Foreign Currency Borrowing and Exporter Dynamics in Emerging Markets*

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Abstract

This paper studies the interaction between firms' export activities and currency choice of financing, uncovering the underlying driving forces behind this interaction and exploring the associated policy implications. Using Indian firm-level data, I find that exporters, particularly those with a large share of export sales, are more likely to borrow in foreign currency, and have more foreign currency borrowing compared to non-exporting firms. To uncover the underlying driving forces of such correlations along both extensive and intensive margins, I develop a heterogeneous firm model with endogenous choices of export and currency of financing. There are three potential channels through which firms' exports correlate with the currency composition of borrowing. Foreign currency revenues from exports can directly repay or serve as collateral for foreign currency borrowing. In addition, exporting firms could face reduced fixed costs of foreign currency borrowing. Disciplined by the observed correlations, the model implies that exporters face 35% lower fixed costs of foreign currency borrowing. Furthermore, without accounting for these correlations, the cost of capital control policies would be underestimated by 27% of the output losses.

Keywords: Foreign Currency Borrowing, Exporter Dynamics, Capital Control Policy, Hedging, Collateral Constraint, Cost Complementarity

JEL classification: F4, F34, F38

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1 Introduction

Non-financial firms in emerging markets heavily rely on foreign currency-denominated debt for financing (Acharya et al., 2015; Gutierrez et al., 2021). The literature on the balance-sheet effects of foreign currency-denominated debt points out that firms' reliance on foreign currency financing makes them more vulnerable to exchange rate risks. They have difficulties in repayment and become more financially distressed during periods of currency depreciation (Kim et al., 2015; Kalemli-Ozcan et al., 2016). This paper aims to addresses two critical questions: (i) If firms in emerging markets are aware of these risks, why do they continue to borrow in foreign currencies? (ii) Should governments in emerging markets implement regulations to limit firms' foreign currency borrowing?

Meanwhile, it is observed that firms in emerging markets often invoice their exports in foreign currencies (Boz et al., 2020; Gopinath and Itskhoki, 2022). This paper answers these questions by focusing on the interaction between firms' export decisions and their choice of financing currency, uncovering the underlying driving forces behind this interaction, and exploring the associated policy implications.

This paper makes three contributions. First, it provides new empirical micro-evidence on the correlation between firms' export activities and their currency choice of financing along both extensive and intensive margins. Specifically, exporters are more likely to borrow in foreign currency and engage in more intensive foreign currency borrowing compared to non-exporting firms. Among exporters, those with a larger share of export sales tend to borrow more intensively in foreign currency. Second, this paper develops a heterogeneous firm model that incorporates endogenous decisions on both exporting and currency of financing, providing microfoundations for these observed correlations. Finally, the calibrated model elucidates the contribution of each driving force to the correlations between export activities and foreign currency borrowing, thus allowing for a more precise quantification of the impact of capital control policies in emerging markets.

This paper starts by empirically documenting the relationship between firms' export activities and their choice of financing currency in emerging markets. Using micro-level data from India, the empirical analysis reveals a positive correlation between firms' foreign currency borrowing and export, along both the extensive and intensive margins of export and financing. Specifically, upon first entering the

export market, firms are more likely to engage in foreign currency borrowing, and intensity of foreign currency borrowing goes up. Conversely, when firms exit the export market, their likelihood of borrowing in foreign currency decreases, and firms shift their overall borrowing towards borrowing denominated in the home currency. Moreover, when examining the export intensive margin, firms highly involved in international export exhibit a greater tendency to finance in foreign currency and have a higher intensity of foreign currency borrowing.

To study the underlying driving forces of the observed correlations and quantify the associated policy implications, I develop a heterogeneous firm model following Kohn et al. (2020). In the model, there are final goods producers and a unit measure of monopolistically competitive entrepreneurs. The final goods producers generate domestic final goods using both domestic varieties produced by entrepreneurs and foreign varieties from the foreign market. The risk-averse entrepreneurs own the firms. Firms simultaneously determine their pricing strategies in both domestic and foreign market (in the case of exports), and borrowing arrangements including the currency choice of financing and borrowing intensity. Firms face cash flow-based collateral constraints, and exogenous demand from both domestic and foreign markets. 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 correlations between export and currency choice of financing mainly through three mechanisms. First, firms can directly utilize their foreign currency revenues to repay foreign currency borrowing, 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 borrowing. Third, firms actively engaged in exports 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 borrowing, these firms can complementarily reduce their fixed financing costs associated with foreign currency settlement, thereby establishing what I term the *cost complementarity channel*. This model is flexible in terms of the degree of each mechanism, which can be fully disciplined by the empirical findings.

I first identify the degree of each driving force, by calibrating 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 export and currency of financing, including average export intensity, the average intensity of foreign currency borrowing, the fraction of firms both exporting and borrowing in foreign currency, and so on. In the calibration, I can endogenously pin down the key parameters that govern the relative importance of each driving force. Firms engaged in both export and foreign currency borrowing face 35% lower total fixed costs. Using the calibrated model, I illustrate how export and currency of financing interact in a simplified entrepreneur's problem, 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 borrowing 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 correlations between export 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 correlations between export and currency of financing, the cost of capital control policies in emerging markets would be underestimated. To emphasize the role of each mechanism in accessing the impact of capital control policies, I draw comparisons between the benchmark model and three alternative models. First, by comparing the benchmark model with an alternative model that disables the *cost complementarity channel*, I find that failing to accurately quantify the degree of cost complementarity leads to a misrepresentation of the firm distribution across export and financing activities. This misrepresentation results in significant misallocation and output losses. Secondly, I present an alternative 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 borrowing. 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 alternative model in which firms 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 alternative model results in 61% lower misallocation and 27% lower output losses.

Related Literature. This paper links firms' export with currency choice of financing, and evaluate the effects of capital control policies in the emerging markets when considering the correlations between export 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 export and financing. In particular, as emerging markets are more likely to use dominant currency to invoice their export, they are inclined to borrow 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 of financing and determining the intensity of home/foreign currency borrowing. 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; Wu and Lee, 2024); hedging from exchange rate exposure motive (Froot et al., 1993; Gelos, 2003; Alfaro et al., 2023); 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; Lee, 2022). In this literature, previous studies that discuss the relationship between currency of 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 intensity 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 correlations between export and currency of financing along both extensive and intensive dimensions of export and financing. Moreover, I introduce export 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 borrowing exposes the 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 perspective of firms' real activity, and document that firms' currency choice for financing is correlated with firms' exports. The observed correlations would change the previous understanding in the effects of foreign currency borrowing 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 aggregate implications (Forbes, 2007; Alfaro et al., 2017; Andreasen et al., 2019, 2023). My paper contributes to this body of work by focusing on how these policies affect firms' choice of financing currency. This margin, the currency denomination of debt, is less discussed in the existing literature, which primarily concentrates on debt denominated in foreign final goods or foreign currency. The correlations between export activities and currency of financing provide insights into the impacts of capital control policies, highlighting how these policies impose additional costs on real activities, especially for the most productive exporting firms.

Road Map. This paper proceeds as follows. Section 2 introduces firm-level evidence that explores the relationship between export and the choice of currency of financing. In Section 3, I outline the baseline model, which incorporates simultaneous and endogenous choices of both export and currency of 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 the observed correlations in evaluating these policies. Section 5 concludes.

2 Evidence on Export and Currency of Financing

This section examines the relationship between export and the currency choice of financing, using an Indian firm-level database. First, I discuss the key features of the baseline Indian firm-level sample that enable a comprehensive study of the relationship between export activities and foreign currency borrowing. Second, I introduce the estimation strategy and study the relationship between firms' decisions on export and currency of financing, along both extensive and intensive margins. The extensive margin correlation refers to how firms' export status relates to their foreign currency borrowing behaviors. The intensive margin discusses the relationship between firms' export intensity and intensity of foreign currency borrowing.

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 database includes information related to both listed firms and a broader range of unlisted Indian firms, spanning the period from 1988 to 2023. This database is used in other research to conduct detailed firm-level analysis due to its wealth of firm-level information (Goldberg et al., 2010; Banerjee et al., 2014; Khan and Khederlarian, 2021). The main advantage of using this database in my analysis is that it contains data on both export activities and the currency composition of financing at the firm-level.

The baseline analysis focuses on all non-financial firms in manufacturing, mining, electricity, non-financial services, and construction. I clean the baseline sample to be at annual frequency, ranging from 2000 to 2016. The CMIE Prowess database releases

3 vintages for each calendar year, namely March, September, and December vintages. The annual firm-level sample mainly uses the information from the March vintages. The firm-level information mainly comes from firms' annual report, prospectus or interim financials. What's more, the vintages in 2017 was expected to include 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 reports information on firms' currency composition of financing, export activities as well as other balance-sheet information. More specifically, the core variables used in the baseline empirical analysis contain firms' foreign currency borrowing, total export earnings, total liabilities, total sales, total assets, and some other firm-level variables.

Foreign currency borrowing are defined as any loans taken in foreign currency other than Indian rupees, including external commercial borrowing, such as convertible bonds, non-convertible bonds and subordinated debt, as well as foreign suppliers' credit obtained for capital goods.[1] I focus on both extensive and intensive margin of holding foreign currency borrowing, namely firms' likelihood and intensity of holding foreign currency borrowing ($\mathcal{I}_{FCB}$ and S_{FCB}).

In the baseline empirical analysis, I mainly use an indicator for starters (firms that first enter the export market), $\mathcal{I}_{starter}$, an indicator for stoppers (firms that exit the export market and never export thereafter), $\mathcal{I}_{stopper}$, 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. Conditional on firms with positive foreign currency borrowing, the average intensity of foreign currency borrowing, measured as the ratio of foreign currency borrowing to total borrowing, is around 13%. Appendix A.2 shows more details on variable construction.

2.2 Correlation between Export and Currency of Financing

In this section, I first estimate a local projection approach with a clean control condition to derive the extensive margin correlation between firms' export status and their

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

Table 1: Summary Statistics

	N	Mean	Std. Dev.	min	max	p25	Median	p75
$I_{starter}$	233757	.018	.132	0	1	0	0	0
$I_{stopper}$	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. $\mathcal{I}_{FCB}$ take a value of 1 when firms have positive foreign currency borrowing. S_{FCB} represents the intensity of firms' foreign currency borrowing. Statistics of S_{FCB} are reported using observations ever holding positive foreign currency borrowing. More details are listed in Appendix A.2.

foreign currency borrowing activities. Second, I group all observations based on their export intensity and discuss the correlation between their export intensity and intensity of foreign currency borrowing.

2.2.1 Export Extensive Margin

The extensive margin analysis focuses on how firms' currency of financing decisions evolve after firms' first entering and exiting the export market. I summarize the extensive margin correlation into the following two facts.

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

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

$$y_{j,t+h} - y_{j,t-1} = \alpha^h \Delta D_{jt} + Z'_{j,t-1}\beta + \eta^h_t + \delta^h_s + e^h_{jt},$$

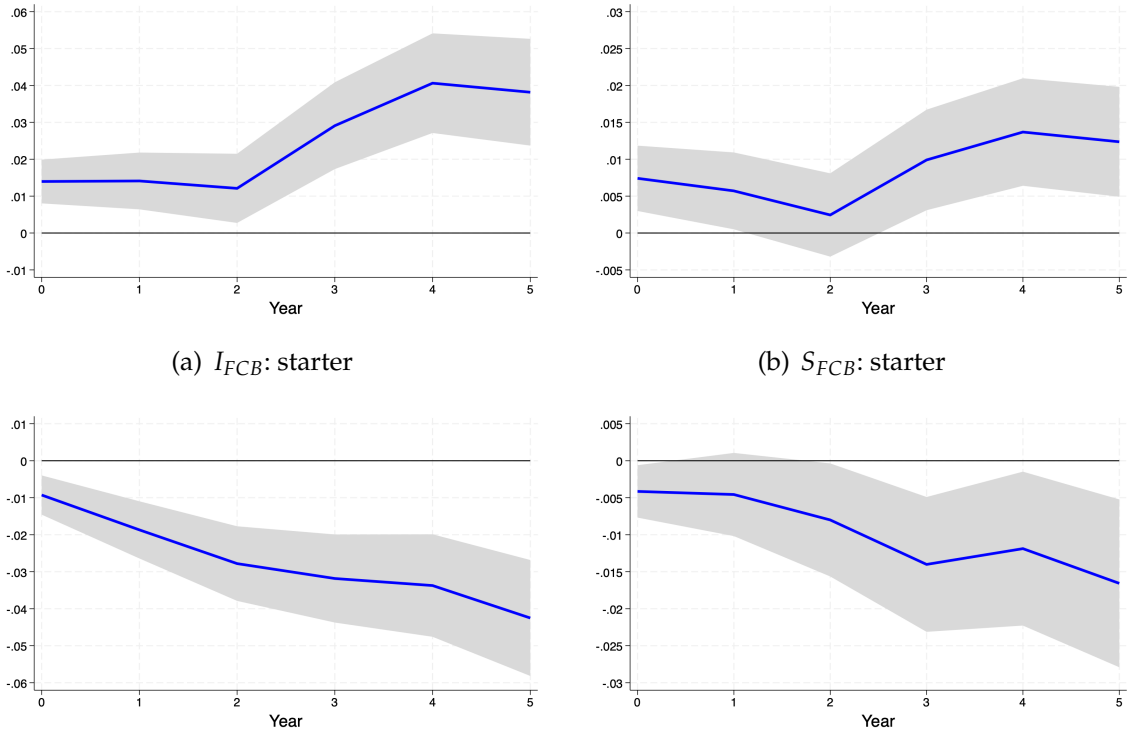
restricting sample to observations that are either

$$\begin{cases} \text{new exporters:} & \Delta D_{jt} = 1, \\ \text{or never exporting before:} & D_{j,t+h} = 0. \end{cases}$$

where $y_{j,t}$ could be either an indicator that takes a value of 1 if firm j borrows in foreign currency I_{FCB}, or the share of foreign currency borrowing in their overall borrowing S_{FCB}. The indicator $\Delta D_{jt} = 1$ means that firm j starts to export 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 j starts to export. Controls $Z'_{j,t1}$ includes firm size (log of total assets), log of total liability, total leverage, fixed asset turnover ratio. The time fixed effects η_t^h control for potential time trend. The industry fixed effects δ_s^h control for time-invariant differences across industries. The error term at each horizon h is denoted by e_{jt}^h. The key parameter of interest α^h for each horizon h captures the cumulative change in dependent variable after firm j 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.

Figure 1 depicts the cumulative responses to firms' first entering the export market. The top left panel plots how probability of holding foreign currency borrowing



(a) I_{FCB}: starter

(b) S_{FCB}: starter

(c) I_{FCB}: stopper

(d) S_{FCB}: stopper

Figure 1: Response of Foreign Currency Borrowing

Notes: $\mathcal{I}_{FCB}$ take a value of 1 when firms have positive foreign currency borrowing. S_{FCB} represents the intensity of firms' foreign currency borrowing. Panel (a) shows the responses of extensive margin of foreign currency borrowing to firms' first entering the export market. Panel (b) plots the response of foreign currency borrowing 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 borrowing to firms' exiting the export market. Panel (d) plots the response of foreign currency borrowing intensity to firms' exiting the export market, conditional on firms ever financing in foreign currency. 90% confidence bands displayed.

changes h years after firm j 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 borrowing in the following 5 years. On the other hand, there are more foreign currency borrowing in their overall borrowing, as shown in the top right panel of Figure 1 (intensive margin of financing in foreign currency). The intensity of foreign currency borrowing increases by 0.2-1.4pp after starting to export, which is 1.6%-10.9% relative to the baseline sample's average foreign currency borrowing intensity of 12.8%.

Fact 2. After stopping to export,
(i) likelihood of financing in foreign currency falls by 0.9-4.3pp;
(ii) intensity of foreign currency borrowing 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 $\Delta D_{jt} = 1$ with an alternative indicator that takes the value 1 if firm j permanently exits the export market in the baseline sample. Figure 1 shows the corresponding cumulative responses to firms' exiting export market. The bottom left panel shows that the likelihood of holding foreign currency borrowing goes down by 0.9-4.3pp, indicating that firms gradually deleverage their foreign currency borrowing after exiting the export market. For the intensive margin of foreign currency borrowing, there are less foreign currency borrowing in their overall borrowing, as shown in the bottom right panel of Figure 1. The foreign currency borrowing 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 borrowing. This correlation between export and currency of financing is also significant for intensity margin of export. In next section, I present the correlation between export intensity and intensity of foreign currency borrowing.

2.2.2 Export Intensive Margin

Besides the effects of firm export status on firms' decisions on currency of financing, this section would continue to discuss the relationship between export intensity

and intensity of foreign currency borrowing, by restricting the sample to firms ever holding positive amount of foreign currency borrowing.

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 presents the correlation between export intensity and intensity of foreign currency borrowing, by grouping firms based on their export intensity. Export intensity is defined as the ratio of export sales to total sales. Non-exporting firms, shown in the first row, have a conditional average intensity of foreign currency borrowing at 12.7%. Firms with top 5% of export intensity borrow more heavily in foreign currency, with a conditional average intensity of 16.3%. The top 5% of exporters demonstrate significantly higher average foreign currency borrowing intensity compared to non-exporting firms and small exporters, statistically significant at the 10% level.

Table 2: Correlation between Intensities of Export and Foreign Currency Borrowing

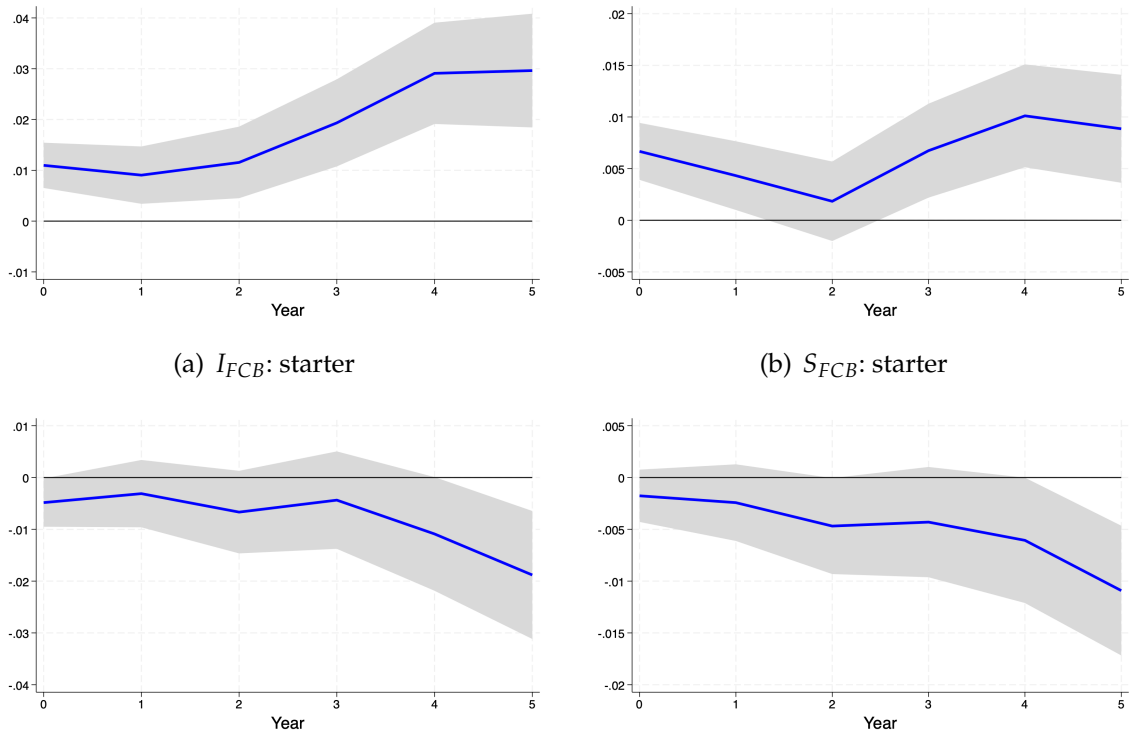
By export intensity	Intensity of FCB
Non-exporters	0.127
$\leq$ p(95)	0.124
> p(95)	0.163

Notes: Export intensity is defined as the ratio of export sales to total sales. The average intensity of foreign currency borrowing, Mean(S_{FCB}), is the average conditional on I_{FCB}=1.

2.3 Robustness

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

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_{jt} with an indicator that takes value 1 if firm j enters the export market. That is to say, $\Delta D_{jt} = 1$ includes firms' re-entering the export market.



(a) I_{FCB}: starter

(b) S_{FCB}: starter

(c) I_{FCB}: stopper

(d) S_{FCB}: stopper

Figure 2: Response of Foreign Currency Borrowing: Including Re-entering

Notes: $\mathcal{I}_{FCB}$ take a value of 1 when firms have positive foreign currency borrowing. S_{FCB} represents the intensity of firms' foreign currency borrowing. Panel (a) shows the responses of extensive margin of foreign currency borrowing to firms' first entering the export market. Panel (b) plots the response of foreign currency borrowing 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 borrowing to firms' exiting the export market. Panel (d) plots the response of foreign currency borrowing intensity to firms' exiting the export market, 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 borrowing 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.

Similarly, if I replace the treatment ΔD_{jt} with an indicator that takes 1 if firm j exits export market, Figure 2 shows that the baseline results remain robust. Now, $\Delta D_{jt} = 1$ 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 borrowing 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.

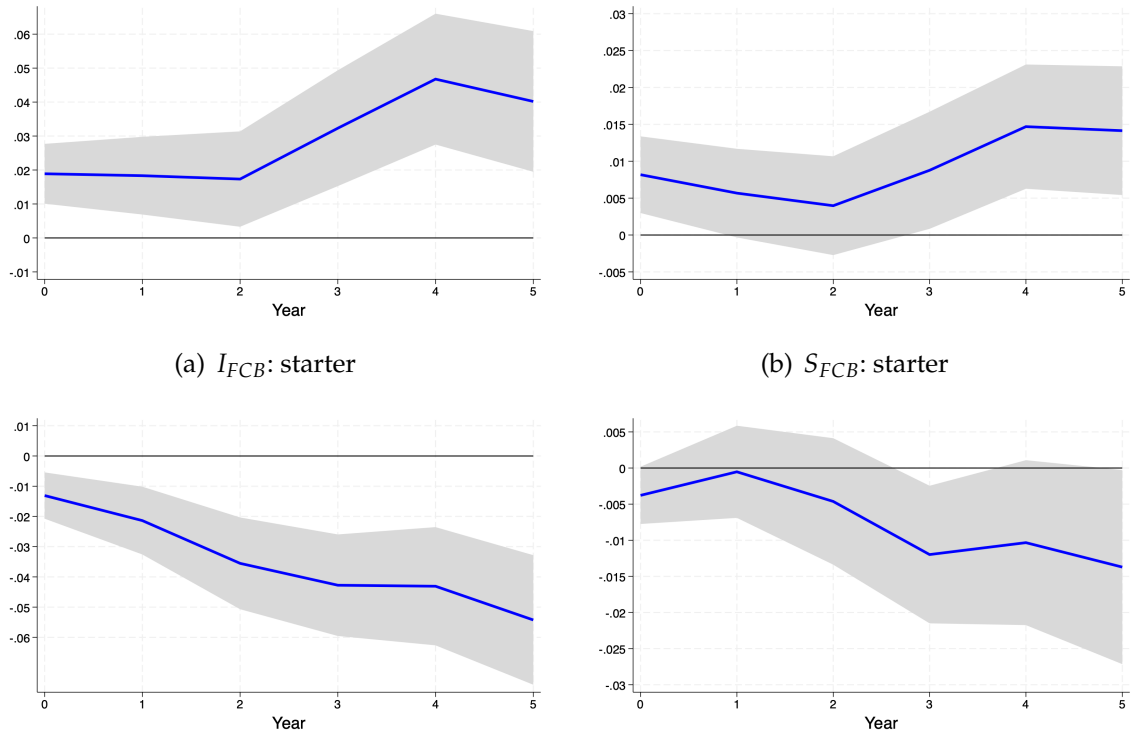
Sample: Manufacturing Industry. The baseline sample incorporates manufacturing, mining, electricity, non-financial services and construction firms. In this section, I restrict the baseline sample to just manufacturing firms, which are relatively more tradable than firms in other industries.

The results are shown in Figure 3. After firms' first entering the export market, likelihood of financing in foreign currency increases by 1.7-4.0pp. Intensity of foreign currency borrowing 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 borrowing falls by 0.1-1.4pp, conditional on firms' ever borrowing in foreign currency. Using the manufacturing sample, the extensive margin of foreign currency borrowing is more responsive to changes in export status.

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 correlations between foreign currency financing and export are 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 export status and currency of financing remains robust, as shown in Appendix B.2.

Besides analyzing the responses to changes in export status, I also estimate the responses of foreign currency borrowing to changes in import status. Appendix B.3 reveals that firms are more likely to finance in foreign currency and increase their



(a) I_{FCB}: starter

(b) S_{FCB}: starter

(c) I_{FCB}: stopper

(d) S_{FCB}: stopper

Figure 3: Responses of Foreign Currency Borrowing using Manufacturing Sample

Notes: $\mathcal{I}_{FCB}$ take a value of 1 when firms have positive foreign currency borrowing. S_{FCB} represents the intensity of firms' foreign currency borrowing. Panel (a) shows the responses of extensive margin of foreign currency borrowing to firms' first entering the export market. Panel (b) plots the response of foreign currency borrowing 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 borrowing to firms' exiting the export market. Panel (d) plots the response of foreign currency borrowing intensity to firms' exiting the export market, conditional on firms ever financing in foreign currency. 90% confidence bands displayed.

borrowing intensity after entering the import market. Conversely, after firms exit the import market, they exhibit a reduced likelihood of borrowing in foreign currency. However, unlike the response observed for exiting the export market, the intensity of foreign currency borrowing does not significantly change upon exiting the import market.

To further solve the concern that the baseline responses of foreign currency borrowing 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 export 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.[2]

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 eliminate their foreign currency borrowing. As about 60% of the foreign currency borrowing are long-term borrowing, it takes years for firms completely deleverage.

In summary, firms' decisions on currency of financing are closely related to their export status and the intensity of their export involvement. One key follow-up question is that what are the underlying forces driving borrowing in foreign currency by exporting firms. Besides, the implementation of capital control policies aimed at restricting the use of foreign currency financing could result in efficiency losses, especially for exporters. Then the other key question I need to address is: How significant are these losses? In the following section, I provide a micro-foundation for the correlations between export and foreign currency borrowing along both extensive and intensive margins. I will discuss the relative importance of each driving force, and study how the observed correlations change the evaluation of capital control policies in emerging markets.

[2]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 export currency mismatch and currency of financing. I would extend the baseline model by incorporating the import decisions in the future.

3 Model

In this section, I develop a heterogeneous firm model that incorporates endogenous decisions on both export and currency of financing, following Kohn et al. (2020). This model extends previous research by granting exporters the flexibility to determine which currency to borrow and the extent of their home and foreign currency borrowing. My theoretical framework establishes the micro-foundations for understanding the observed correlations between export and foreign currency borrowing. Through this framework, I can quantify the relative importance of each driving force influencing exporters' decisions to borrow in foreign currency, and explore how the correlations changes the evaluation of capital control policies.

In the model, there is a small open economy with a unit measure of monopolistically competitive entrepreneurs and final good producers. Final good producers produce domestic final goods using both imported foreign varieties and domestic varieties produced by entrepreneurs. The international trade activities only involve varieties. The imported foreign varieties are produced by the foreign market and sold to domestic final good producers. Entrepreneurs consume final goods, use final goods to invest in capital, and own heterogenous firms that produce differentiated domestic varieties and sell them to either final good producers or foreign markets. Firms jointly make decisions on their pricing plans, borrowing schemes and investment strategies, facing a persistent idiosyncratic productivity shock and an exchange rate shock.

Firms face both financial and trade frictions. Follow the literature on exporter dynamics (Baldwin, 1988; Baldwin and Krugman, 1989; Dixit and Pindyck, 1994; Das et al., 2007; Ruhl and Willis, 2017; Alessandria et al., 2021), trade frictions are modeled as a fixed export cost that depends on export experience and an iceberg cost. In terms of financial frictions, firms must cover fixed costs associated with foreign currency financing and face collateral constraints when borrowing in either home currency or foreign currency. Besides, there is a capital control tax, which captures the degree of capital control policies.

3.1 Set-up

3.1.1 Entrepreneurs

There is a unit measure of monopolistically competitive entrepreneurs $j \in [0,1]$. They are risk-averse with time-separable preferences $\mathbb{E}_0 \sum_{t=0}^{\infty} \beta^t \frac{c_{jt}^{1-\gamma}}{1-\gamma}$, where β is the discount factor and γ is the coefficient of relative risk aversion. Let j also index the firm that own by entrepreneur j.

Firm j produces domestic variety j with capital k_{jt}:

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

where A_t denotes the aggregate productivity shock. Idiosyncratic productivity, z_{jt}, follows an AR(1) process $\log(z_{jt}) = \rho_z \log(z_{jt-1}) + \sigma_z \varepsilon_{jt}$, where the error term, ε_{jt}, follows a standard normal random process. The income share of capital is denoted as $\alpha < 1$.[3] Firm j can sell either to domestic final good producers y_{jt} or to foreign market y_{jt}^*. x_{jt} denotes firm j's export decision, and takes a value of 1 if firm j exports at time t. Capital is accumulated using domestic final goods. The stock of capital, k_{jt}, depreciates after production every period at the rate δ. The law of motion for capital follows

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

where i_{jt} refers to capital investment of firm j at time t.

Firms can finance their investment with one-period non-contingent bonds denominated in either foreign final good b_{jt}^* or home final good b_{jt}. I assume that bonds denominated in home (foreign) final good b_{jt} (b_{jt}^*) are supplied perfectly elastically at given interest rates r_t (r_t^*) by deep-pocket investors. Firms 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,

[3] 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_{jt}.

instead of the liquidation value of their assets, which is given as

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

where p_{jt} is the price that firms sell in domestic market, denominated in units of home final goods; p^*_{jt} is the price in foreign market, denominated in units of foreign final goods.[4] The real exchange rate is defined as the price of foreign final good relative to the domestic final good, $e_t = P^*_t / P_t = 1/P_t$, where the price of foreign final goods P^*_t is assumed to be 1 (numeraire), and P_t is domestic final good price index in period t. If firm j borrows in bonds denominated in foreign final good, it's subject to additional fixed cost of financing f^* in each period.[5]

Firms are subject to costs of entering and maintaining their export status. When a firm j enters the export market, it must pay f^x_0, if it has not exported in the previous period. This export entry cost refers to the costs associated with initially setting up their exports. If the firm j has exported in the previous period, and continues to export, it pays f^x_1. The export entry cost outweighs the continuation cost, $f^x_0 > f^x_1$. The part, $f^x_0 - f^x_1$, usually refers to the sunk entry cost. Exporters also face an iceberg trade cost τ for each unit of export. If firm j does not borrow by issuing bonds denominated in foreign final good, it's only subject to trade costs. The total exporting cost is given by

$$F\left(x_{j,t-1}, x_{jt}, b^*_{j,t+1} = 0\right) = \begin{cases} 0 & \text{for } x_{jt} = 0, \\ x_{j,t-1} f^x_1 + \left(1 - x_{j,t-1}\right) f^x_0 & \text{for } x_{jt} = 1. \end{cases} \tag{4}$$

If firm j also issues debt denominated in foreign good, the total cost is

$$F\left(x_{j,t-1}, x_{jt}, b^*_{j,t+1} > 0\right) = \begin{cases} f^* & \text{for } x_{jt} = 0, \\ \zeta \left[f^* + x_{j,t-1} f^x_1 + \left(1 - x_{j,t-1}\right) f^x_0 \right] & \text{for } x_{jt} = 1, \end{cases}$$

where ζ governs the degree of cost complementarity between export fixed/sunk costs

[4] 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.

[5] 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 borrowing 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.

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 borrowing denominated in foreign currency. If firms have already exposed to exports 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.[6]

Firm j is subject to a budget constraint in each period, denominated in units of the domestic final good. The new issuance of $b_{j,t+1}$ and $b^*_{j,t+1}$ are subject to borrowing interest rate r_t and r^*_t, respectively. There is a capital control tax τ_{ct} on bond denominated in foreign final good $b^*_{j,t+1}$ in the economy, which captures the intensity of capital control policies in targeted countries.[7] This budget constraint is represented by

$$\begin{aligned} c_{jt} + i_{jt} + b_{jt} + e_t b^*_{jt} =& p_{jt} y_{jt} + x_{jt} e_t p^*_{jt} y^*_{jt} + \frac{b_{j,t+1}}{(1+r_t)(1+\tau_{ct})} \\ &+ e_t \frac{b^*_{j,t+1}}{(1+r^*_t)(1+\tau_{ct})} - F(x_{j,t-1}, x_{jt}, b^*_{j,t+1}). \end{aligned} \tag{5}$$

The entrepreneurs choose their consumption, investment, pricing plans in each market, export status, borrowing schemes, subject to their budget constraint, law of motion for capital, production technology, collateral constraints and demand schedules. The domestic demand schedule solves the final good producers' problem and the foreign demand comes from the foreign market.

3.1.2 Final Good Producers

Final goods are produced by the final good producers, using both domestic varieties from entrepreneurs and foreign varieties imported from foreign market. The final good producers produce following a constant elasticity of substitution production technology, with elasticity of substitution between domestic and foreign varieties

[6] Alternatively, if firm j gets involved in export, it's a good signal to foreign investors and it's less costly for foreign investors to verify their financial conditions.

[7] 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.

given by σ. The final good producers face the price of domestic varieties p_{jt} that denominated in units of home final goods and the price of imported foreign varieties p^*_{mt} that is denominated in foreign final goods, and choose their inputs of domestic and imported varieties, y_{jt} and y^*_{mt}. The final good producers' problem is given as

$$\max_{y_{jt}, y^*_{mt}} Y_t - \int_0^1 p_{jt} y_{jt} di - e_t p^*_{mt} y^*_{mt}$$
$$\text{s.t.} \quad Y_t = \left[\int_0^1 y_{jt}^{\frac{\sigma-1}{\sigma}} di + \eta^{\frac{1}{\sigma}} y^{*\frac{\sigma-1}{\sigma}}_{mt} \right]^{\frac{\sigma}{\sigma-1}}$$

where Y_t is the quantity of the domestic final goods and the maximization problem is in units of home final good. The home bias parameter η denotes the weight on foreign varieties. The solution gives the demand schedules faced by entrepreneurs and the foreign market $y_{jt} = \left(p_{jt}\right)^{-\sigma} Y_t$, and $y^*_{mt} = \left(e_t p^*_{mt}\right)^{-\sigma} \eta Y_t$. The price index of domestic final good is given as

$$P_t = \left[\int_0^1 \left(p_{jt}/e_t\right)^{1-\sigma} di + \eta \left(p^*_{mt}\right)^{1-\sigma} \right]^{\frac{1}{1-\sigma}}$$

3.1.3 Foreign Market

The foreign market supplies foreign varieties to the final good producers. I assume the foreign supply is perfectly elastic at an exogenous price p^*_{mt}. The foreign market also demands domestic varieties, with a demand function given by

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

where Y^* is the exogenous amount of foreign final goods.

3.2 Stationary Competitive Equilibrium

First, I rewrite the entrepreneur's problem in recursive form. Assume that the aggregate productivity A_t, interest rate r^*_t, r_t, import price p^*_{mt} and capital control tax τ_{ct}, are constant in a stationary equilibrium. Let $V(z, k, b, b^*, x_{-1})$ 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^*, and

export status in time $t-1$. Given the aggregate variables $\{A, r, r^*, \tau_c, e, Y, Y^*\}$, monopolistically competitive entrepreneurs choose the consumption, pricing plans, export status, borrowing schemes, subject to their budget constraints, collateral constraints and demand schedules. The entrepreneur's problem can be given as

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

Let $\mathcal{S} := \mathcal{Z} \times \mathcal{K} \times \mathcal{B} \times \mathcal{B}^* \times \mathcal{X}$ denote the state space of entrepreneurs, where $\mathcal{Z} = \mathbb{R}^+$, $\mathcal{K} = \mathbb{R}^+$, $\mathcal{B} = \mathbb{R}_0^+$, $\mathcal{B}^* = \mathbb{R}_0^+$, and $\mathcal{X} = \{0,1\}$ denote the set of possible values of productivity, capital stock, bonds denominated in home good, bonds denominated in foreign good, and export status in the previous period, respectively. Denote $s \in \mathcal{S}$ be an element of the state space. Assume that aggregate variables A_t, r_t, r_t^*, p_{mt}^* and τ_{ct} are constant, and the cost structure in the equilibrium is denoted as $\hat{F}(s) = F(x_{-1}, x(s), b^{*\prime}(s))$. Then I can define the stationary competitive equilibrium in the economy.

Definition: A **recursive stationary competitive equilibrium** consists of policy functions $\{c, p, y, p^*, y^*, k', b', b^{*\prime}, x, Y, y_m\}$, real exchange rate $\{e\}$, 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) policy functions solve the final good producers' problem; (iii) final goods market clears: $\int_{\mathcal{S}} [c(s) + i(s) + \hat{F}(s)]\phi(s)ds = Y$; (iv) measure ϕ is stationary.

3.3 Mechanism

There are three mechanisms that can generate the observed correlations between export 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, firms 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 closely related to firms' exports. These correlations between export and financing are modeled via three main channels in the model: (i) natural hedge; (ii) collateral constraints; and (iii) cost complementarity.

Natural Hedge. Exporters' budget constraint is given by

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

where both the revenues from exporting and bonds denominated in foreign final good are subject to the real exchange rate shocks. Within each firm, the hedging motive encourages them to sell in the foreign currency in which they have debt exposure, mitigating their currency risk at the individual currency level, which is well documented in the literature (Keloharju and Niskanen, 2001; Kedia and Mozumdar, 2003). I term this mechanism the *natural hedge* channel, wherein the export revenues denominated in foreign final good ep^*y^*, can be directly used to repay the bonds denominated in foreign final good eb^*.

Collateral Constraints. In the model, exporters face the correlations between export and foreign currency financing through the collateral constraint channel, compared with non-exporters. Non-exporters' collateral constraints are given as

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

During depreciation period, non-exporters face tightening borrowing constraint for foreign currency borrowing $b^{*\prime}$, as the real exchange rate e goes up.

In contrast, exporters' collateral constraints are affected by both the depreciation shock and the market reallocation. Their collateral constraints can be rewritten as

$$b' \leq \theta \left(py + ep^* y^* \right), \quad b^{*\prime} \leq \theta^* \left(py/e + p^* y^* \right).$$

Without considering the response of market reallocation across markets to depreciation, a depreciation shock in the real exchange rate e makes the collateral constraint for home currency borrowing b' more relaxed, while the collateral constraint for foreign currency borrowing $b^{*\prime}$ is more binding. However, from the first-order conditions, firms sell more in foreign market during devaluation period, as shown in Eq. (6).

$$\text{export intensity} = \frac{ep^* y^*}{py + ep^* y^*} = 1 - \frac{1}{1 + \tau^{1-\sigma} e^{2\sigma} Y^* / Y}. \tag{6}$$

The market reallocation towards foreign market could in turn relax exporters' collateral constraints of foreign currency borrowing $b^{*\prime}$. Therefore exporters can have more access to low-cost foreign currency financing, compared to non-exporters.

Cost Complementarity. The total costs $F(x_{-1}, x = 1, b^{*\prime})$ faced by firms depend on their participation in export and foreign currency borrowing activities. When firms only engage in exporting without foreign currency borrowing, they are subject to only export-related costs. These costs include export entry costs (if they are new to exporting), export fixed costs, and iceberg costs. In contrast, firms that actively participate in both exporting and foreign currency borrowing, benefit from a discount $(1 - \zeta)$ in their overall costs related to both exporting and foreign currency financing. This cost discount, $1 - \zeta$, indicates a cost advantage for exporting firms borrowing in foreign currency at the same time.

The benchmark model incorporates three mechanisms that can potentially explain the observed correlations between export and foreign currency borrowing in the empirical section: natural hedge, collateral constraints, and cost complementarity channels. More importantly, this framework is flexbile enough, in the sense that the relative importance of each driving force can be precisely identified using the empirical evidence. In the subsequent quantitative analysis, I will further discuss how each mechanism contributes to the observed extensive and intensive correlations,

and how these findings alter the evaluation of capital control policies in emerging markets.

4 Quantitative Analysis

This section calibrates the benchmark model using India data to provide quantitative insights into the contributions of each mechanism to the observed correlations between export activities and currency choice of financing, and their implications for evaluating capital control policies in emerging markets.

First, the model is parameterized to match Indian macro- and micro-economic evidence from the sample period. Second, I discuss how the correlations between export and financing in the benchmark model work by plotting the impulse responses of firm borrowing and exports to a depreciation exchange rate shock. Third, the impacts of capital control policies are re-evaluated using the benchmark model as a laboratory. Lastly, I study how each mechanism drives the correlations between export and foreign currency borrowing, and how these mechanisms influence the associated policy implications for assessing capital control policies in emerging markets. The current quantitative analysis focuses on a simplified entrepreneur's problem with an exogenously estimated real exchange rate process.

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 firms 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

$$\log(z_{jt}) = \rho_z \log(z_{j,t-1}) + \sigma_z \varepsilon_{jt}, \quad \varepsilon_{jt} \sim N(0,1). \tag{7}$$

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

$$\log(e_t) = \rho_e \log(e_{t-1}) + \sigma_e \varepsilon_t, \quad \varepsilon_t \sim N(0,1). \tag{8}$$

The persistence and volatility of the exchange rate shock are estimated, using real exchange rate series at annual frequency.[8]

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 $\{f_0^x, f_1^x\}$, a parameter measuring the fixed cost for borrowing in foreign currency f^* and a parameter for the degree of complementarity between export and financing costs ζ.

These parameters are jointly determined by matching ten Indian micro moments that reflect companies' joint decisions on export and currency of financing. The moments include the volatility of sales, the total leverage, the intensity of foreign currency borrowing conditional on firms having foreign currency borrowing, average intensive responses of foreign currency borrowing to changes in export status (entering and

[8]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 borrowing	2.696%	Inflation-adjusted U.S. lending rate from World Bank
ρ_e	Persistence of exchange rate shock	0.943	Persistence of Indian rupees to U.S. dollar real exchange rate
σ_e	Volatility of exchange rate shock	0.084	Volatility of Indian rupees to U.S. dollar real exchange rate
ρ_z	Persistence of firm productivity shock	0.95	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_1^x	Export fixed cost	0.50	Export enter rate
f^*	Fixed cost of FCB	0.50	Share of firms holding FCB
f_0^x	Export entry cost	2.30	Share of exporting firms
ζ	Cost complementarity between f^x and f^*	0.65	Share of firms both exporting and holding FCB

exiting), the export intensity conditional on firms exporting, the exporters enter rate, the fraction of firms that hold foreign currency borrowing, the share of exporting firms and share of firms both exporting and holding foreign currency borrowing. 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 borrowing 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.

Though the parameters are jointly pinned down, there is still implicit connection between the parameters and the targeted moments. 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 borrowing and the average responses of foreign currency borrowing intensity estimated in the empirical part. The iceberg cost governs the average export intensity for those exporters. The trade cost structure $\{f_0^x, f_1^x\}$ are matching the exporters enter rate and the fraction of exporting firms.

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 borrowing to total assets. Foreign currency borrowing (FCB) intensity, S_{FCB}, is measured as the ratio of foreign currency borrowing to total liability. Export intensity is the ratio of export sales to total sales. The average response measures the mean estimated response of S_{FCB} over horizons 0-5 after firms' entering/exiting the export market. More details can be found in Appendix F.

The fixed cost of foreign currency borrowing f^* is mainly related to the mass of companies borrowing in foreign currency. The parameter governing the degree of cost complementarity between the export costs and foreign currency borrowing fixed cost, ζ, mainly corresponds to the mass of firms that both exporting and holding foreign currency borrowing. Table 4 shows the moments in the data and in the model. The model can generate similar statistics as the ones in the data.

The intensive and extensive margin correlations obtained from the baseline sample are informative to identify the degree of complementarity between export and foreign currency borrowing. The baseline model is flexible in evaluating the relative importance of each channel that drives the overall correlations. The degree of cost complementarity ζ is 0.65 in the benchmark calibration, which is mainly driven by the extensive margin correlation between export and financing. This degree of cost complementarity means that if a firm is engaged in both export and foreign currency borrowing, it faces 35% lower total costs. This reduction in overall cost indicates an additional selection margin for exporting firms, besides the selection based on productivity, known as selection through fixed costs.

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 borrowing. Table 6 also shows the comparison between data and model in terms of the correlation between export intensity and foreign currency borrowing. The calibration undershoots the conditional intensity of foreign currency

Table 5: Untargeted Moments

Untargeted	Data	Model
Corr(export intensity, FCB intensity)	0.12	0.22
Mean(FCB intensity)	0.005	0.003
Mean(export intensity)	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

Notes: Foreign currency borrowing (FCB) intensity, S_{FCB}, is measured as the ratio of foreign currency borrowing to total liability. Export intensity is the ratio of export sales to total sales. $\mathcal{I}_{FCB}$ take a value of 1 when firms have positive foreign currency borrowing. The average response measures the mean estimated response of $\mathcal{I}_{FCB}$ over horizons 0-5 after firms' entering/exiting the export market. More details can be found in Appendix F.

borrowing, but it captures that firms highly involved in export market are more likely to finance in foreign currency and borrow more intensively.

Table 6: Correlation at Intensive Margin

	Mean(I_{FCB})		Mean(S_{FCB})	
	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

Notes: $\mathcal{I}_{FCB}$ take a value of 1 when firms have positive foreign currency borrowing. S_{FCB} refers to the intensity of foreign currency borrowing, which is measured as the ratio of foreign currency borrowing to total liability. Export intensity is defined as the ratio of export sales to total sales. The average intensity of foreign currency borrowing, Mean(S_{FCB}), is the average conditional on I_{FCB}=1.

4.2 Mechanism: Correlations between Export and Financing

This section shows how export 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.[9] When considering the correlations between export and currency of financing, the balance-sheet effects weaken in the benchmark model.

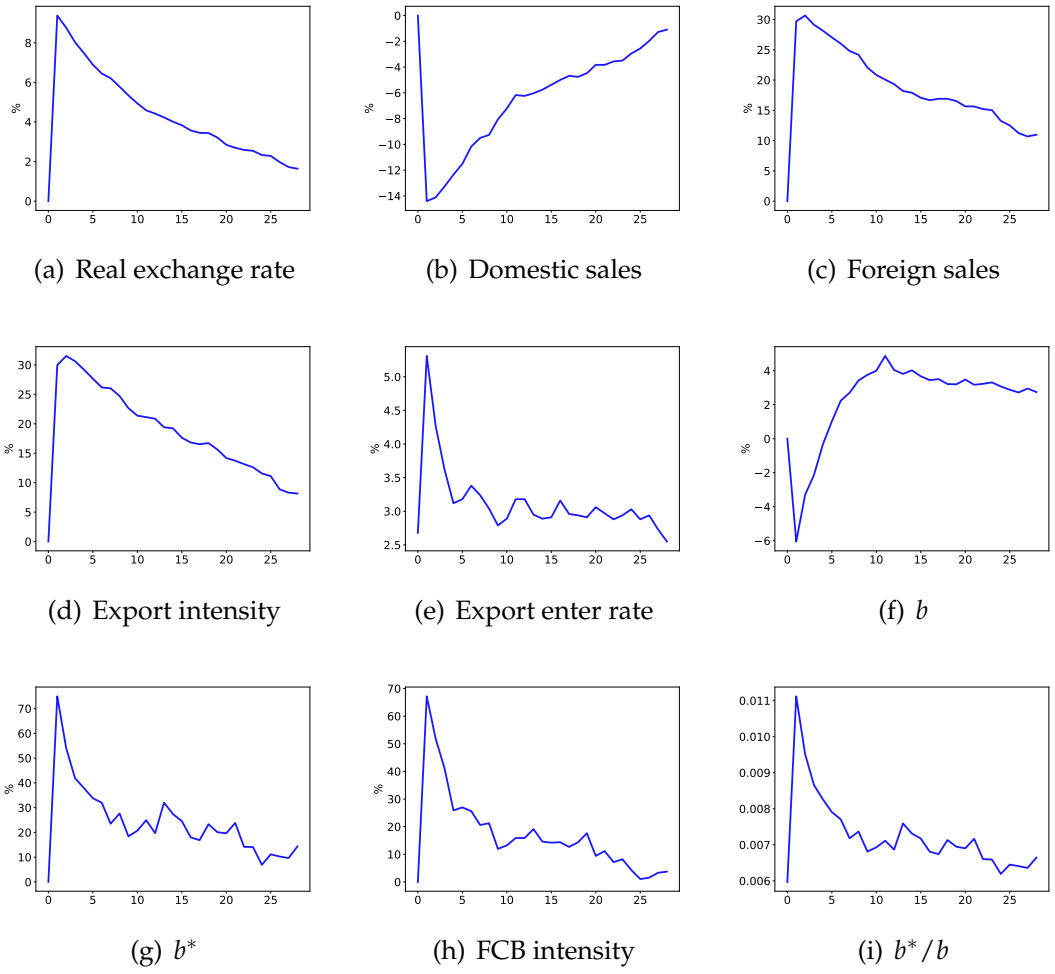
The shock to real exchange rate increases the real exchange rate by 1 standard deviation. I simulate 10,000 paths for the model for 130 periods. For the first 100 periods, the real exchange rate follows the underlying Markov chain process. There is a positive shock to the real exchange rate process, 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 4 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 correlations between export and currency of financing, the share of foreign currency borrowing 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 borrowing in response.

The impulse response functions can highlight the role of each machanism: natural hedge, collateral channel and cost complementarity channel. On one hand, the natural hedge channel refers that foreign currency denominated revenues can be directly used to repay foreign currency borrowing one to one. On the other hand, foreign currency denominated revenues can collateralize foreign currency borrowing, 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 borrowing intensity increases by 70%. The unproportional responses in export and foreign currency borrowing intensities reflect the existence of both natural hedge and collateral channel. What's more, there are more foreign currency borrowing when there are more exporters in the economy, indicating the correlation along the extensive margin (cost complementarity channel).

[9] 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 4: Comoplementarity between Export and Financing: IRFs to e

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.

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 alternative 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' export, currency of financing and overall performance, by comparing the benchmark model with two alternative models with 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 alternative models, where the capital control tax is at $\tau_c = 2\%$ and $\tau_c = 6\%$. Under stricter capital control regulations, firms deleverage their overall borrowing. This is consistent with the literature on effects of capital control policies, indicating that capital controls policies could prevent over-borrowing. 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 borrowing decreases under stricter capital controls. In a sum, higher capital control tax deleverages the whole economy, and depresses the correlation between export and financing in general.

Since the majority of foreign currency borrowing in the economy is 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.

When emerging markets strictly regulate the international financing, both home currency borrowing and foreign currency borrowing 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 borrowing. This disruption

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

Notes: The intensive margin correlation is reflected in the correlation between export intensity and foreign currency borrowing (FCB) intensity. The extensive margin correlation is measured by the fraction of firms engaged in both exporting and holding foreign currency borrowing.

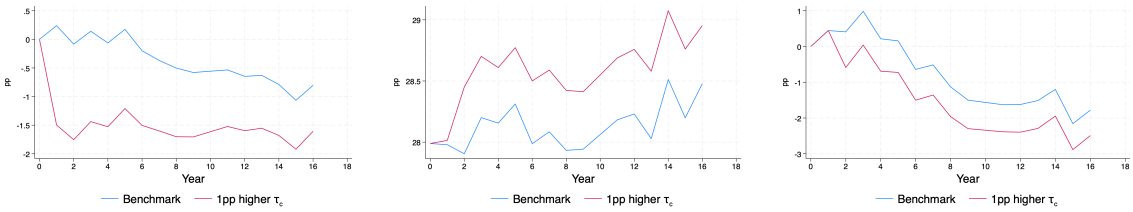
is costly to the whole economy, as exporters are more productive and profitable, compared to non-exporters.

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 an alternative 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 alternative 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 5 shows the aggregate effects of capital control tax. The red line refers to the benchmark model, while the blue line represents the alternative 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.

Next, I present how the main mechanisms, natural hedge, collateral channel and cost complementarity channel, would change the degree of correlations between export and foreign currency borrowing and the evaluation of capital control policies.



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

Figure 5: 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 alternative economy where there is a 1pp shock of capital control tax at period 0.

4.4 Role of Cost Complementarity between Export and Financing

To investigate the role of cost complementarity, I compare the benchmark model with an alternative *no-cost-complementarity model* with $\zeta = 1$. In the 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 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 borrowing. Therefore, there is no hedging for foreign currency borrowing 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.

Table 8: Role of Correlation 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 an alternative model where there is no cost complementarity. The intensive margin correlation is reflected in the correlation between export intensity and foreign currency borrowing (FCB) intensity. The extensive margin correlation is measured by the fraction of firms engaged in both exporting and holding foreign currency borrowing. 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.

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 alternative model with *asset-based collateral constraints* has the same parameter values as the benchmark model. By comparing the benchmark model with the alternative 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 Correlation 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 an alternative model where I replace the cash flow-based collateral constraints with asset-based collateral constraints. The intensive margin correlation is reflected in the correlation between export intensity and foreign currency borrowing (FCB) intensity. The extensive margin correlation is measured by the fraction of firms engaged in both exporting and holding foreign currency borrowing. 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 alternative

model with asset-based collateral constraints. Without the collateral channel that foreign currency revenues can better pledge the foreign currency borrowing, the correlations 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 borrowing is lower in the alternative model with asset-based collateral constraints. As a result, there are less firms borrowing in foreign currency, and conditional intensity of foreign currency borrowing 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 an alternative model where exporters price their exports in producers' currency (PCP). Since it's hard to solely shut down natural hedge, this alternative model with PCP closes both the natural hedge and the collateral channels. In the alternative 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 entrepreneur's problem in this alternative model with PCP can be written as

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

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

Table 10: Role of Correlation 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 an alternative model where firms price their products in foreign market with home final good. The intensive margin correlation is reflected in the correlation between export intensity and foreign currency borrowing (FCB) intensity. The extensive margin correlation is measured by the fraction of firms engaged in both exporting and holding foreign currency borrowing. 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 alternative model incorporating producer currency pricing (PCP). In the alternative 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 borrowing is lower. The prevalence of firms borrowing in foreign currency is also diminished, and conditional intensity of foreign currency borrowing 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 borrowing within the alternative 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 interaction between firms' export and currency of financing, empirically, theoretically and quantitatively. Firms' choice of currency of financing is correlated to their export activities, not only along the intensive margin as discussed in the literature, but also along the extensive margin. Taking into account the observed correlations between export and financing, I develop a heterogenous model that includes endogenous decisions on export, currency of financing and borrowing intensity. This theoretical framework micro-founds the observed correlations, and sheds light on the role of the observed correlations in assessing the impact of capital control policies in emerging markets.

A key contribution of this paper is the introduction of the correlations between export decisions and currency choice of financing, considering both extensive and intensive margins. The calibrated model indicates that exporting firms face 35% lower total fixed costs, providing insights into why firms in emerging markets opt for foreign currency borrowing based on the real activities of firms.

Without accounting for the observed correlations, the costs of capital control policies in emerging markets would be underestimated. Capital control taxes disrupt

productive exporters' access to low-cost foreign currency financing, leading to greater misallocation and output losses in the economy. This indicates that to accurately quantify the impacts of capital control policies, it is essential to consider the currency composition of borrowing. The interaction between exports and currency choice of financing plays a crucial role in evaluating the effectiveness of capital control policies in emerging markets.

This project provides a comprehensive toolkit for identifying the correlations between export activities and currency choice of financing, as well as for evaluating the impact of capital control policies in emerging markets from empirical, theoretical, and quantitative perspectives. The framework developed in this paper not only offers deep insights into the interaction between trade and financial decisions, but also allows for precise quantification of policy effects. Moreover, this framework can be extended to study a range of other monetary and trade policies in emerging markets, such as the implications of exchange rate management, trade liberalization, and other regulatory measures. The flexibility of this framework contributes to understanding how the interaction between trade and financial frictions shapes economic dynamics in emerging markets.

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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 firm has an observation on 0331 (March vintage available) of that year, drop other repeated observations in that year;
- If a firm 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 firm j's total outside liabilities to total assets. In CMIE's ProwessIQ, total outside liabilities include the overall borrowing of a firm and the amount of current liabilities as on the date of the balance sheet. It measures the amount that the firm 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 firm'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 Borrowing in CMIE's ProwessIQ

A.3.1 Definition

In CMIE'S ProwessIQ, foreign currency borrowing of an Indian firm is 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 firm 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.[10]

There is rich information on foreign currency borrowing 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

[10]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.

Act, 1956, which is in accordance with the IFRS requirements. Accordingly, a firm's foreign currency borrowing are also required to be segregated into non-current and current categories. Foreign currency borrowing capture the sum of both, long term as well as short term components. Although data pertaining to long term and short term classification of a firm's foreign currency borrowing 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

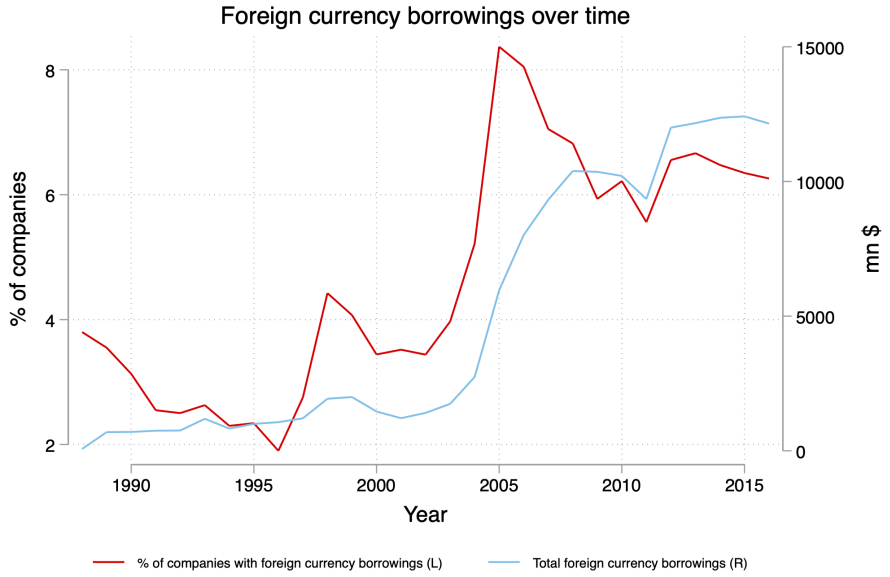


Figure 6: Foreign Currency Borrowing Over Time

For the baseline sample from 2000-2016, there is a growing trend in holding foreign currency borrowing, as shown in Figure 6. The red line (L) refers to the share of companies that hold foreign currency borrowing in each year. On average, there is about 5-6% of companies in the baseline sample holding positive foreign currency borrowing. The blue line (R) shows the overall magnitude of foreign currency borrowing in the sample. Though there is no exact counterpart aggregate statistic for foreign currency borrowing of non-financial corporations, the magnitude of foreign currency borrowing 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.[11]

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

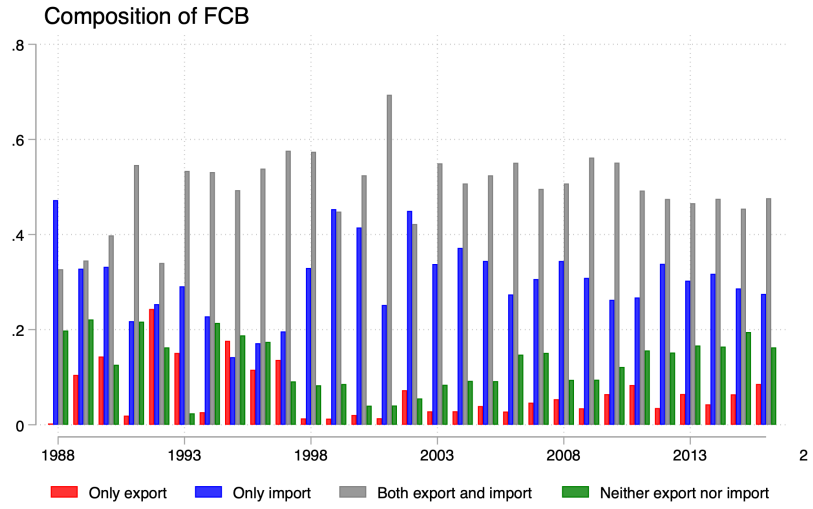


Figure 7: Foreign Currency Borrowing by Export Groups

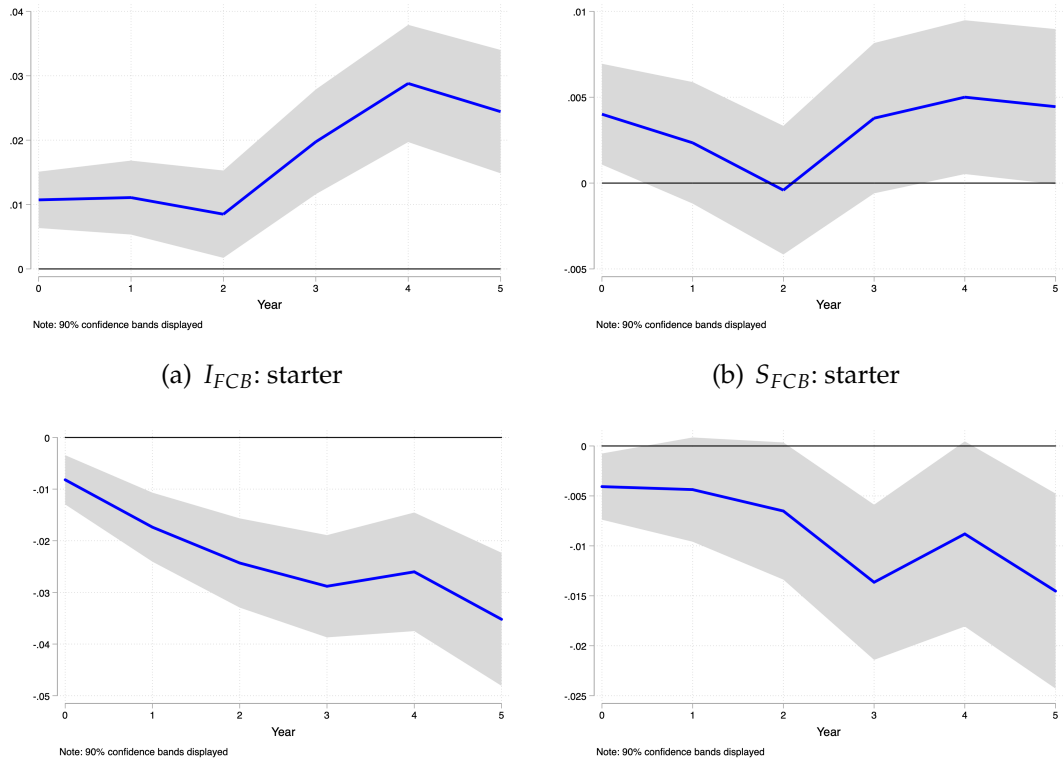
B Robustness

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.

As shown in Figure 8, 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 borrowing increases by 0.2-1.4pp, conditional on ever issuing foreign currency borrowing. After firms' exiting the export market, likelihood of

[11]The foreign currency borrowing 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 borrowing in CMIE's ProwessIQ.



(a) I_{FCB}: starter

(b) S_{FCB}: starter

(c) I_{FCB}: stopper

(d) S_{FCB}: stopper

Figure 8: Responses of Foreign Currency Borrowing: 1988-2016

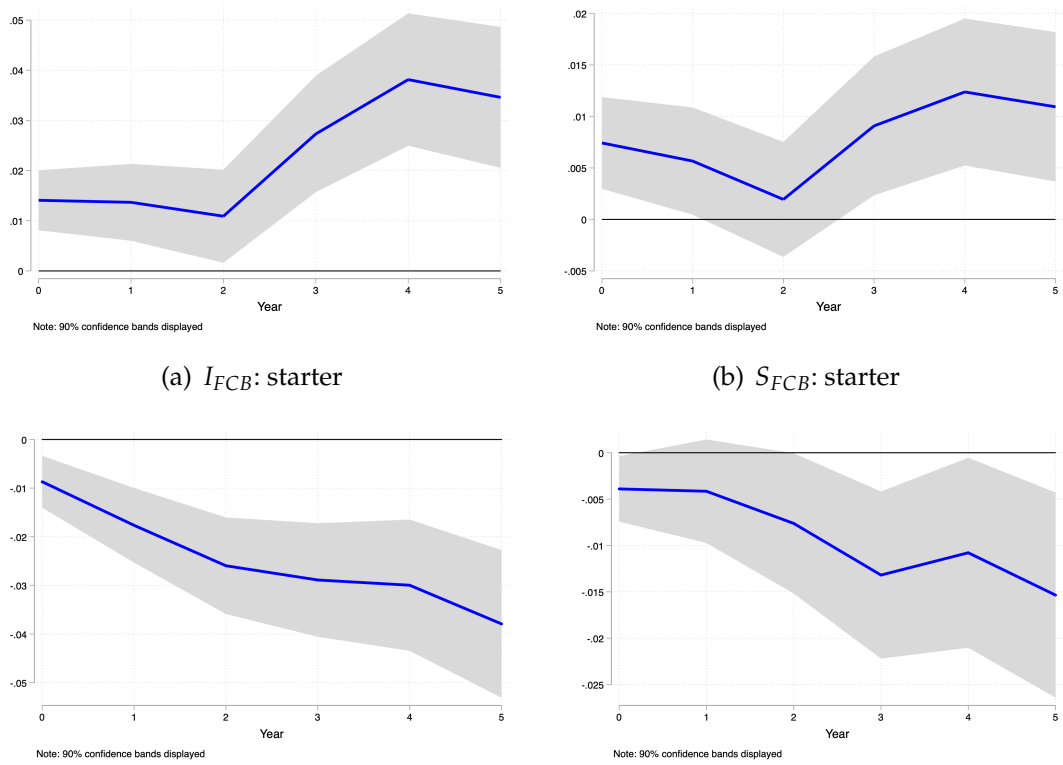
Notes: $\mathcal{I}_{FCB}$ take a value of 1 when firms have positive foreign currency borrowing. S_{FCB} represents the intensity of firms' foreign currency borrowing. Panel (a) shows the responses of extensive margin of foreign currency borrowing to firms' first entering the export market. Panel (b) plots the response of foreign currency borrowing 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 borrowing to firms' exiting the export market. Panel (d) plots the response of foreign currency borrowing intensity to firms' exiting the export market, conditional on firms ever financing in foreign currency.

financing in foreign currency falls by 0.94-3.4pp, as shown in Panel (c). Intensity of foreign currency borrowing 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 export status and financing decisions. This section shows the results if I just apply a conventional local projection method without a clean control condition.

Table 9 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 borrowing 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 borrowing falls by 0.4-1.4pp, conditional on firms' ever borrowing in foreign currency.



(a) I_{FCB}: starter

(b) S_{FCB}: starter

(c) I_{FCB}: stopper

(d) S_{FCB}: stopper

Figure 9: Responses of Foreign Currency Borrowing: Local Projection

Notes: $\mathcal{I}_{FCB}$ take a value of 1 when firms have positive foreign currency borrowing. S_{FCB} represents the intensity of firms' foreign currency borrowing. Panel (a) shows the responses of extensive margin of foreign currency borrowing to firms' first entering the export market. Panel (b) plots the response of foreign currency borrowing 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 borrowing to firms' exiting the export market. Panel (d) plots the response of foreign currency borrowing intensity to firms' exiting the export market, conditional on firms ever financing in foreign currency.

B.3 Responses to Changes in Import Status

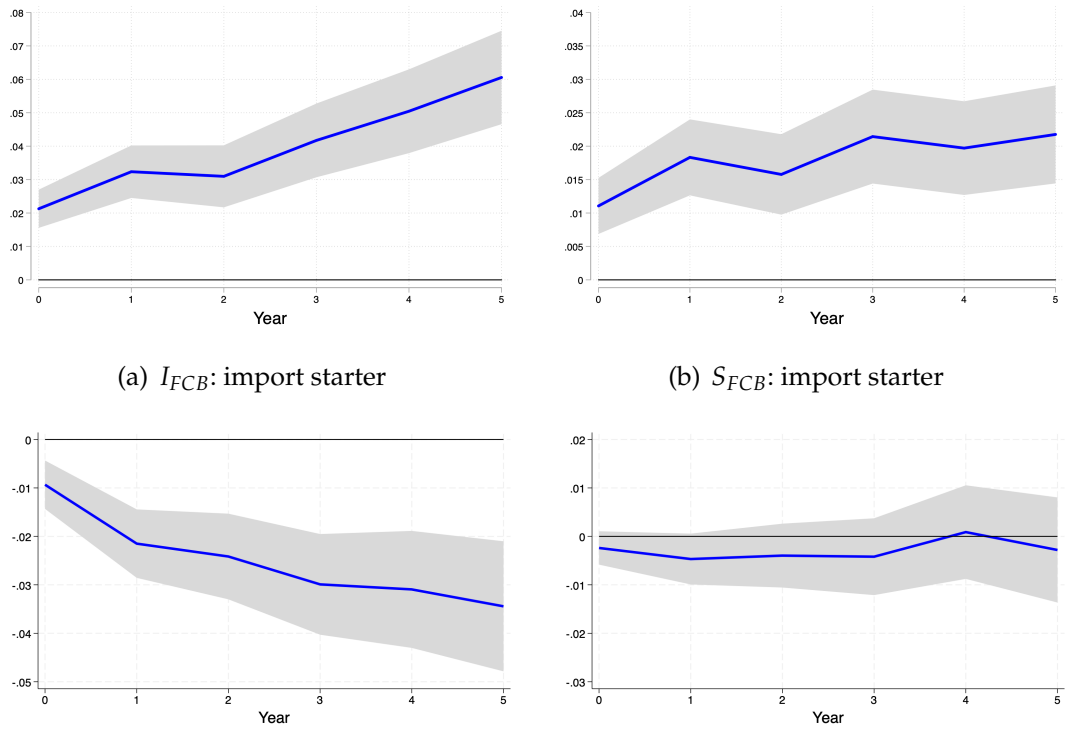
The effects of firms' entering and exiting import market can be similarly estimated, by replacing $\Delta D_{jt} = 1$ with counterparts for import market. Figure 10 plots the corresponding cumulative responses of foreign currency borrowing for import market. After firms' first entering the import market, firms are 2.1-6.0pp more likely to hold foreign currency borrowing, as shown in Panel (a) of Figure 10. Panel (b) shows that the intensity of foreign currency borrowing increases by 1.1-2.2pp. Similarly, after firms' exiting the import market, likelihood of holding foreign currency borrowing falls by 0.9-3.4pp, as shown in Panel (c). There is no significant response of foreign currency borrowing intensity to firms' exiting the import market.

B.4 Drop Only-importers

Section B.3 shows that foreign currency borrowing 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 borrowing 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 11, after newly entering the export market, likelihood of financing in foreign currency increases by 0.2-3.7pp, and intensity of foreign currency borrowing increases by 0.2-1.9pp, conditional on firms' ever issuing foreign currency borrowing. After exiting the export market, firms are 0.9-4.7pp more likely to finance in foreign currency, and intensity of foreign currency borrowing 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 12. Panel (a) presets that likelihood of financing in foreign currency increases by 2.5-7.2pp, after entering the



(a) I_{FCB}: import starter

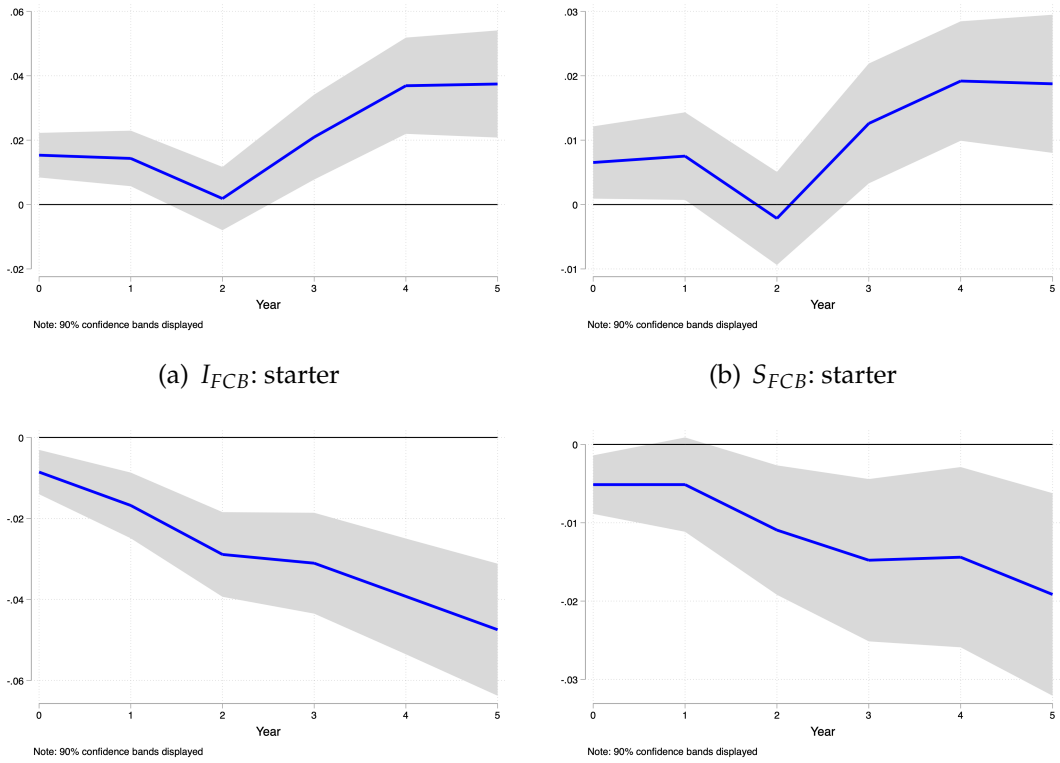
(b) S_{FCB}: import starter

(c) I_{FCB}: import stopper

(d) S_{FCB}: import stopper

Figure 10: Response to Entering/Exiting Import Market

Notes: $\mathcal{I}_{FCB}$ take a value of 1 when firms have positive foreign currency borrowing. S_{FCB} represents the intensity of firms' foreign currency borrowing. Panel (a) shows the responses of extensive margin of foreign currency borrowing to firms' first entering the export market. Panel (b) plots the response of foreign currency borrowing 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 borrowing to firms' exiting the export market. Panel (d) plots the response of foreign currency borrowing intensity to firms' exiting the export market, conditional on firms ever financing in foreign currency.



(a) I_{FCB}: starter

(b) S_{FCB}: starter

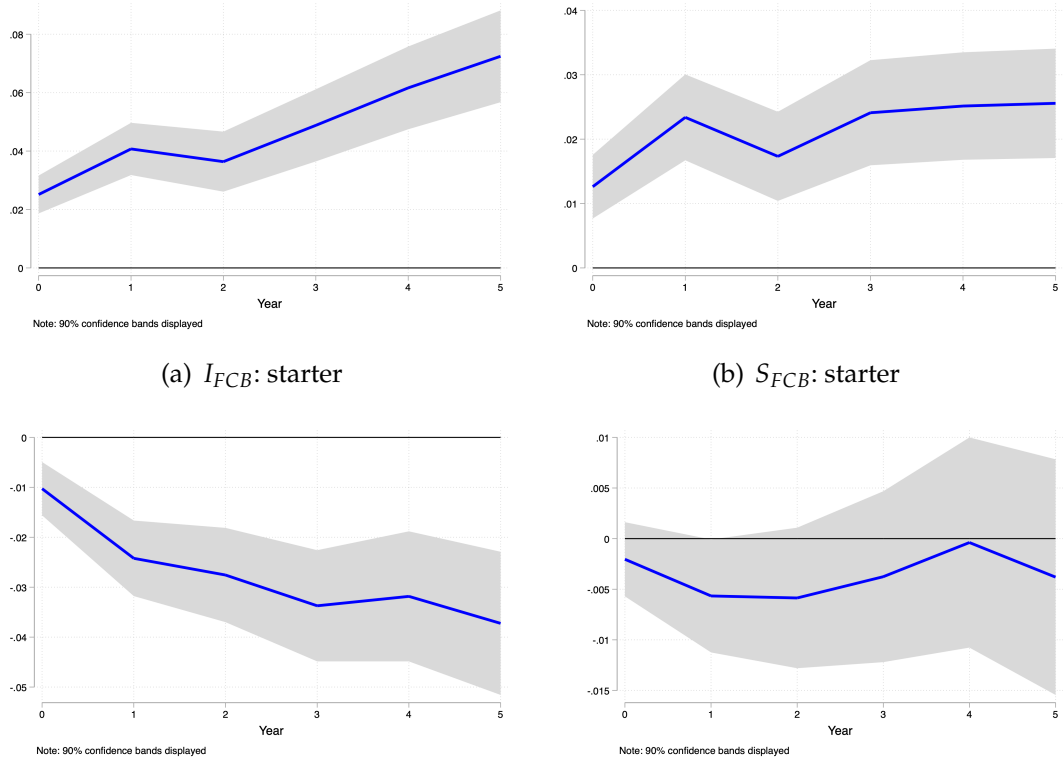
(c) I_{FCB}: stopper

(d) S_{FCB}: stopper

Figure 11: Response of Foreign Currency Borrowing: Drop Only-importers

Notes: $\mathcal{I}_{FCB}$ take a value of 1 when firms have positive foreign currency borrowing. S_{FCB} represents the intensity of firms' foreign currency borrowing. Panel (a) shows the responses of extensive margin of foreign currency borrowing to firms' first entering the export market. Panel (b) plots the response of foreign currency borrowing 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 borrowing to firms' exiting the export market. Panel (d) plots the response of foreign currency borrowing intensity to firms' exiting the export market, conditional on firms ever financing in foreign currency.

import market. Intensity of foreign currency borrowing 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 12. The intensity of foreign currency borrowing is not responsive to changes in import status.



(a) I_{FCB}: starter

(b) S_{FCB}: starter

(c) I_{FCB}: stopper

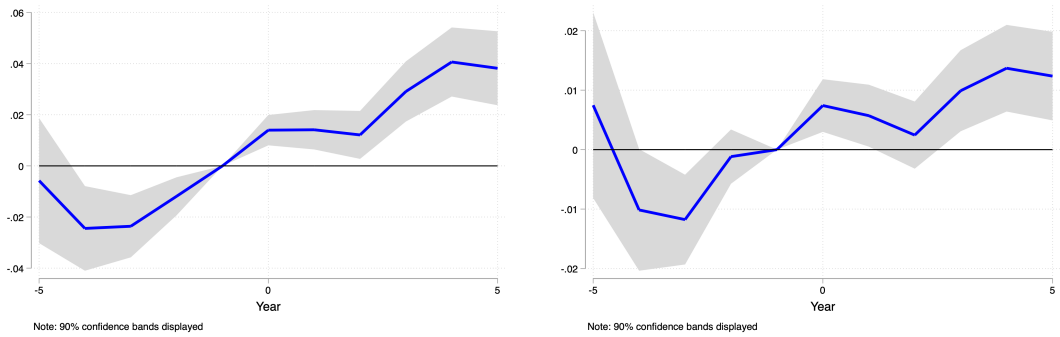
(d) S_{FCB}: stopper

Figure 12: Response of Foreign Currency Borrowing: Drop Only-exporters

Notes: $\mathcal{I}_{FCB}$ take a value of 1 when firms have positive foreign currency borrowing. S_{FCB} represents the intensity of firms' foreign currency borrowing. Panel (a) shows the responses of extensive margin of foreign currency borrowing to firms' first entering the export market. Panel (b) plots the response of foreign currency borrowing 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 borrowing to firms' exiting the export market. Panel (d) plots the response of foreign currency borrowing 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 13 shows that pre-treatment effects on the extensive margin of foreign currency borrowing are not exactly zero, while there is no pre-trend along the intensive margin of foreign currency borrowing.



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

Figure 13: Response of Foreign Currency Borrowing: Pre-trend

Notes: $\mathcal{I}_{FCB}$ take a value of 1 when firms have positive foreign currency borrowing. S_{FCB} represents the intensity of firms' foreign currency borrowing. Panel (a) shows the responses of extensive margin of foreign currency borrowing to firms' first entering the export market. Panel (b) plots the response of foreign currency borrowing 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 export and currency of financing from the other direction. For the baseline specification, I replace the key variation with firms' first financing in foreign currency

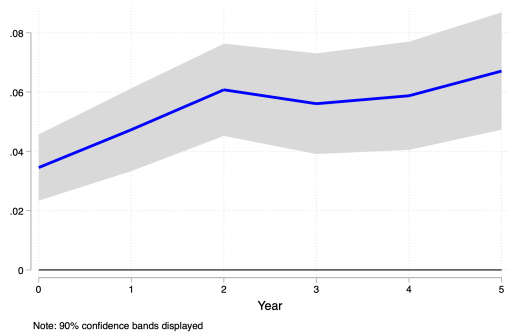
$$y_{j,t+h} - y_{j,t-1} = \alpha^h \Delta D_{jt} + Z'_{j,t-1}\beta + \eta_t^h + e_{jt}^h,$$

restricting sample to observations that are either

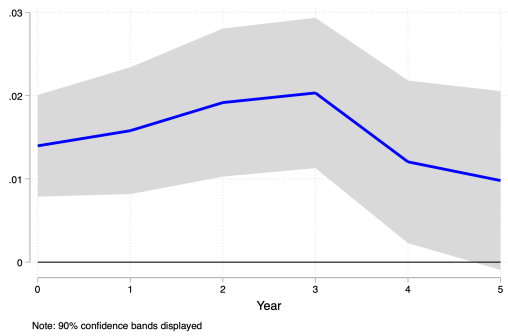
$$\begin{cases} \text{firms that newly borrow in foreign currency} & \Delta D_{jt} = 1, \\ \text{or never borrow in foreign currency before (clean control)} & D_{j,t+h} = 0. \end{cases}$$

where $y_{j,t}$ could be either an indicator that takes value 1 if firm j exports I_{FCB}, or the export intensity S_{FCB}. $\Delta D_{jt} = 1$ indicates that firm j starts financing in foreign currency at time t. I focus on the effects at horizon $h = 0, 1, 2, 3, 4, 5$ after firm j first financing in foreign currency. Controls remain the same as the baseline estimation. e_{jt}^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 j starts financing in foreign currency.

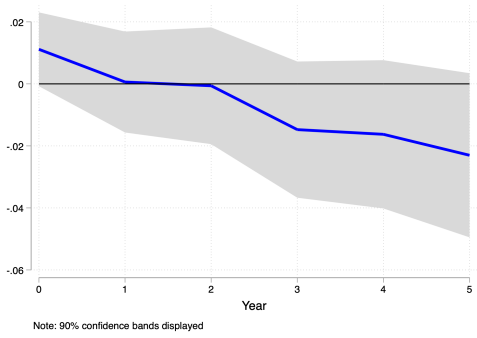
As shown in Figure 14, after firms start holding foreign currency borrowing, likelihood of exporting increases by 3.5-6.7pp, and export intensity increases by 1.2-2.0pp, conditional on firms' ever exporting. Panel (c) and (d) indicate that there is no significant response in export activities after firms' completely deleveraging their holding of foreign currency borrowing.



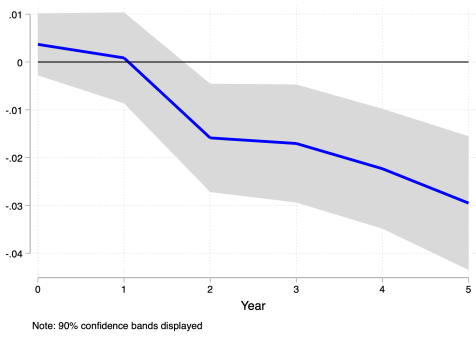
(a) I_{exp}: FCB starter



(b) S_{exp} : FCB starter



(c) I_{exp}: FCB stopper



(d) S_{exp} FCB stopper

Figure 14: Response of Exports to First Financing in Foreign Currency

Notes: $\mathcal{I}_{exp}$ take a value of 1 when firms have positive export sales. S_{exp} represents the export intensity. 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 borrowing. Panel (d) plots the response of export intensity to firms' complete deleveraging their foreign currency borrowing, 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 15 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.

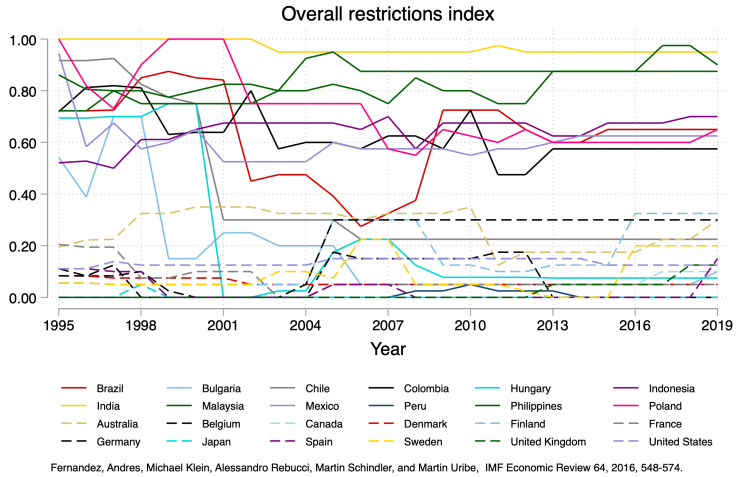


Figure 15: Capital Control Index Across Countries

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 16 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.

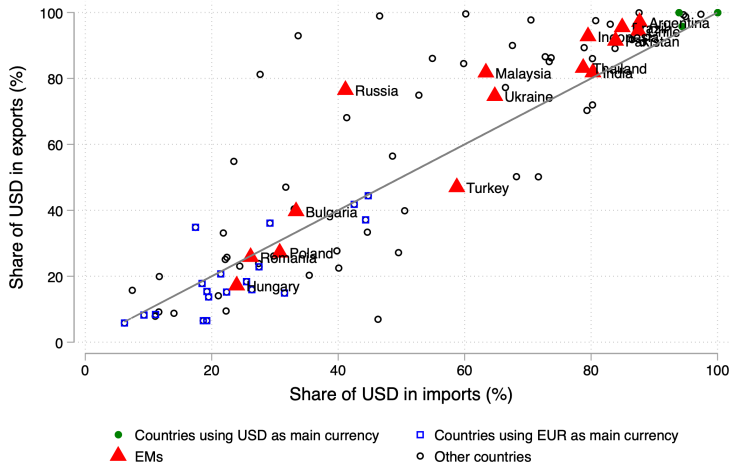


Figure 16: Cross-country Currency of Trade Invoicing

D Entrepreneur's 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.

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

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

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

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

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

$$\tau = e^2 \left(\frac{y^*/y}{Y^*/Y} \right)^{-\frac{1}{\sigma}} \tag{9}$$

$$c^{-\gamma} = \beta E \left[(1-\delta) \left(c'\right)^{-\gamma} + \alpha A z' \left(k'\right)^{\alpha-1} \frac{1-\frac{1}{\sigma}}{e'} \left(\frac{y'}{Y'} \right)^{-\frac{1}{\sigma}} \left[\left(c'\right)^{-\gamma} + \lambda_3' \theta + \lambda_4' \theta^* \right] \right], \tag{10}$$

$$c^{-\gamma} = \beta(1+r)(1+\tau_c) E \left(c'\right)^{-\gamma} + (1+r)(1+\tau_c)\lambda_3, \tag{11}$$

$$c^{-\gamma} = \beta(1+r^*)(1+\tau_c) E \left(\frac{e'}{e} \left(c'\right)^{-\gamma} \right) + (1+r^*)(1+\tau_c)\lambda_4, \tag{12}$$

$$c + k' - \frac{b'}{(1+r)(1+\tau_c)} - e\frac{b^{*\prime}}{(1+r^*)(1+\tau_c)} = \frac{y^{1-\frac{1}{\sigma}}}{e(Y)^{-\frac{1}{\sigma}}} + e\frac{(y^*)^{1-\frac{1}{\sigma}}}{(Y^*)^{-\frac{1}{\sigma}}} + (1-\delta)k - b - eb^* - F \tag{13}$$

$$y + \tau x y^* = A z k^{\alpha}, \tag{14}$$

$$b' \leq \theta \left(\frac{y^{1-\frac{1}{\sigma}}}{e(Y)^{-\frac{1}{\sigma}}} + e\frac{(y^*)^{1-\frac{1}{\sigma}}}{(Y^*)^{-\frac{1}{\sigma}}} \right), \tag{15}$$

$$eb^{*\prime} \leq \theta^* \left(\frac{y^{1-\frac{1}{\sigma}}}{e(Y)^{-\frac{1}{\sigma}}} + e\frac{(y^*)^{1-\frac{1}{\sigma}}}{(Y^*)^{-\frac{1}{\sigma}}} \right). \tag{16}$$

where unknowns are $y, y^*, c, k', b, b^{*\prime}, \lambda_3, \lambda_4$. From Eq. (11) and (12), 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

1. ***Standard deviation of log sales***

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

2. ***Total leverage***

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

3. ***Share of firms holding foreign currency borrowing***

The mean share of firms that have foreign currency borrowing is 0.06.

4. ***Intensity of foreign currency borrowing, conditional on firms with foreign currency borrowing***

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

5. ***Share of exporting firms***

Firms that export constitute 0.32 of the total sample.

6. ***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.

7. ***Exporter enter rate***

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

8. ***Share of firms both exporting and holding foreign currency borrowing***

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

F.2 Untargeted Moments

1. ***Corr(export intensity, foreign currency borrowing intensity)***

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

2. ***Unconditional average intensity of foreign currency borrowing***

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

3. ***Unconditional average export intensity***

The mean export intensity for the whole sample is 0.07.