in trade status and currency of financing remains robust, as shown in Appendix B.2.

Besides the responses to changes in export status, I also estimate the responses of foreign currency borrowings to changes in import status. Appendix B.3 shows that firms are more likely to finance in foreign currency and borrow more intensively after they enter the import market. After firms exiting the import market, they gradually deleverage their holding of foreign currency borrowings.

To solve the concern that the baseline responses of foreign currency borrowings to changes in export status is driven by import side, I further drop firms that only import in the baseline sample, which only constitutes 9.8% of total observations. I re-estimate the baseline regression. The correlation between trade and currency of financing is robust, as shown in Appendix B.4. That is to say, the baseline results are mainly driven by firms that both export and import[3].

Furthermore, I reverse the estimation strategy, and estimate how firms first financing in foreign currency affects firms' export decisions. As shown in Appendix B.6, firms are responsive in terms of their exports after they start financing in foreign currency, while there is no significant response after they completely deleverage their holding of foreign currency borrowings. As about 60% of the foreign currency borrowings are long-term borrowings, it takes years for firms completely deleverage.

To summarize, firms' currency of financing decisions are closely related with firms' trade status and trade intensity. I call this correlation between trade and currency of financing as the **complementarity between trade and financing**. In next section, I rationalize this complementarity between trade and financing and discuss how

[3]In the benchmark model, I would mainly focus on the interaction between export and currency of financing. As documented in the literature, the import-side story is more intuitive, as firms that import need borrow in foreign currency to directly pay for their imports. It's also interesting to discuss the correlation between trade currency mismatch and currency of financing. I would extend the baseline model by incorporating the import decisions in the future.

this complementarity changes the evaluation of capital control policies in emerging markets.

3 Model

The baseline empirical analysis presented in Section 2 highlights that exporting firms tend to find foreign currency borrowing a cost-effective financing strategy. Consequently, the implementation of capital control policies aimed at restricting the use of foreign currency financing could result in efficiency losses. However, the question arises: how significant are these losses? In this section, I introduce a partial equilibrium model with both endogenous decisions on international trade and currency for financing, following Kohn et al. (2020), which will enable me to quantify the extent of these efficiency losses. This model extends previous research by granting exporters the flexibility to determine which currency to borrow and the extent of their home/foreign currency borrowings.

In the model, there is a small open economy, with a unit measure of monopolistically competitive entrepreneurs. Entrepreneurs own the firms, which produce differentiated goods and sell to both domestic and foreign markets. The real exchange rate is defined as the price of foreign final good relative to the domestic final good. I assume that the numeraire good is the foreign final good, so that the price of domestic final good is implied by the real exchange rate.

3.1 Set-up

There is a unit measure of monopolistically competitive entrepreneurs $i \in [0, 1]$. They are risk-averse with preference $\mathbb{E}_0 \sum_{t=0}^{\infty} \beta^t \frac{c_{it}^{1-\gamma}}{1-\gamma}$, where β is the discount factor and γ refers to the coefficient of relative risk aversion.

Production: Each entrepreneur i produces domestic good i with capital k_{it}:

$$y_{it} + \tau x_{it} y_{it}^* = A_t z_{it} k_{it}^{\alpha} \tag{1}$$

where A_t denotes the aggregate productivity shock. z_{it} is the idiosyncratic productivity shock that follows $\log(z_{it}) = \rho_z \log(z_{it-1}) + \sigma_z \varepsilon_{it}$; ε_{it} follows a standard normal random process. $\alpha < 1$ is the income share of capital.[4] k_{it} is the stock of capital. Capital k_{it} depreciates every period at the rate δ. Then the capital is accumulated at time t following

$$i_{it} = k_{i,t+1} - (1-\delta)k_{it}, \tag{2}$$

where i_{it} refers to investment. Entrepreneur i can sell in domestic market y_{it} and foreign market y^*_{it}. x_{it} denotes firm i's export decision, and takes value 1 if firm i exports at time t.

Financial friction: Entrepreneurs can borrow by trading one-period bonds denominated in either foreign final good b^*_{it} or home final good b_{it}. I assume that both bonds are supplied perfectly elastically at given interest rates r^*_t (b^*_{it}) and r_t (b_{it}) by international investors. Entrepreneurs face collateral constraints for both bonds. Following Lian and Ma (2021) and Camara and Sangiacomo (2022), it is assumed that collateral borrowing constraints are more based on firms' cash flows, instead of the liquidation value of their assets, which is given as

$$\begin{aligned} b_{i,t+1} &\leq \theta \left(p_{it} y_{it} + x_{it} e_t p^*_{it} y^*_{it} \right), \\ e_t b^*_{i,t+1} &\leq \theta^* \left(p_{it} y_{it} + x_{it} e_t p^*_{it} y^*_{it} \right), \end{aligned} \tag{3}$$

where p_{it} is the price that entrepreneurs sell in domestic market, denominated in home good; p^*_{it} is the price in foreign market, denominated in foreign good[5]. $e_t = P^*_t / P_t = 1/P_t$ is the real exchange rate, where the price of foreign final good P^*_t is assumed to be 1 (numeraire), and P_t is domestic final good price index in period t. If company i borrows in bonds denominated in foreign final good, it's subject to additional fixed cost of financing f^* in each period[6].

[4] This production function can be interpreted as producing using a constant unit of labor. Alternatively, there is another sector that would clear the labor market with wage w, according to the endogenous choice on capital k_{it}.

[5] Emerging markets are heavily using dominant currency for trade invoicing, which is call dominant currency pricing (DCP). More details can be found in Appendix C.2.

[6] This fixed cost of financing can be interpreted by the fact that cross-boarder financial institution is hard to verify firm information when purchasing foreign currency denominated bonds of non-financial corporations in emerging markets. The frequency and intensity of foreign currency borrowings are informative about this fixed costs of financing. If I observe a large fixed cost of financing, one should expect infrequent issuance of bonds denominated in foreign good.

Trade friction: Firms are subject to a sunk entry cost of exporting c^x when starting to export, an iceberg trade cost τ for each unit of export, and a fixed cost f^x for each period.

Cost complementarity: If firm i does not borrow by issuing bonds denominated in foreign final good, the total cost is given as:

$$F\left(x_{it-1}, x_{it}, b^*_{i,t+1} = 0\right) = \begin{cases} 0 & \text{for } x_{it} = 0, \\ f^x + c^x\left(1 - x^x_{it-1}\right) & \text{for } x_{it} = 1. \end{cases} \tag{4}$$

Exporting firms are only subject to trade costs. If firm i issues debt denominated in foreign good, the total cost is

$$F\left(x_{it-1}, x_{it}, b^*_{i,t+1} > 0\right) = \begin{cases} f^* & \text{for } x_{it} = 0, \\ \zeta\left[f^* + f^x + c^x\left(1 - x_{it-1}\right)\right] & \text{for } x_{it} = 1, \end{cases}$$

where ζ governs the degree of complementarity between export fixed/sunk costs and fixed cost of financing by issuing bonds denominated in foreign final good. This cost complementarity can be rationalized by the fact that there is common foreign exchange settlement costs for both trade invoiced in foreign currency and borrowings denominated in foreign currency. If firms have already exposed to international trade that invoiced in foreign currency, they have paid costs associated with foreign currency settlement. Once they start borrowing in foreign currency, settlement costs are partially paid previously [7].

Demand functions: The domestic demand schedule is given as

$$y_{it} = \left(p_{it}/P_t\right)^{-\sigma} Y_t = \left(e_t p_{it}\right)^{-\sigma} Y_t, \tag{5}$$

and the foreign demand by the rest of the world is

$$y^*_{it} = \left(p^*_{it}/P^*_t\right)^{-\sigma} Y^*_t = \left(p^*_{it}\right)^{-\sigma} Y^*_t \tag{6}$$

[7] Alternatively, if firm i gets involved in international trade, it's a good signal to foreign investors and it's less costly for foreign investors to verify their financial conditions.

where Y and Y^* refer to exogenous domestic and foreign aggregate demand, respectively.

Budget constraints: Entrepreneurs are subject to a budget constraint in each period, denominated in units of the domestic final good, which is represented by

$$\begin{aligned} c_{it} + i_{it} + b_{it} + e_t b^*_{it} =& p_{it} y_{it} + x_{it} e_t p^*_{it} y^*_{it} + \frac{b_{i,t+1}}{(1+r_t)(1+\tau_{ct})} \\ &+ e_t \frac{b^*_{i,t+1}}{(1+r^*_t)(1+\tau_{ct})} - F(x_{i,t-1}, x_{it}, b^*_{i,t+1}). \end{aligned} \tag{7}$$

The new issuance of $b_{i,t+1}$ and $b^*_{i,t+1}$ are subject to borrowing interest rate r_t and r^*_t, respectively. There is a capital control tax τ_{ct} on overall borrowings in the economy, which captures the intensity of capital control policies in targeted countries[8].

3.2 Entrepreneur's problem: recursive formulation

Assume that the aggregate productivity A_t, interest rate r^*_t, r_t and capital control tax τ_{ct}, are constant in a stationary equilibrium. Let $V(z, k, b, b^*, x_{-1}, e)$ denote the value function for an entrepreneur with idiosyncratic productivity z, capital stock k, bonds denominated in home final good b, bonds denominated in foreign final good b^*, export status in time $t-1$, facing exogenous real exchange rate e. Monopolistically competitive entrepreneurs choose the consumption, pricing plans, export status, borrowing schemes, subject to their budget constraints, collateral constraints and

[8]Emerging markets have greater breadth, comprehensiveness and intensity of capital controls, compared to develop countries, as shown in Appendix C.1. Therefore, the benchmark model is subject to a certain level of capital controls.

demand schedules. The entrepreneur's problem can be given as

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

3.3 Stationary competitive equilibrium

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 $\{c, p, y, p^*, y^*, k', b', b^{*\prime}, x\}$, a value function $V(s)$, and a measure $\phi : \mathcal{S} \to [0,1]$, such that (i) policy and value functions solve the entrepreneurs' problem; (ii) measure ϕ is stationary.

3.4 Mechanism

This section presents the main mechanisms that can generate the observed complementarity between trade and currency of financing. In the model, bonds denominated in foreign final good feature lower interest rate $r^* < r$ than bonds denominated in home final good. However, bonds denominated in foreign final good are subject

to currency risk, arising from the real exchange rate shock. Compared to bonds denominated in home final good, entrepreneurs have difficulties in repaying when there is a depreciation in real exchange rate. Another key distinction between two bonds is that bonds denominated in foreign final good is complementary to firms' exports. This complementarity between trade and financing is modeled via three main channels in the model: (i) natural hedge; (ii) collateral constraints; and (iii) cost complementarity.

Natural hedge. Recall the budget constraint if firm i exports,

$$c + k' + b + eb^* = py + xep^*y^* + (1-\delta)k + \frac{b'}{(1+r)(1+\tau_c)} + e\frac{b^{*\prime}}{(1+r^*)(1+\tau_c)} - F,$$

where export revenues denominated in foreign final good ep^*y^* can be directly used to repay the bonds denominated in foreign final good eb^*. This **natural hedge** channel is widely documented in the literature (Keloharju and Niskanen, 2001; Kedia and Mozumdar, 2003).

Collateral constraints. Firms with more export revenues that denominated in foreign final good can obtain more bonds denominated in foreign final good $b^{*\prime}$, as indicated by the collateral constraints for $b^{*\prime}$.

Rewrite exporters' collateral constraints,

$$\begin{aligned} b' &\leq \theta\left(py + ep^*y^*\right), \\ eb^{*\prime} &\leq \theta^*\left(py + xep^*y^*\right) \Rightarrow b^{*\prime} \leq \theta^*\left(py/e + p^*y^*\right). \end{aligned}$$

Without any responses in exports, firms face tightening collateral constraint for $b^{*\prime}$ when devaluation (higher e). From the first-order conditions, firms sell more in foreign market during devaluation period, as shown in Eq. (3.4). Market reallocation towards foreign market could relax exporters' collateral constraints of $b^{*\prime}$.

$$\text{export intensity} = \frac{ep^*y^*}{py + ep^*y^*} = 1 - \frac{py}{py + ep^*y^*} = 1 - \frac{1}{1 + \tau^{1-\sigma}e^{2\sigma}Y^*/Y}.$$

In contrast, non-exporters' collateral constraint for $b^{*\prime}$ is not relaxed, as there is no

market reallocation during devaluation.

$$b' \leq \theta py,$$
$$eb^{*\prime} \leq \theta^* py \Rightarrow b^{*\prime} \leq \theta^* py/e.$$

Cost complementarity. For the overall cost $F(x_{-1}, x = 1, b^{*\prime})$, there is a cost discount if firm i both exports and finances in foreign currency. Therefore, exporting firms are more likely to finance in foreign currency, due to lower settlement cost.

In the following quantitative analysis, there are more quantitative discussions about the main mechanisms.

4 Quantitative Analysis

This section fits the benchmark model to India data and provide quantitative results to highlight how the complementarity between trade and currency of financing matters for evaluating capital control policies in emerging markets. First, Section 4.1 parameterizes the model to match Indian macro- and micro-economic evidence during the sample period. Section 4.2 then highlights the complementarity between trade and financing in the benchmark model by plotting the impulse responses of firm borrowings, trade to a depreciation exchange rate shock. Section 4.3 re-evaluates the impacts of capital control policies, leveraging the benchmark model as a laboratory. Section 4.4, 4.5 and 4.6 highlight the role of cost complementarity, collateral constraint and natural hedge when evaluating the effects of capital control policies.

4.1 Parameterization

The model is at annual frequency. There are two categories of parameters. The first category includes parameters on preference, technology and some aggregate parameters. The values of the first category are assigned based on either conventional values in the existing work, or from aggregate data. The second category of parameters are jointly determined to match a set of moments relating to Indian economy. Table 3 lists all the parameter values.

Fixed parameters. The fixed parameters are $\{\beta, \gamma, \alpha, \delta, \sigma, r^*, \rho_e, \sigma_e, \rho_z\}$. The discount factor β is set to be 0.9, showing that entrepreneurs are less patient in emerging markets. Following the standard real business cycle literature (Backus et al., 1992; Kehoe and Perri, 2002; Alessandria and Choi, 2007), the relative risk aversion parameter γ takes the value 2. I set the income share of capital to be 0.33, and the depreciation rate of capital is 0.1, which are the conventional values in the literature. The demand elasticity for both home demand and foreign demand is 3. The aggregate demands are normalized to $Y = Y^* = 1$. To simplify the analysis for the current stage, I assume constant borrowing cost for bonds denominated in foreign final good (r^*) , which takes the average value of inflation-adjusted U.S. lending rate from World Bank. From international business cycle literature (Kehoe and Perri, 2002; Alessandria and Choi, 2007), I set the persistence of firm productivity shock to be 0.95. I calibrate the volatility of productivity shock, following

$$\log(z_{it}) = \rho_z \log(z_{i,t-1}) + \sigma_z \varepsilon_{it}, \quad \varepsilon_{it} \sim N(0,1). \tag{8}$$

The exchange rate is assumed to be exogenous and takes an AR(1) process, which is given as

$$\log(e_t) = \rho_e \log(e_{t-1}) + \sigma_e \varepsilon_t, \quad \varepsilon_t \sim N(0,1). \tag{9}$$

The persistence and volatility of the exchange rate shock are estimated, using real exchange rate series at annual frequency [9].

Fitted parameters. The rest of the parameters in the model include parameters for the volatility of firm productivity shock σ_z, parameters governing the collateral requirements for bonds denominated in both home and foreign final good $\{\theta, \theta^*\}$, interest rate for bonds denominated in home final good r, the capital control tax τ_c, the iceberg cost for exporting τ, parameters about export costs $\{f^x, c^*\}$, a parameter measuring the fixed cost for borrowing in foreign currency f^* and a parameter for the degree of complementarity between trade and financing costs ζ.

These parameters are jointly determined by matching ten Indian micro moments

[9] The Indian real exchange rate is constructed using price level of real consumption (CCON), which includes both private (C) and public consumption (G). I first demeaned the log of annual real exchange rate using the whole series ranging from 1950 to 2019, and then estimate an AR(1) process of the demeaned log series. The persistence parameter is 0.943, and the standard deviation of the white noise is 0.084.

Table 3: Parameters

Parameter	Description	Value	Target/Source
Fixed parameters			
β	Discount factor	0.9	Conventional value in EMs
γ	Coefficient of relative risk aversion	2	Alessandria and Choi (2007)
α	Income share of capital	0.33	Kohn et al. (2020)
δ	Depreciation of capital	0.1	Alessandria et al. (2015)
σ	Demand elasticity	3	Alessandria et al. (2015)
r^*	Interest rate of foreign currency borrowings	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	Alessandria and Choi (2007)
Fitted parameters			
σ_z	Volatility of z	0.30	Standard deviation of sales
θ	Collateral requirement of HCB	1.90	Total leverage
θ^*	Collateral requirement of FCB	0.15	Intensity of FCB, (if with FCB)
r	Interest rate of HCB	0.05	Average response of S_{FCB} after exiting
τ_c	Capital control tax	0.01	Average response of S_{FCB} after entering
τ	Iceberg cost	1.40	Export intensity conditional on exporting
f^x	Export fixed cost	0.50	Export enter rate
f^*	Fixed cost of FCB	0.50	Share of firms holding FCB
c^x	Export sunk entry cost	1.80	Share of exporting firms
ζ	Cost complementarity between f^x and f^*	0.65	Share of firms both exporting and holding FCB

that reflect companies' joint decisions on trade and currency of financing. The moments include the volatility of sales, the total leverage, the intensity of foreign currency borrowings conditional on firms having foreign currency borrowings, average intensive responses of foreign currency borrowings to changes in export status (entering and exiting), the export intensity conditional on firms exporting, the exporters enter rate, the fraction of firms that hold foreign currency borrowings, the share of exporting firms and share of firms both exporting and holding foreign currency borrowings. The model is solved using global methods, and simulated to get the model-implied counterparts of the targeted moments. In terms of the average responses of foreign currency borrowings intensity, I estimate exactly the same regressions as the empirical part. The fitted parameters are jointly chosen to match these ten sample moments by minimizing the sum of the distance between the moments in the model and their corresponding counterparts in the data.

The volatility of firm productivity shock σ_z is mainly matched to the volatility of sales, which includes both home and foreign currency revenues. The parameters related to collateral constraints $\{\theta, \theta^*\}$, domestic interest rate r, and capital control tax τ_c are jointly targeted at the total leverage, the intensity of foreign currency borrowings and the average responses of foreign currency borrowings intensity

estimated in the empirical part. The iceberg cost governs the average export intensity for those exporters. The trade cost structure $\{f^x, c^x\}$ are matching the exporters enter rate and the fraction of exporting firms. The fixed cost of foreign currency borrowings f^* is mainly related to the mass of companies borrowing in foreign currency. The complementarity between the export costs $\{f^x, c^x\}$ and foreign currency borrowing fixed cost f^* corresponds to the mass of firms that both exporting and holding foreign currency borrowings. Table 4 shows the moments in the data and in the model. The model can generate similar statistics as the ones in the data.

Table 4: Targeted moments

Targeted	Data	Model
Std(sales)	0.63	0.63
Leverage	0.40	0.29
Share of firms holding FCB	0.06	0.04
FCB intensity, conditional on with FCB	0.13	0.07
Share of exporting firms	0.32	0.27
Export intensity, conditional on exporting	0.27	0.26
Export enter rate	0.034	0.034
Share of firms both exporting and holding FCB	0.04	0.04
Average response of S_{FCB} after entering	0.01	0.01
Average response of S_{FCB} after exiting	-0.01	-0.01

Notes: Leverage is defined as the ratio of total borrowings to total assets. Foreign currency borrowings (FCB) intensity is measured as the ratio of foreign currency borrowings to total liability. Export intensity is the ratio of export sales to total sales.

Moreover, the untargeted moments also match well in the model, as shown in Table 5. These moments are a little off in terms of the average responses of extensive margin of foreign currency borrowings. Table 6 also shows the comparison between data and model in terms of the correlation between trade intensity and foreign currency borrowings. The calibration undershoots the conditional intensity of foreign currency borrowings, but it captures that firms highly involved in export market are more likely to finance in foreign currency and borrow more intensively.

Table 5: Untargeted moments

Untargeted	Data	Model
Corr(export intensity, FCB intensity)	0.12	0.22
Mean(FCB/Total borrowings)	0.005	0.003
Mean(FC Rev/Total sales)	0.07	0.07
Average response of I_{FCB} after entering	0.03	0.17
Average response of I_{FCB} after exiting	-0.02	-0.13

Table 6: Correlation at intensive margin

	I_{FCB}		S_{FCB} if I_{FCB}=1	
	data	model	data	model
Not exporting	0.03	0.01	0.13	0.07
(p0, p25]	0.12	0.09	0.12	0.07
(p25, p50]	0.14	0.13	0.12	0.06
(p50, p75]	0.17	0.13	0.12	0.07
(p75, p100]	0.14	0.19	0.15	0.07

4.2 Mechanism: complementarity between trade and financing

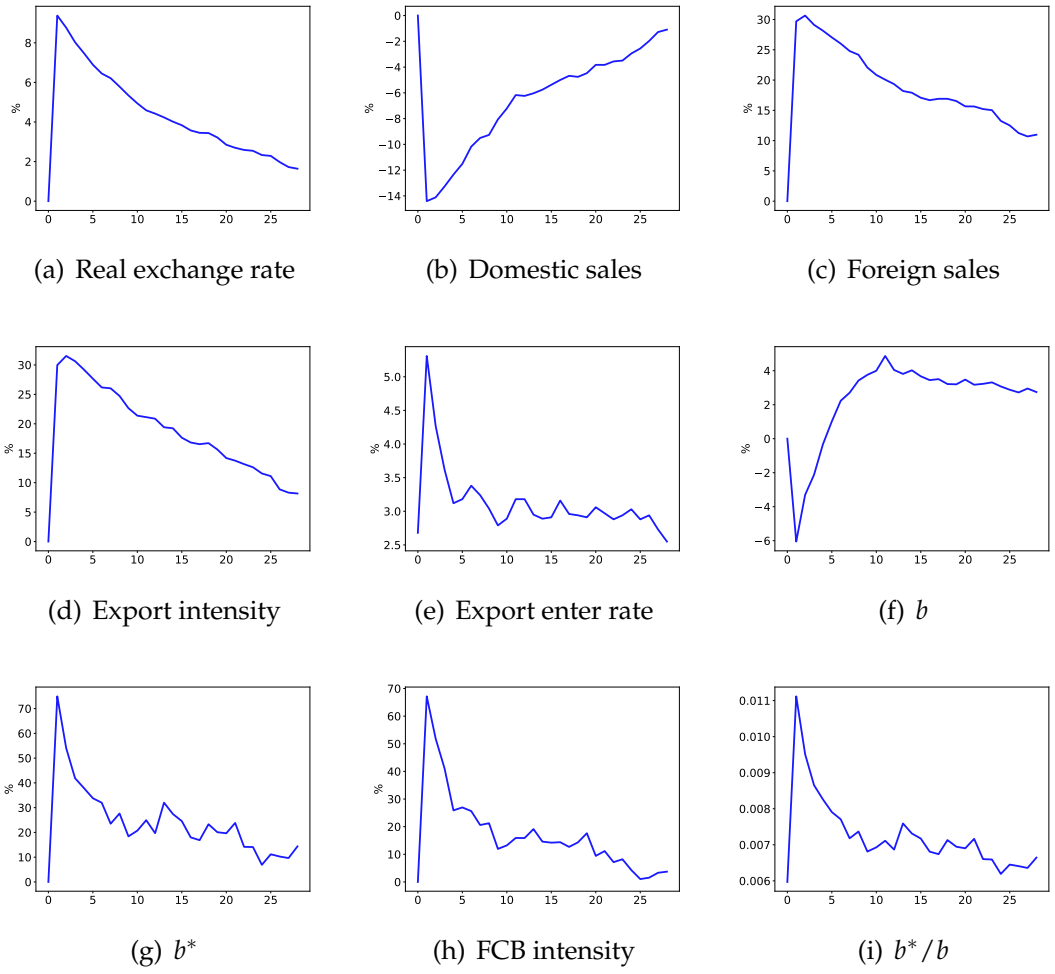
This section shows how trade and currency of financing interact in the benchmark model, by plotting firms' impulse response functions (IRFs) to an exchange rate depreciation shock. When there is an exchange rate depreciation during a financial crisis, non-financial firms are negatively affected if they have foreign currency denominated liabilities on their balance sheets, as they have to repay more, which is called the balance-sheet effects[10]. When considering the complementarity between trade and currency of financing, the balance-sheet effects weaken in the benchmark model.

The shock to real exchange rate increases the real exchange rate by 1 standard deviation. I simulate 10,000 paths for the model for 130 periods. For the first 100 periods, the real exchange rate follows the underlying Markov chain process. There is a positive shock to the real exchange rate process, increasing the real exchange rate e by 1 standard deviation. From period 101 on, the real exchange rate shocks for all the paths still follow its underlying Markov process. The impulse response functions plot the average responses in the last 30 periods, across all 10,000 paths.

Figure 6 plots firms' impulse responses to one standard deviation increase in real exchange rate (Panel (a)). When there is a depreciation shock to real exchange rate, domestic sales decrease (Panel (b)) and foreign sales increase (Panel (c)), due to export-expansion effect of depreciation. The export intensity increase by 30% in response to one standard deviation increase in real exchange rate shock (Panel (d)). Besides, more firms enter the export market in response.

Without the complementarity between trade and currency of financing, the share

[10]See literature about the balance-sheet effects, for example, Feldstein (1999); Hausmann et al. (2001); Céspedes et al. (2004); Kim et al. (2015).



(a) Real exchange rate (b) Domestic sales (c) Foreign sales

(d) Export intensity (e) Export enter rate (f) b

(g) b^* (h) FCB intensity (i) b^*/b

Figure 6: Comoplementarity between trade and financing: IRFs to e shock

Notes: Impulse response functions to a real exchange rate e shock by one standard deviation. Before the shock, the stochastic real exchange rate e follows its underlying Markov chain. In period 1, there is a positive shock to real exchange rate e. After period 1, the e shocks follow the conditional Markov process. The impulse responses plot the average across different simulations.

of foreign currency borrowings is expected to decrease, due to the negative balance-sheet effects. As both the export enter rate and the export intensity go up, I actually have more foreign currency borrowings in response.

Recall three main channels mentioned in Section 3.4, namely natural hedge, collateral channel and cost complementarity channel. The impulse response functions can highlight the role of each of them. On one hand, the natural hedge channel refers that foreign currency denominated revenues can be directly used to repay foreign currency borrowings one to one. On the other hand, foreign currency denominated revenues can collateralize foreign currency borrowings, with a ratio greater than one to one. The export intensity increases by 30% in response to the exchange rate shock, while the foreign currency borrowings intensity increases by 70%. The unproportional responses in export and foreign currency borrowings intensities reflect the existence of both natural hedge and collateral channel. What's more, there are more foreign currency borrowings when there are more exporters in the economy, indicating the complementarity along the extensive margin (cost complementarity channel).

4.3 Re-evaluate effects of capital control policies

This section studies the effects of capital control policies in the benchmark model. I first compare the benchmark model with two reference models with different levels of capital control tax, capturing the long-run effects of capital control policies across different stationary equilibria. Then I study the dynamic effects of capital control tax along a transition path along which I shock the benchmark economy with one unit increase in capital control tax.

4.3.1 Long-run effects

To visualize how capital control policies in emerging markets would affect the economy, this section discusses the effects of capital control tax on firms' trade, currency of financing and overall performance, by comparing the benchmark model with two reference model different levels of capital control tax.

In the benchmark model, the capital control tax is $\tau_c = 1\%$. Table 7 compare the

benchmark model with two reference models, where the capital control tax is at $\tau_c = 2\%$ and $\tau_c = 6\%$. Under stricter capital control regulations, firms deleverage their overall borrowings. This is consistent with the literature on effects of capital control policies, indicating that capital controls policies could prevent over-borrowings. However, there are less firms financing in foreign currency. Therefore, I can observe that less firms both export and borrow in foreign currency, and the correlation between export intensity and intensity of foreign currency borrowings decreases under stricter capital controls. In a sum, higher capital control tax deleverages the whole economy, and depresses the complementarity between trade and financing in general.

Since the majority of foreign currency borrowings in the economy are owned by exporters, the stricter capital control tax makes exporters less likely to borrow in foreign currency, which features lower financing cost. Only larger exporters borrow in foreign currency, and they borrow more intensively, to fully take advantage of the low-cost financing.

Table 7: Moments comparison: benchmark and different τ_c

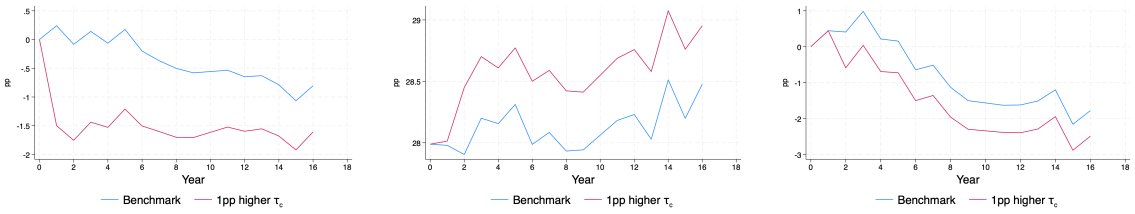
	Benchmark	$\Delta\tau_c = 1\%$	$\Delta\tau_c = 5\%$
All sample			
Leverage	0.29	0.21	0.09
Share of firms holding FCB (%)	4.08	3.99	3.32
FCB intensity, conditional on with FCB (%)	6.51	8.26	14.10
Share of exporting firms (%)	26.56	26.55	27.63
Export intensity, conditional on exporting (%)	26.36	25.52	26.94
Share of firms that both exporting and holding FCB (%)	3.62	3.40	2.88
Corr(export intensity, FCB intensity)	0.23	0.20	0.14
Exporters			
Leverage	0.23	0.18	0.11
Share of firms holding FCB (%)	19.19	18.81	17.23
FCB intensity, conditional on with FCB (%)	10.05	11.45	17.21

When emerging markets strictly regulate the international financing, both home currency borrowings and foreign currency borrowings get depressed, as entrepreneurs are risk-averse and borrow less, when facing higher financing cost. The stricter capital controls disrupt exporters' access to foreign currency borrowings. This disruption is costly to the whole economy, as exporters are more productive and profitable, compared to non-exporters.

4.3.2 Dynamic effects

Besides the comparison across stationary equilibria with different levels of capital control tax, this section further studies the aggregate effects of capital control policies along a transition path. I compare the benchmark economy with a reference economy where there is a shock to capital control tax at period 0.

With constant real exchange rate, I simulate both the benchmark model and the reference case with the same sample length as the baseline empirical sample. There is an unexpected change in capital control tax $\Delta\tau_c = 1\%$ at period 0. Figure 7 shows the aggregate effects of capital control tax. The red line refers to the benchmark model, while the blue line represents the reference economy. 1pp higher capital tax is associated with 1.2pp lower aggregate consumption, 3.6pp lower aggregate capital, 0.48pp higher misallocation, and 0.83pp lower aggregate output along the transition path. The misallocation is measured as the standard deviation of marginal revenue product of capital, relative to world interest rate r.



(a) Consumption (b) Misallocation (c) Output

Figure 7: Dynamic effects of capital control policies

Notes: Panel (a) plot the dynamics of aggregate consumption in the economy. Misallocation in Panel (b) is measured as the standard deviation of marginal revenue product of capital, relative to world interest rate r. Panel (c) plots the aggregate output in the economy. The red line refers the the dynamic path of the benchmark economy, and the blue line denotes that of the reference economy where there is a 1pp shock of capital control tax at period 0.

Recall there are three main channels linking trade and currency of financing in the benchmark model, namely natural hedge, collateral channel and cost complementarity channel. Next, I present how these three features that can generate the complementarity in the benchmark model would change the evaluation of capital control policies.

4.4 Role of cost complementarity between trade and financing

To investigate the role of cost complementarity, I compare the benchmark model with a reference *no-cost-complementarity model* with $\zeta = 1$. In *no-cost-complementarity model*, there is no cost discount if firms both export and borrow in foreign currency. The other parameters of the benchmark model remain the same. The comparison between the benchmark model and the *no-cost-complementarity model* directly highlight the role of cost complementarity.

Table 8: Role of complementarity through cost complementarity channel

	benchmark	$\zeta = 1$
All sample		
Leverage	0.29	0.31
Share of firms holding FCB (%)	4.08	0
FCB intensity, conditional on with FCB (%)	6.51	.
Share of exporting firms (%)	26.56	25.51
Export intensity, conditional on exporting (%)	26.36	29.11
Share of firms that both exporting and holding FCB (%)	3.62	0
Corr(export intensity, FCB intensity)	0.23	.
Exporters		
Leverage	0.23	0.29
Share of firms holding FCB (%)	19.19	0
FCB intensity, conditional on with FCB (%)	10.05	.
Increase τ_c by 1pp		
Misallocation increases (pp)	1.96	2.64
Aggregate c increases (pp)	-2.79	-3.85
Aggregate output increases (pp)	-1.62	-2.21

Notes: $\zeta = 1$ refers to a reference model where there is no cost complementarity. The aggregate effects of 1pp increase in capital control tax are calculated exactly as what I do in Section 4.3.2. Misallocation is measured as the standard deviation of marginal revenue product of capital, relative to world interest rate.

Table 8 presents the comparison of main moments and aggregate effects of capital control policies between the benchmark model and the *no-cost-complementarity model*. In the *no-cost-complementarity model*, there is no firms both exporting and holding foreign currency borrowings. Therefore, there is no hedging for foreign currency borrowings from export side, so that the increase in capital control tax is much more costly in this extreme case than that in the benchmark model. The *no-cost-complementarity model* has 0.68pp higher misallocation, 1.06pp more consumption losses, and 0.59pp more output losses. Without correctly pinning down the degree of cost complementarity, I would overestimate the negative effects of capital control

policies with 34.87% more misallocation, 38.11% more consumption losses, as well as 36.17% more output losses.

4.5 Role of collateral constraints

To study the role of collateral constraints, I replace the cash flow-based collateral constraints to asset-based collateral constraints, which is given by

$$b' \leq \theta k,$$
$$eb^{*\prime} \leq \theta^* k.$$

The reference model with *asset-based collateral constraints* has the same parameter values as the benchmark model. By comparing the benchmark model with the reference model with *asset-based collateral constraints*, I can figure out how cash flow-based collateral constraints contribute to evaluating the effects of capital control policies.

Table 9: Role of complementarity through collateral constraints

	Benchmark	Asset-based
All sample		
Leverage	0.29	0.31
Share of firms holding FCB (%)	4.08	3.52
FCB intensity, conditional on with FCB (%)	6.51	5.42
Share of exporting firms (%)	26.56	25.76
Export intensity, conditional on exporting (%)	26.36	21.92
Share of firms that both exporting and holding FCB (%)	3.62	2.90
Corr(export intensity, FCB intensity)	0.23	0.14
Exporters		
leverage_mean	0.23	0.24
Share of firms holding FCB (%)	19.19	18.36
FCB intensity, conditional on with FCB (%)	10.05	9.33
Increase τ_c by 1pp		
Misallocation increases (pp)	0.48	0.36
Aggregate c increases (pp)	-1.21	-0.99
Aggregate output increases (pp)	-0.83	-0.61

Notes: Asset-based refers to a reference model where I replace the cash flow-based collateral constraints with asset-based collateral constraints. The aggregate effects of 1pp increase in capital control tax are calculated exactly as what I do in Section 4.3.2. Misallocation is measured as the standard deviation of marginal revenue product of capital, relative to world interest rate.

Table 9 presents the comparison of the key moments and the aggregate effects of one unit increase in capital control tax between the benchmark model and the reference model with *asset-based collateral constraints*. Without the collateral channel that foreign currency revenues can better pledge the foreign currency borrowings, the complementarity along both extensive and intensive margin gets depressed. Less firms both export and borrow in foreign currency, and the correlation between export intensity and intensity of foreign currency borrowings is lower in the reference model with *asset-based collateral constraints*. As a result, there are less firms borrowing in foreign currency, and conditional intensity of foreign currency borrowings is lower. Absence of this collateral channel, I would underestimate the cost of capital control policies, as I miss 25.2% of the misallocation, 18.2% of the aggregate consumption losses, as well as 26.5% of the aggregate output losses.

4.6 Role of natural hedge and collateral constraints

This section compares the benchmark model with a reference model where exporters price their exports in producers' currency (PCP). Since it's hard to solely shut down natural hedge, this reference model with *PCP* closes both the natural hedge and the collateral channels. In the reference model with *PCP*, export sales are also invoiced in home final good, so that there is no exchange rate exposure for the export side. Export revenues cannot provide hedging or collateral for bonds denominated in foreign final good. The entrepreneurs' problem in the reference model with *PCP* can be writen as

$$
\begin{aligned}
V(z,k,b,b^*,x_{-1},e) &= \max_{c,p,y,p^*,y^*,k',b',b^{*\prime},x} \frac{c^{1-\gamma}}{1-\gamma} + \beta \mathbb{E}_{z',e'|z,e} V(z',k',b',b^{*\prime},x,e') \\
\text{s.t. } c + k' + b + eb^* &= py + x\tilde{p}^* y^* + (1-\delta)k + \frac{b'}{(1+r)(1+\tau_c)} \\
&\quad + e\frac{b^{*\prime}}{(1+r^*)(1+\tau_c)} - F(x_{-1},x,b^{*\prime}), \\
y + \tau x y^* &= Azk^{\alpha}, \\
b' &\leq \theta\left(py + x\tilde{p}^* y^*\right), \\
eb^{*\prime} &\leq \theta^*\left(py + x\tilde{p}^* y^*\right), \\
y &= (p/P)^{-\sigma} Y = (ep)^{-\sigma} Y, \\
y^* &= (e\tilde{p}^*/P^*)^{-\sigma} Y^* = (e\tilde{p}^*)^{-\sigma} Y^*,
\end{aligned}
$$

where $\tilde{p}^*$ is the price in foreign market that denominated in home final good.

Table 10: Role of complementarity through natural hedge and collateral constraints

	Benchmark	PCP
All sample		
Leverage	0.29	0.29
Share of firms holding FCB (%)	4.08	2.54
FCB intensity, conditional on with FCB (%)	6.51	5.27
Share of exporting firms (%)	26.56	35.99
Export intensity, conditional on exporting (%)	26.36	17.35
Share of firms that both exporting and holding FCB (%)	3.62	2.03
Corr(export intensity, FCB intensity)	0.23	0.06
Exporters		
Leverage	0.23	0.19
Share of firms holding FCB (%)	19.19	5.83
FCB intensity, conditional on with FCB (%)	10.05	10.62
Increase τ_c by 1pp		
Misallocation increases (pp)	0.48	0.19
Aggregate c increases (pp)	-1.21	-1.01
Aggregate output increases (pp)	-0.83	-0.60

Notes: PCP refers to a reference model where entrepreneurs price their products in foreign market with home final good. The aggregate effects of 1pp increase in capital control tax are calculated exactly as what I do in Section 4.3.2. Misallocation is measured as the standard deviation of marginal revenue product of capital, relative to world interest rate.

Table 10 provides a comparative analysis between the benchmark model and the reference model incorporating producer currency pricing (PCP). In the reference model with PCP, fewer firms engage in both exporting and financing in foreign currency, and the correlation between export intensity and intensity of foreign currency borrowings is lower. The prevalence of firms borrowing in foreign currency is also diminished, and conditional intensity of foreign currency borrowings decreases. As export revenues are now invoiced in home final goods, the motivations for exporters to seek financing in foreign currency—such as hedging and collateral considerations—have dissipated. Exporting firms exhibit a lower propensity to engage in foreign currency borrowings within the reference model. In the absence of both the natural hedge and collateral channels, the impact of capital control policies is markedly underestimated, with a reduction of 60.8% in misallocation, 16.1% in aggregate consumption losses, and a substantial 27.2% decline in aggregate output losses.

5 Conclusion

This paper examines the impact of capital control polices in emerging markets, considering the newly documented complementarity between trade and the choice of currency for financing. Firms' choice of currency for financing is complementary to their trade activities, not only along the intensive margin as discussed in the literature, but also along the extensive margin. Taking into account this complementarity between trade and financing, I develop a model that includes endogenous export decisions with simultaneous and endogenous decisions on currency for financing and borrowing intensity. This theoretical framework allows for quantifying the degree of complementarity, and sheds light on the role of complementarity in assessing the impact of capital control policies in emerging markets.

A key contribution of this paper is the introduction and the identification of a novel complementarity between trade and the choice of currrency for financing. Without this complementarity, I would underestimate the effects of capital control policies in emerging markets. Considering this complementarity, capital control tax disrupts productive exporters' access to low-cost foreign currency financing, thereby giving rise to more misallocation and output losses in the economy. Without the *cost complementarity channel*, the estimates could overstate the misallocation by 35% and output losses by 36%. Furthermore, the absence of *cash flow-based collateral constraints* leads to an underestimation of misallocation by 25% and output losses by 27%. In the context of producer price pricing, instead of the *dominant currency pricing*, a 1pp increase in capital control tax results in a 61% reduction in misallocation and a 27% decrease in output losses.

This paper provides new insights on the complementarity between trade and financing, underscoring the significance of this complementarity in the evaluation of capital control policies in emerging markets. This project equips us with a comprehensive toolkit to identify degree of complementarity and evaluate the impact of capital control policies in emerging markets, empirically, theoretically and quantitatively.

References

Acharya, V., S. G. Cecchetti, J. De Gregorio, Ş. Kalemli-Özcan, P. R. Lane, and U. Panizza (2015). Corporate debt in emerging economies: A threat to financial stability?

Acharya, V. V. and S. Vij (2020). Foreign currency borrowing of corporations as carry trades: Evidence from india. Technical report, National Bureau of Economic Research.

Alessandria, G. and H. Choi (2007). Do sunk costs of exporting matter for net export dynamics? *The Quarterly Journal of Economics 122*(1), 289–336.

Alessandria, G., H. Choi, J. P. Kaboski, and V. Midrigan (2015). Microeconomic uncertainty, international trade, and aggregate fluctuations. *Journal of Monetary Economics 69*, 20–38.

Alfaro, L., A. Chari, and F. Kanczuk (2017). The real effects of capital controls: Firm-level evidence from a policy experiment. *Journal of International Economics 108*, 191–210.

Andreasen, E., S. Bauducco, E. Dardati, et al. (2019). Capital controls and firm performance. Technical report, Central Bank of Chile.

Andreasen, E., S. Bauducco, E. Dardati, and E. G. Mendoza (2023). Beware the side effects: Capital controls, trade, misallocation and welfare. Technical report, National Bureau of Economic Research.

Avdjiev, S., P. McGuire, and G. von Peter (2020). International dimensions of eme corporate debt. *BIS Quarterly Review, June*.

Backus, D., P. J. Kehoe, and F. Kydland (1992). Dynamics of the trade balance and the terms of trade: The s-curve.

Beck, T. (2003). Financial dependence and international trade. *Review of international Economics 11*(2), 296–316.

Bellone, F., P. Musso, L. Nesta, and S. Schiavo (2010). Financial constraints and firm export behaviour. *World Economy 33*(3), 347–373.

Boz, E., C. Casas, G. Georgiadis, G. Gopinath, H. Le Mezo, A. Mehl, and T. Nguyen (2020). Patterns in invoicing currency in global trade.

Bruno, V. and H. S. Shin (2017). Global dollar credit and carry trades: a firm-level analysis. *The Review of Financial Studies 30*(3), 703–749.

Caballero, J., U. Panizza, and A. Powell (2016). The second wave of global liquidity: Why are firms acting like financial intermediaries?

Callaway, B. and P. H. Sant'Anna (2021). Difference-in-differences with multiple time periods. *Journal of econometrics 225*(2), 200–230.

Calvo, G. A. and C. M. Reinhart (2002). Fear of floating. *The Quarterly journal of economics 117*(2), 379–408.

Camara, S. and M. Sangiacomo (2022). Borrowing constraints in emerging markets. *arXiv preprint arXiv:2211.10864*.

Céspedes, L. F., R. Chang, and A. Velasco (2004). Balance sheets and exchange rate policy. *American Economic Review 94*(4), 1183–1193.

De Chaisemartin, C. and X. d'Haultfoeuille (2020). Two-way fixed effects estimators with heterogeneous treatment effects. *American Economic Review 110*(9), 2964–2996.

Du, W. and J. Schreger (2022). Sovereign risk, currency risk, and corporate balance sheets. *The Review of Financial Studies 35*(10), 4587–4629.

Dube, A., D. Girardi, O. Jorda, and A. M. Taylor (2023). A local projections approach to difference-in-differences event studies. Technical report, National Bureau of Economic Research.

Feenstra, R. C., Z. Li, and M. Yu (2014). Exports and credit constraints under incomplete information: Theory and evidence from china. *Review of Economics and Statistics 96*(4), 729–744.

Feldstein, M. S. (1999). Self-protection for emerging market economies.

Forbes, K. J. (2007). One cost of the chilean capital controls: increased financial constraints for smaller traded firms. *Journal of International Economics 71*(2), 294–323.

Froot, K. A., D. S. Scharfstein, and J. C. Stein (1993). Risk management: Coordinating corporate investment and financing policies. *the Journal of Finance 48*(5), 1629–1658.

Gelos, R. G. (2003). Foreign currency debt in emerging markets: firm-level evidence from mexico. *Economics Letters 78*(3), 323–327.

Goodman-Bacon, A. (2021). Difference-in-differences with variation in treatment timing. *Journal of Econometrics 225*(2), 254–277.

Greenaway, D., A. Guariglia, and R. Kneller (2007). Financial factors and exporting decisions. *Journal of international economics 73*(2), 377–395.

Gutierrez, B., V. Ivashina, and J. Salomao (2021). Why is dollar debt cheaper? evidence from peru. *Evidence from Peru (September 24, 2021)*.

Harasztosi, P. and G. Kátay (2020). Currency matching by non-financial corporations. *Journal of Banking & Finance 113*, 105739.

Hausmann, R., U. Panizza, and E. Stein (2001). Why do countries float the way they float? *Journal of development economics 66*(2), 387–414.

Huang, Y., U. Panizza, and R. Portes (2018). Corporate foreign bond issuance and interfirm loans in china. Technical report, National Bureau of Economic Research.

Jeanne, O. (2000). Foreign currency debt and the global financial architecture. *European Economic Review 44*(4-6), 719–727.

Jiao, Y. and O. Kwon (2022). Trade shocks and the currency composition of corporate debt. *Available at SSRN 4271176*.

Jordà, Ò. (2005). Estimation and inference of impulse responses by local projections. *American economic review 95*(1), 161–182.

Kalemli-Ozcan, S., H. Kamil, and C. Villegas-Sanchez (2016). What hinders investment in the aftermath of financial crises: Insolvent firms or illiquid banks? *Review of Economics and Statistics 98*(4), 756–769.

Kedia, S. and A. Mozumdar (2003). Foreign currency–denominated debt: An empirical examination. *The Journal of Business 76*(4), 521–546.

Kehoe, P. J. and F. Perri (2002). International business cycles with endogenous incomplete markets. *Econometrica 70*(3), 907–928.

Keloharju, M. and M. Niskanen (2001). Why do firms raise foreign currency denominated debt? evidence from finland. *European Financial Management 7*(4), 481–496.

Kim, J. and A. S. Lee (2023). Liability dollarization and exchange rate pass-through.

Kim, Y. J., L. L. Tesar, and J. Zhang (2015). The impact of foreign liabilities on small firms: Firm-level evidence from the korean crisis. *Journal of International Economics 97*(2), 209–230.

Kohn, D., F. Leibovici, and M. Szkup (2016). Financial frictions and new exporter dynamics. *International economic review 57*(2), 453–486.

Kohn, D., F. Leibovici, and M. Szkup (2020). Financial frictions and export dynamics in large devaluations. *Journal of International Economics 122*, 103257.

Kohn, D., F. Leibovici, and M. Szkup (2022). Financial frictions and international trade: A review. *Oxford Research Encyclopedia of Economics and Finance*.

Leibovici, F. (2021). Financial development and international trade. *Journal of Political Economy 129*(12), 3405–3446.

Lian, C. and Y. Ma (2021). Anatomy of corporate borrowing constraints. *The Quarterly Journal of Economics 136*(1), 229–291.

Maggiori, M., B. Neiman, and J. Schreger (2020). International currencies and capital allocation. *Journal of Political Economy 128*(6), 2019–2066.

Manova, K. (2013). Credit constraints, heterogeneous firms, and international trade. *Review of Economic Studies 80*(2), 711–744.

Minetti, R. and S. C. Zhu (2011). Credit constraints and firm export: Microeconomic evidence from italy. *Journal of International Economics 83*(2), 109–125.

Salomao, J. and L. Varela (2022). Exchange rate exposure and firm dynamics. *The Review of Economic Studies 89*(1), 481–514.

Smith, C. W. and R. M. Stulz (1985). The determinants of firms' hedging policies. *Journal of financial and quantitative analysis 20*(4), 391–405.

A Data

A.1 Data cleaning

1. Clean sample to annual frequency. The March vintage of each year contains much richer information. Therefore I clean the sample as follows (in the order of operation);

- If a company has an observation on 0331 (March vintage available) of that year, drop other repeated observations in that year;
- If a company does not have an available observation on 0331 of that year, keep the last observation of that year.
  - observation on 1231 (December vintage);
  - observation on 0930 (September vintage);
  - observation on 0630 (various sources);

2. Keep observations in 1998-2016, as the data coverage changes after 2017;

3. Keep companies in manufacturing, mining, electricity, non-financial services and construction industries;

After applying the sample selection operations, I winsorize the variables mentioned above at the top and bottom 1% of the distribution.

A.2 Variable construction

1. ***Size***

Size is measured as the log of total assets.

2. ***Total leverage***

Total leverage is defined as the ratio of company i's total outside liabilities to total assets. In CMIE's ProwessIQ, total outside liabilities include the overall borrowings of a company and the amount of current liabilities as on the date of the balance sheet. It measures the amount that the company owes to outsiders at the end of the year.

3. ***Fixed asset turnover ratio***

The fixed asset turnover ratio (FAT) is used to measure operating performance. This efficiency ratio compares net sales (income statement) to fixed assets (balance sheet) and measures a company's ability to generate net sales from its fixed-asset investments, namely property, plant, and equipment (PPE).

4. ***Export intensity***

Export intensity is defined as the ratio of export to total sales.

5. ***Import intensity***

Import intensity is measured as the ratio of raw material imports to raw material purchases.

A.3 Foreign currency borrowings in CMIE's ProwessIQ

A.3.1 Definition

In CMIE'S ProwessIQ, foreign currency borrowings of an Indian company are defined as any loan taken in foreign currency other than Indian rupees. Such loans can be taken from Indian banks, foreign banks, foreign branches of Indian banks, export-import banks and multinational lending institutions, such as World Bank, IBRD, and the Asian Development Bank, external commercial borrowings (ECBs), global depository receipts (GDRs) and American depository receipts (ADRs).

The term "loans" also includes external commercial borrowings, such as convertible bonds, non-convertible bonds and subordinated debt, as well as foreign suppliers' credit. Suppliers' credit is different from sundry creditors . Sundry creditors include liabilities to regular suppliers from whom the company has bought goods on credit and to whom payments are due in the course of routine trading and operating activities such as purchase of goods, materials and services. Suppliers' credit is generally obtained for capital goods.[11]

[11]The suppliers' credit is different from the trade credit. Trade credit refers to an arrangement to buy goods and/or services on account without making immediate cash or cheque payments. Only 0.4% of the observations in the baseline sample report suppliers' credit.

There is rich information on foreign currency borrowings in CMIE's ProwessIQ. 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.

A.3.2 Statistics

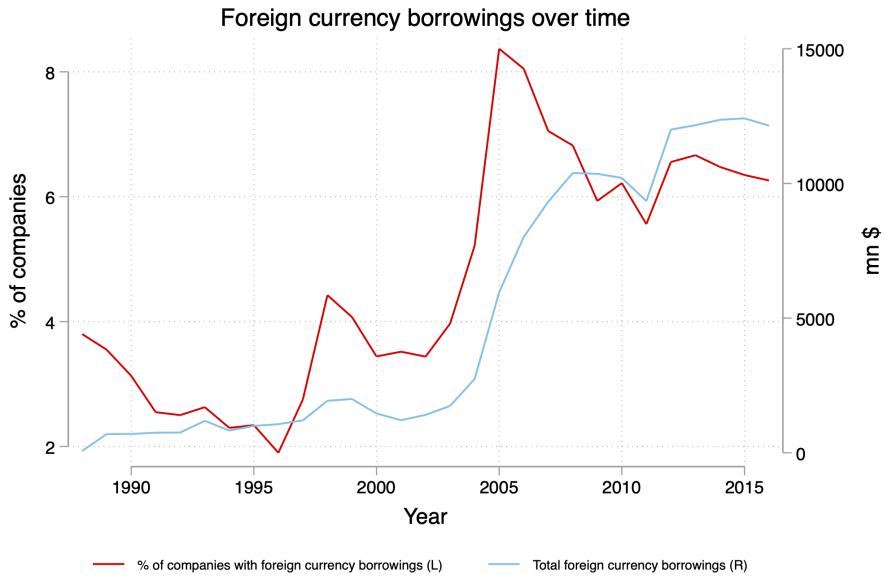


Figure 8: Foreign currency borrowings over time

For the baseline sample from 2000-2016, there is a growing trend in holding foreign currency borrowings, as shown in Figure 8. The red line (L) refers to the share of companies that hold foreign currency borrowings in each year. On average, there is about 5-6% of companies in the baseline sample holding positive foreign currency borrowings. The blue line (R) shows the overall magnitude of foreign currency borrowings in the sample. Though there is no exact counterpart aggregate statistic for

foreign currency borrowings of non-financial corporations, the magnitude of foreign currency borrowings in the baseline sample is comparable to some similar aggregate measures. Avdjiev et al. (2020) use the BIS bank reported data and show that Indian foreign currency debt of non-financial corporates is about 150 billion USD at the end of 2019.[12]

In the baseline sample, it can be shown that most foreign currency borrowings are held by companies that both export and import.

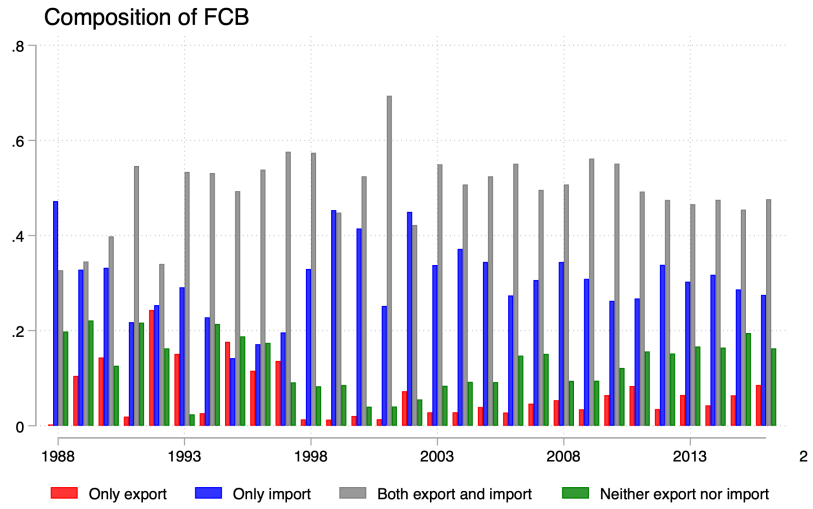


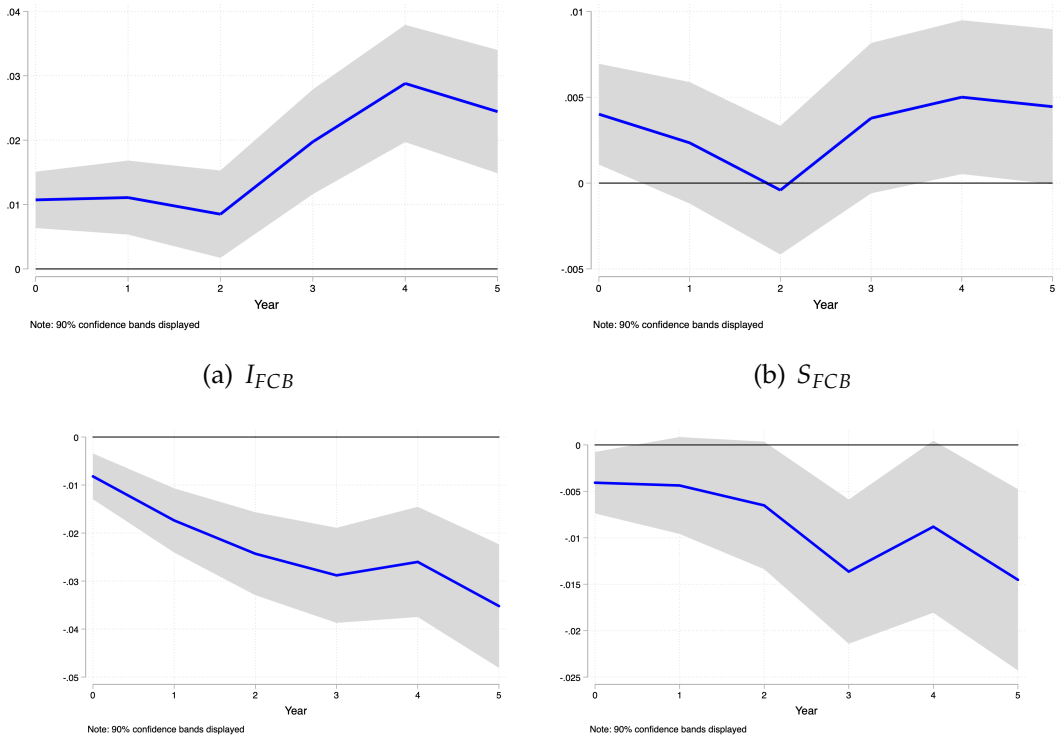
Figure 9: Foreign currency borrowings by trade groups

B Robustness

B.1 Alternative sample: 1988-2016

The baseline sample is ranging from 2000 to 2016. In this section, I use expand the baseline sample and incorporate the sample period in 1990s, when India had significant trade liberalization.

[12]The foreign currency borrowings defined in CMIE's ProwessIQ is broader than that in Avdjiev et al. (2020), as the lenders of foreign currency debt are mainly cross-boarder banks in BIS. The lenders are not only banks, but also other financial institutions and multinational institutions for foreign currency borrowings in CMIE's ProwessIQ.



(a) I_{FCB} (b) S_{FCB}

(c) I_{FCB} (d) S_{FCB}

Figure 10: Responses of foreign currency borrowings: 1988-2016

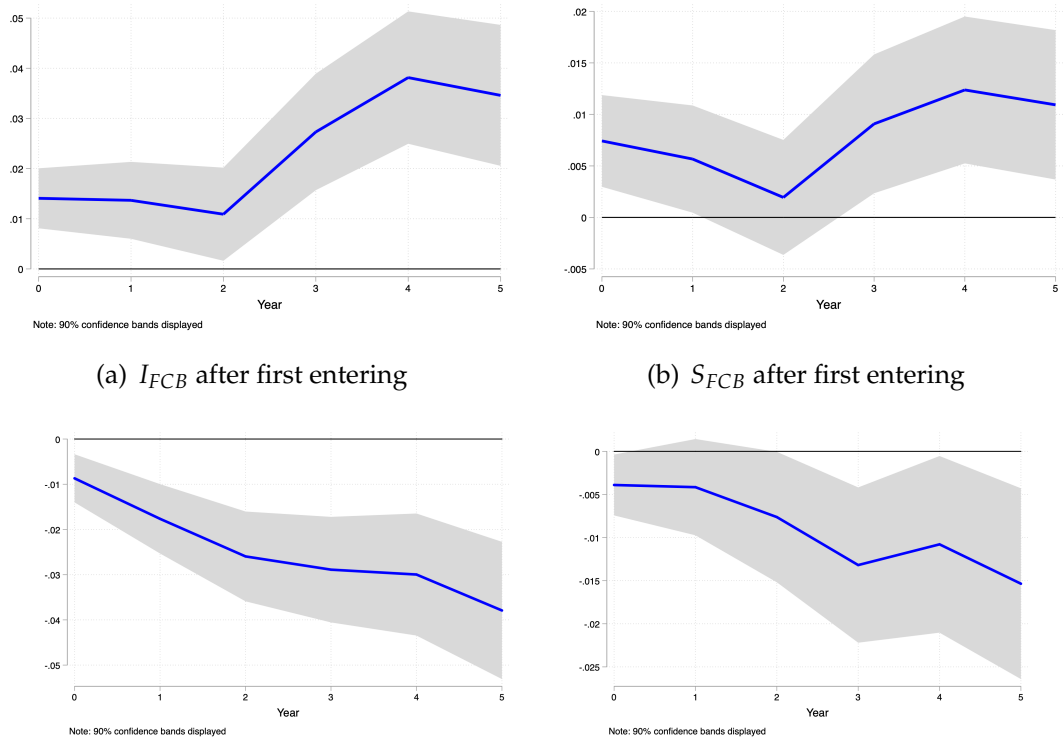
Notes: Panel (a) shows the responses of extensive margin of foreign currency borrowings to firms' first entering the export market. Panel (b) plots the response of foreign currency borrowings intensity to firms' first entering the export market, conditional on firms ever financing in foreign currency. Panel (c) shows the responses of extensive margin of foreign currency borrowings to firms' exiting the export market. Panel (d) plots the response of foreign currency borrowings intensity to firms' exiting the export market, conditional on firms ever financing in foreign currency.

As shown in Figure 10, after firms' first entering the export market, likelihood of financing in foreign currency increases by 1.4-3.8pp. Panel (b) shows that intensity of foreign currency borrowings increases by 0.2-1.4pp, conditional on ever issuing foreign currency borrowing. After firms' exiting the export market, likelihood of financing in foreign currency falls by 0.94-3.4pp, as shown in Panel (c). Intensity of foreign currency borrowings falls by 0.4-1.4pp, conditional on ever borrowing in foreign currency.

B.2 Local project without clean-control condition

I apply a local projection specification with clean control condition in the baseline empirical part, which aims at drawing a much cleaner conditional correlation between trade status and financing decisions. This section shows the results if I just apply a conventional local projection method without a clean control condition.

Table 11 presents the estimation results, which remain robust to the baseline results. After newly entering the export market, likelihood of financing in foreign currency increases by 1.2-3.8pp, and intensity of foreign currency borrowings increases by 0.2-1.4pp, conditional on firms' ever borrowing in foreign currency. After firms' exiting the export market and never entering again, likelihood of financing in foreign currency falls by 0.9-3.4pp, and intensity of foreign currency borrowings falls by 0.4-1.4pp, conditional on firms' ever borrowing in foreign currency.



(a) I_{FCB} after first entering

(b) S_{FCB} after first entering

(c) I_{FCB} after exiting

(d) S_{FCB} after exiting

Figure 11: Responses of foreign currency borrowings: local projection

Notes: Panel (a) shows the responses of extensive margin of foreign currency borrowings to firms' first entering the export market. Panel (b) plots the response of foreign currency borrowings intensity to firms' first entering the export market, conditional on firms ever financing in foreign currency. Panel (c) shows the responses of extensive margin of foreign currency borrowings to firms' exiting the export market. Panel (d) plots the response of foreign currency borrowings intensity to firms' exiting the export market, conditional on firms ever financing in foreign currency.

B.3 Responses to changes in import status

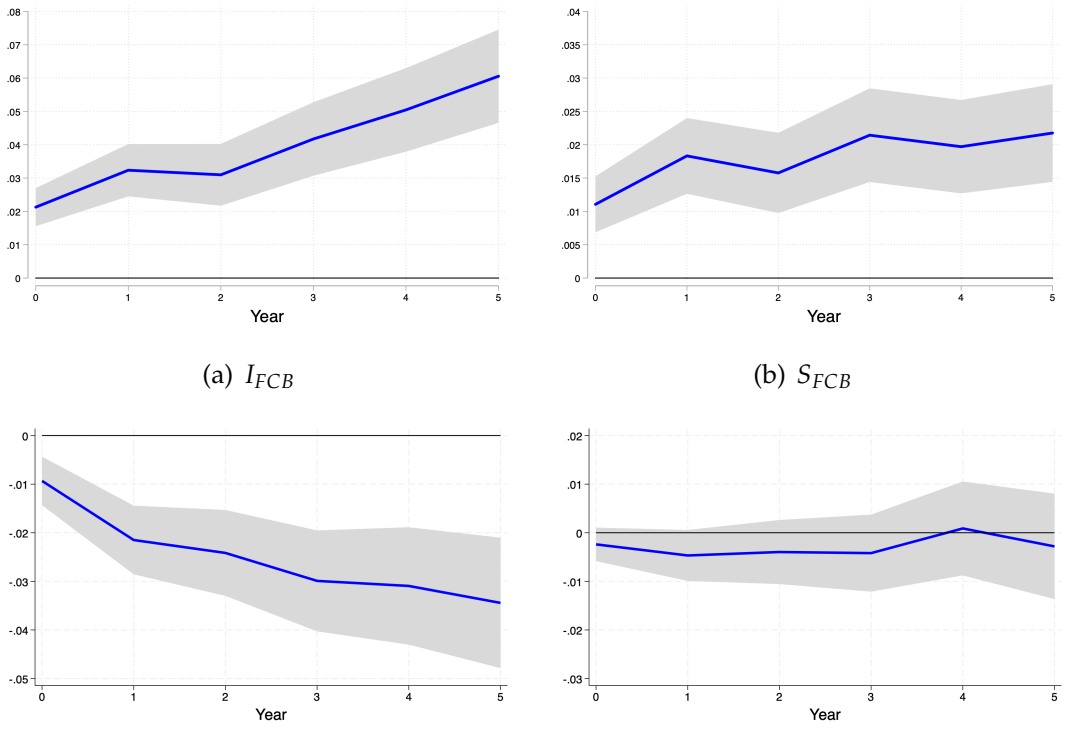
The effects of firms' entering and exiting import market can be similarly estimated, by replacing $\Delta D_{it} = 1$ with counterparts for import market. Figure 12 plots the corresponding cumulative responses of foreign currency borrowings for import market. After firms' first entering the import market, firms are 2.1-6.0pp more likely to hold foreign currency borrowings, as shown in Panel (a) of Figure 12. Panel (b) shows that the intensity of foreign currency borrowings increases by 1.1-2.2pp. Similarly, after firms' exiting the import market, likelihood of holding foreign currency borrowings falls by 0.9-3.4pp, as shown in Panel (c). There is no significant response of foreign currency borrowings intensity to firms' exiting the import market.

B.4 Drop only-importers

Section B.3 shows that foreign currency borrowings are also responsive to changes in import status. Then there raises a concern that whether the baseline results are driven by imports. This section presents the results when dropping those firms that only import in the sample, and the baseline results remain robust. That is to say, the baseline responses of foreign currency borrowings are mainly driven by firms that both export and import.

In the baseline sample, there are 9.8% observations that only import, compared to 20.0% observations that both export and import, as well as 62.1% observations that neither export and import. Without observations that only import, I re-estimate the baseline local projection, and the results are robust. As shown in Figure 13, after newly entering the export market, likelihood of financing in foreign currency increases by 0.2-3.7pp, and intensity of foreign currency borrowings increases by 0.2-1.9pp, conditional on firms' ever issuing foreign currency borrowings. After exiting the export market, firms are 0.9-4.7pp more likely to finance in foreign currency, and intensity of foreign currency borrowings falls by 0.5-1.9pp, conditional on ever borrowing in foreign currency.

Similarly, I drop firms that only export (8.1% observations) and re-estimate the local projection specification for changes in import status. The results for responses to import status changes remain unchanged, as shown in Figure 14. Panel (a) presets that

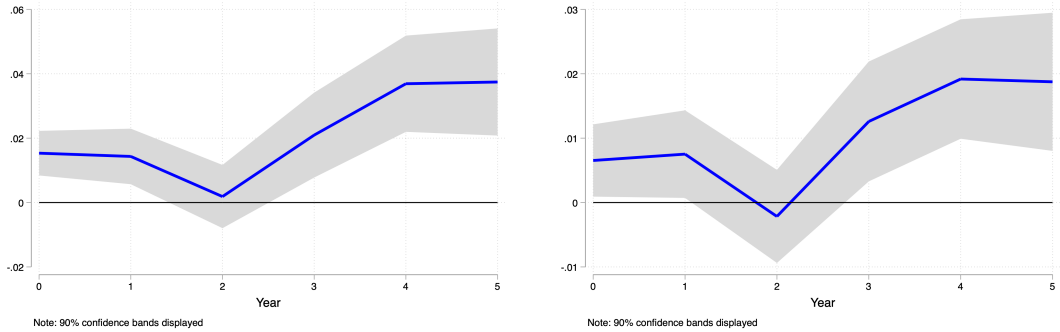


(a) I_{FCB} (b) S_{FCB}

(c) I_{FCB} (d) S_{FCB}

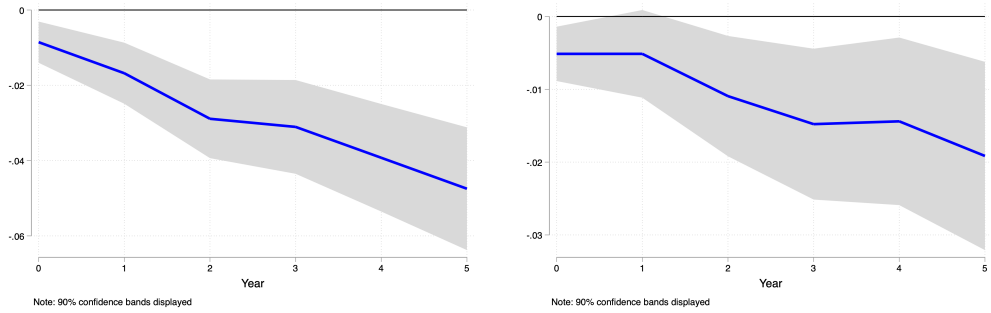
Figure 12: Response to entering/exiting import market

Notes: Panel (a) shows the responses of extensive margin of foreign currency borrowings to firms' first entering the export market. Panel (b) plots the response of foreign currency borrowings intensity to firms' first entering the export market, conditional on firms ever financing in foreign currency. Panel (c) shows the responses of extensive margin of foreign currency borrowings to firms' exiting the export market. Panel (d) plots the response of foreign currency borrowings intensity to firms' exiting the export market, conditional on firms ever financing in foreign currency.



(a) I_{FCB} after first entering

(b) S_{FCB} after first entering



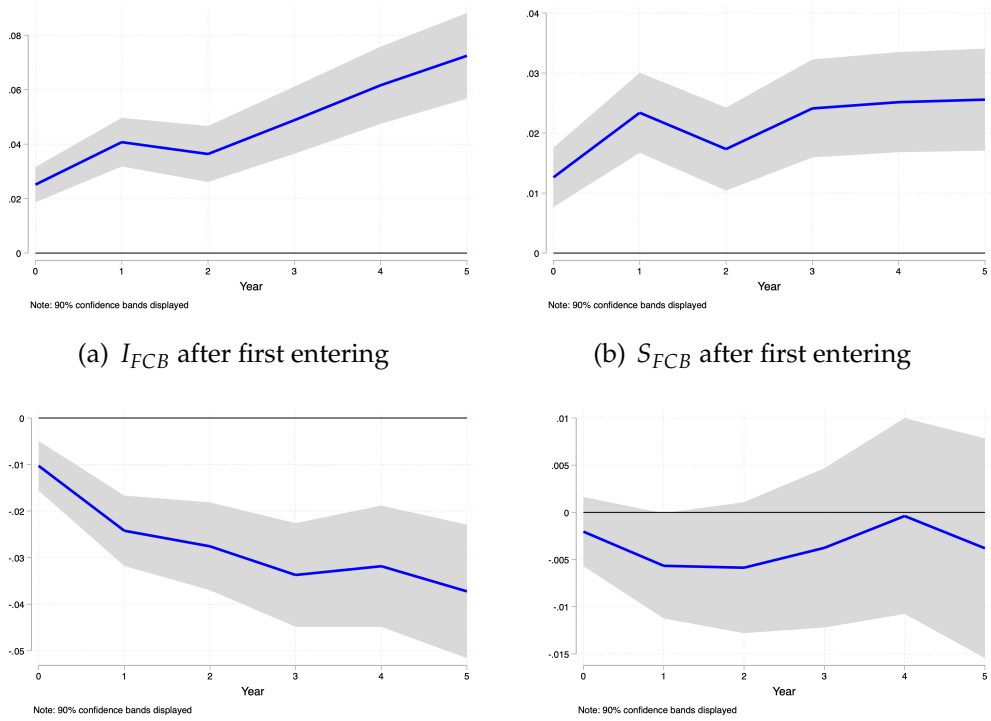
(c) I_{FCB} after exiting

(d) S_{FCB} after exiting

Figure 13: Response of foreign currency borrowings: drop only-importers

Notes: Panel (a) shows the responses of extensive margin of foreign currency borrowings to firms' first entering the export market. Panel (b) plots the response of foreign currency borrowings intensity to firms' first entering the export market, conditional on firms ever financing in foreign currency. Panel (c) shows the responses of extensive margin of foreign currency borrowings to firms' exiting the export market. Panel (d) plots the response of foreign currency borrowings intensity to firms' exiting the export market, conditional on firms ever financing in foreign currency.

likelihood of financing in foreign currency increases by 2.5-7.2pp, after entering the import market. Intensity of foreign currency borrowings increases by 1.3-2.5pp after entering the import market, conditional on ever financing in foreign currency. After exiting the import market, firms are 1.0-3.7pp less likely to borrow in foreign currency, as shown in Panel (c) of Figure 14. The intensity of foreign currency borrowings is not responsive to changes in import status.



(a) I_{FCB} after first entering

(b) S_{FCB} after first entering

(c) after exiting I_{FCB}

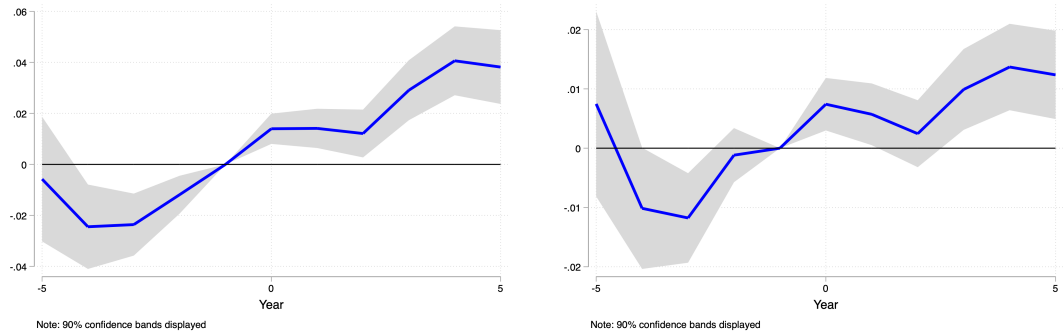
(d) S_{FCB} after exiting

Figure 14: Response of foreign currency borrowings: drop only-exporters

Notes: Panel (a) shows the responses of extensive margin of foreign currency borrowings to firms' first entering the export market. Panel (b) plots the response of foreign currency borrowings intensity to firms' first entering the export market, conditional on firms ever financing in foreign currency. Panel (c) shows the responses of extensive margin of foreign currency borrowings to firms' exiting the export market. Panel (d) plots the response of foreign currency borrowings intensity to firms' exiting the export market, conditional on firms ever financing in foreign currency.

B.5 Pre-trend before entering export market

Although I don't claim causality in the baseline results, I provide more information about how firms decide on their financing before first exporting/exiting. Figure 15 shows that pre-treatment effects on the extensive margin of foreign currency borrowings are not exactly zero, while there is no pre-trend along the intensive margin of foreign currency borrowing.



(a) I_{FCB} after first entering

(b) S_{FCB} after first entering

Figure 15: Response of foreign currency borrowings: pre-trend

Notes: Panel (a) shows the responses of extensive margin of foreign currency borrowings to firms' first entering the export market. Panel (b) plots the response of foreign currency borrowings intensity to firms' first entering the export market, conditional on firms ever financing in foreign currency.

B.6 Effects of first financing in foreign currency

This section tests the correlation between trade and currency of financing from the other direction. For the baseline specification, I replace the key variation with firms' first financing in foreign currency

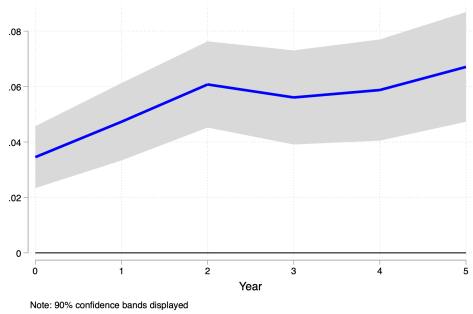
$$y_{i,t+h} - y_{i,t-1} = \alpha^h \Delta D_{it} + Z'_{i,t-1}\beta + \eta_t^h + e_{it}^h,$$

restricting sample to observations that are either

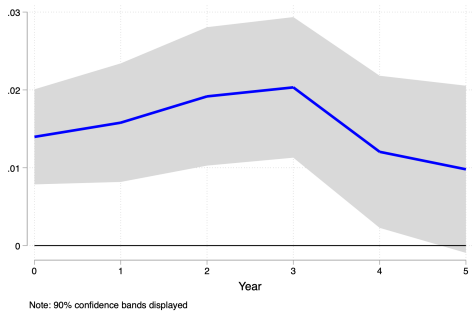
$$\begin{cases} \text{firms that newly borrow in foreign currency} & \Delta D_{it} = 1, \\ \text{or never borrow in foreign currency before (clean control)} & D_{i,t+h} = 0. \end{cases}$$

where $y_{i,t}$ could be either an indicator that takes value 1 if firm i exports I_{FCB}, or the export intensity S_{FCB}. $\Delta D_{it} = 1$ indicates that firm i starts financing in foreign currency at time t. I focus on the effects at horizon $h = 0, 1, 2, 3, 4, 5$ after firm i first financing in foreign currency. Controls remain the same as the baseline estimation. e_{it}^h denote the error term at each horizon h. α^h is the parameter of interest for each horizon h, capturing the cumulative change in dependent variable after firm i starts financing in foreign currency.

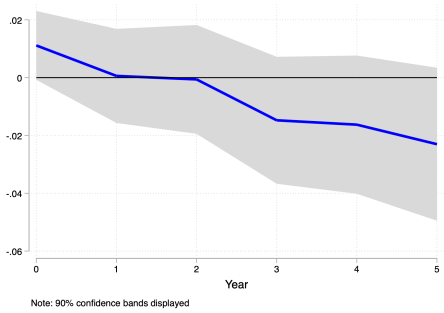
As shown in Figure 16, after firms start holding foreign currency borrowings, likelihood of exporting increases by 3.5-6.7pp, and export intensity increases by 1.2-2.0pp, conditional on firms' ever exporting. Panel (c) and (d) indicate that there is no significant response in export activities after firms' completely deleveraging their holding of foreign currency borrowings.



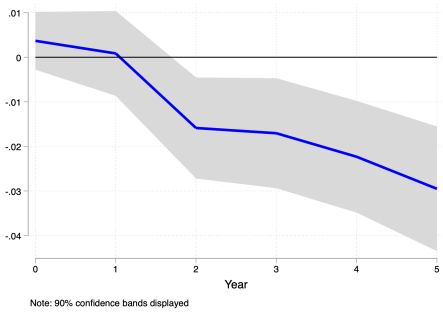
(a) I_{exp} after first financing in foreign currency



(b) S_{exp} after first financing in foreign currency



(c) I_{exp} after complete deleveraging



(d) S_{exp} after complete deleveraging

Figure 16: Response of exports to first financing in foreign currency

Notes: Panel (a) shows the responses of extensive margin of exports to firms' first financing in foreign currency. Panel (b) plots the response of export intensity to firms' first financing in foreign currency, conditional on firms ever exporting. Panel (c) shows the responses of extensive margin of exports to firms' complete deleveraging their foreign currency borrowings. Panel (d) plots the response of export intensity to firms' complete deleveraging their foreign currency borrowings, conditional on firms ever exporting.

C Cross-country evidence

In this section, I show that emerging markets have more intensive capital control policies, compared to developed countries. I then present evidence on trade currency of invoicing patterns across difference emerging markets.

C.1 Capital control restrictions

Fernandez et al.(2016) develops a new dataset of capital control restrictions from IMF's Annual Report on Exchange Rate Arrangements and Restrictions (AREAER). The AREAER reports the presence of rules and regulations for international transactions by asset categories for each country. Fernandez et al.(2016) then constructs a capital control index over all 10 asset categories: equity, bonds, money market, collective investment, financial credit, and foreign direct investment, derivatives, commercial credit, financial guarantees, and real estate. This capital control index lies between 0 to 1, and a higher index indicates a greater breadth, comprehensiveness and intensity of capital controls. Figure 17 shows the overall restriction index for a chosen set of emerging markets (solid lines) and developed countries (dashed lines). Emerging markets implement more intensive capital controls, compared to developed countries.

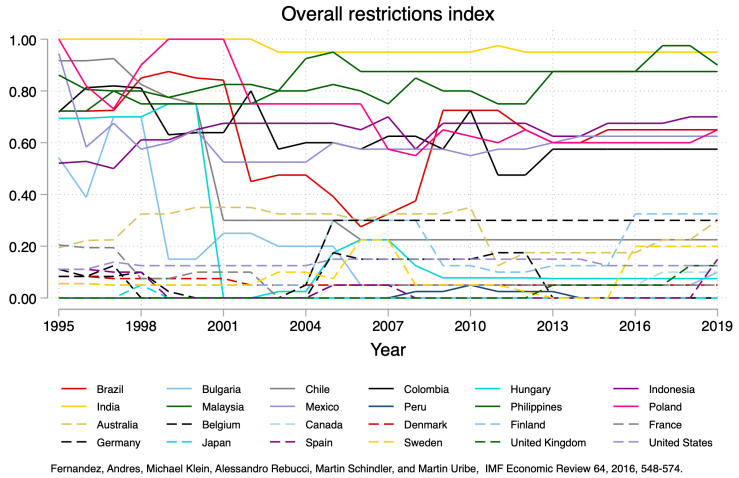


Figure 17: Capital control index across countries

C.2 Currency of trade invoicing in emerging markets

Emerging markets are more likely to use dominant currencies to invoice their international trade. Boz et al. (2020) constructs a cross-country database on currency used in international trade. Figure 18 shows that emerging markets (red triangles) are more likely to use strong currencies to invoice both their exports and imports. For example, more than 80% of Indian exports and imports are invoiced in U.S. dollars.

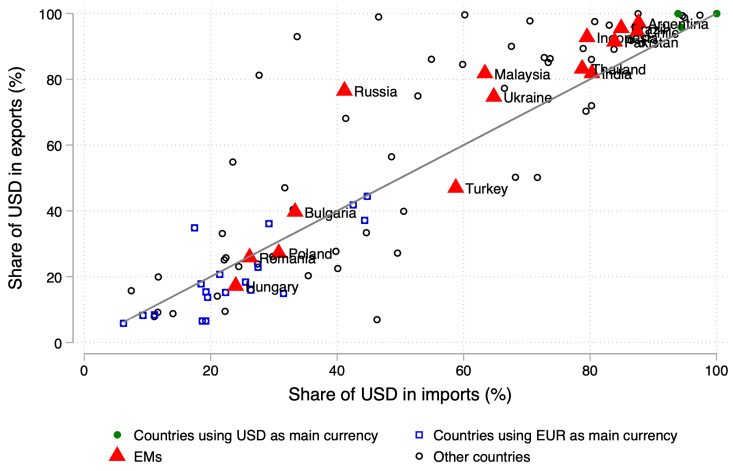


Figure 18: Cross-country currency of trade invoicing

D Entrepreneurs' problem

The entrepreneurs choose their consumption, export status, borrowing schemes, and pricing plans. The entrepreneurs' problem can be written as:

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

s.t.

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

$$[\lambda_2] \qquad y + \tau x y^* = Azk^{\alpha},$$

$$[\lambda_3] \qquad b' \leq \theta \left(\frac{y^{1-\frac{1}{\sigma}}}{e(Y)^{-\frac{1}{\sigma}}} + xe\frac{(y^*)^{1-\frac{1}{\sigma}}}{(Y^*)^{-\frac{1}{\sigma}}} \right),$$

$$[\lambda_4] \qquad eb^{*\prime} \leq \theta^* \left(\frac{y^{1-\frac{1}{\sigma}}}{e(Y)^{-\frac{1}{\sigma}}} + xe\frac{(y^*)^{1-\frac{1}{\sigma}}}{(Y^*)^{-\frac{1}{\sigma}}} \right).$$

D.1 Exporters

When $x = 1$, FOCs are given as:

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

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

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

$$\left[k'\right]: \quad \beta E V_{k'} = \lambda_1 \quad \Rightarrow \quad \beta E\left[\lambda_1'(1-\delta) + \lambda_2'\alpha A z' \left(k'\right)^{\alpha-1}\right] = \lambda_1,$$

$$\left[b'\right]: \quad \beta E V_{b'} + \frac{\lambda_1}{(1+r)(1+\tau_c)} - \lambda_3 = 0 \Rightarrow \beta E\left(-\lambda_1'\right) + \frac{\lambda_1}{(1+r)(1+\tau_c)} - \lambda_3 = 0,$$

$$\left[b^{*\prime}\right]: \quad \beta E V_{b^{*\prime}} + \frac{\lambda_1 e}{(1+r^*)(1+\tau_c)} - \lambda_4 e = 0 \Rightarrow \beta E\left(-e'\lambda_1'\right) + \frac{\lambda_1 e}{(1+r^*)(1+\tau_c)} - \lambda_4 e = 0.$$

Given A, e, Y, Y^*, r, r^*, z, the system equations for $x = 1$ are given as

$$\tau = e^2 \left(\frac{y^*/y}{Y^*/Y} \right)^{-\frac{1}{\sigma}} \tag{10}$$

$$c^{-\gamma} = \beta E \left[(1-\delta) \left(c'\right)^{-\gamma} + \alpha A z' \left(k'\right)^{\alpha-1} \frac{1-\frac{1}{\sigma}}{e'} \left(\frac{y'}{Y'} \right)^{-\frac{1}{\sigma}} \left[\left(c'\right)^{-\gamma} + \lambda_3' \theta + \lambda_4' \theta^* \right] \right], \tag{11}$$

$$c^{-\gamma} = \beta(1+r)(1+\tau_c) E \left(c'\right)^{-\gamma} + (1+r)(1+\tau_c)\lambda_3, \tag{12}$$

$$c^{-\gamma} = \beta(1+r^*)(1+\tau_c) E \left(\frac{e'}{e} \left(c'\right)^{-\gamma} \right) + (1+r^*)(1+\tau_c)\lambda_4, \tag{13}$$

$$c + k' - \frac{b'}{(1+r)(1+\tau_c)} - e\frac{b^{*\prime}}{(1+r^*)(1+\tau_c)} = \frac{y^{1-\frac{1}{\sigma}}}{e(Y)^{-\frac{1}{\sigma}}} + e\frac{(y^*)^{1-\frac{1}{\sigma}}}{(Y^*)^{-\frac{1}{\sigma}}} + (1-\delta)k - b - eb^* - F \tag{14}$$

$$y + \tau x y^* = A z k^{\alpha}, \tag{15}$$

$$b' \leq \theta \left(\frac{y^{1-\frac{1}{\sigma}}}{e(Y)^{-\frac{1}{\sigma}}} + e\frac{(y^*)^{1-\frac{1}{\sigma}}}{(Y^*)^{-\frac{1}{\sigma}}} \right), \tag{16}$$

$$eb^{*\prime} \leq \theta^* \left(\frac{y^{1-\frac{1}{\sigma}}}{e(Y)^{-\frac{1}{\sigma}}} + e\frac{(y^*)^{1-\frac{1}{\sigma}}}{(Y^*)^{-\frac{1}{\sigma}}} \right). \tag{17}$$

where unknowns are $y, y^*, c, k', b, b^{*\prime}, \lambda_3, \lambda_4$. From Eq. (12) and (13), UIP condition only holds if both collateral constraints are slack.

D.2 Non-exporters

When $x = 0$, the FOCs are:

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

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

$$\left[k'\right]: \quad \beta E V_{k'} = \lambda_1 \quad \Rightarrow \quad \beta E \left[\lambda_1'(1-\delta) + \lambda_2' \alpha A z' \left(k'\right)^{\alpha-1} \right] = \lambda_1,$$

$$\left[b'\right]: \quad \beta E V_{b'} + \frac{\lambda_1}{(1+r)(1+\tau_c)} - \lambda_3 = 0 \Rightarrow \beta E \left(-\lambda_1'\right) + \frac{\lambda_1}{(1+r)(1+\tau_c)} - \lambda_3 = 0,$$

$$\left[b^{*\prime}\right]: \quad \beta E V_{b^{*\prime}} + \frac{\lambda_1 e}{(1+r^*)(1+\tau_c)} - \lambda_4 e = 0 \Rightarrow \beta E \left(-\lambda_1' e'\right) + \frac{\lambda_1 e}{(1+r^*)(1+\tau_c)} - \lambda_4 e = 0.$$

Given $A, e, Y, Y^*, r, r^*, z$the system equations for $m = 0$ are

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

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

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

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

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

$$y=Azk^{\alpha},$$

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

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

where unknowns are $y, c, k', b', b^{*\prime}, \lambda_2, \lambda_3, \lambda_4$.

E Numerical Solution

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 $G^0(z, k, b', b^{*\prime}, x, e)$ and choose a stopping criterion $tol > 0$

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

   (a) If $x = 1$, I 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 $eb^{*\prime} \leq \theta^*(py + ep^*y^*)$

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

   (b) If $x = 0$,

$$y = Azk^{\alpha},$$

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

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

   (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

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

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 $B\left(iB_j\right) \leq b\left(ib'\right) + e\left(ie'\right) b^*\left(ib^{*\prime}\right) \leq B\left(iB_{j+1}\right)$

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

where

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

(b) If $B\left(iB_j\right)$ is not well defined,

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

(c) If $B\left(iB_{j+1}\right)$ is not well defined,

$$
V(iz', ik', b\left(ib'\right) + e\left(ie'\right) b^*\left(ib^{*\prime}\right), ix, ie') = V\left(iz', ik', iB_j, ix, ie'\right)
$$

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.

F Data moments

F.1 Targeted moments

Standard deviation of log sales I first take the standard deviation of log-linear detrended sales for each company, and then calculate the average standard deviation across companies, which takes the value 0.63.

Total leverage The total leverage is defined as the ratio of total borrowings over total assets. I first calculate the mean total leverage of each company, and then take the average total leverage across companies, which is 0.42.

Share of firms holding foreign currency borrowings The mean share of firms that have foreign currency borrowings is 0.06.

Intensity of foreign currency borrowings, conditional on firms with foreign currency borrowings Conditional on firms' having foreign currency borrowings, the intensity of foreign currency borrowings is defined the ratio of foreign currency borrowings to total outside liabilities, with average of 0.13.

Share of exporting firms Firms that export constitute 0.32 of the total sample.

Export intensity, conditional on exporting The export intensity is defined as the ratio of total export earnings to total sales. The mean export intensity for exporters is 0.27.

Exporter enter rate The mean share of companies that enter the export market is 3.4%.

Share of firms both exporting and holding foreign currency borrowings The mean share of firms that both export and borrow in foreign currency is 0.04.

F.2 Untargeted moments

Corr(export intensity, foreign currency borrowings intensity) The raw correlation between export intensity and intensity of foreign currency borrowings is 0.12 in the baseline sample. This moment is informative for the estimated complementarity in the baseline empirical part.

Unconditional average intensity of foreign currency borrowings For all firms, the average intensity of foreign currency borrowings is 0.005.

Unconditional average export intensity The mean export intensity for the whole sample is 0.07.