Foreign Currency Borrowing and Exporter Dynamics in Emerging Markets*

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October 2024
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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 aggregate 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. Without accounting for these correlations, aggregate output losses due to foreign currency borrowing during depreciation are underestimated by 32%.

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

JEL classification: F4, F34, F38

*First draft: March 2023. I am immensely grateful to Yan Bai, George Alessandria, Narayana Kocherlakota for their invaluable and continuous guidance and support. I would like to thank Paulo Barelli, Mark Bils, Corina Boar, Gaston Chaumont, Hamid Firooz, Srihari Govindan, Rafael Guntin, Juan Carlos Hatchondo, Lisa Kahn, Marios Karabarbounis, Annie Lee, Yang Lu, Yueran Ma, Marcos Mac Mullen, Gabriel Mihalache, Matias Moretti, Ronni Pavan, Diego Perez, Christopher Sleet, Xiaomei Sui, Haruka Takayama, Kegon Tan, Tiago Tavares, Soo Kyung Woo, Nese Yildiz, and participants at several seminars and conferences for helpful comments and feedback.

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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 addresses a longstanding question with no clear consensus: if firms in emerging markets recognize the risks, why do they continue to borrow in foreign currencies?

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 aggregate 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. This correlation with firms' export status changes has not received much attention in previous literature. Second, this paper develops a heterogeneous firm model that incorporates endogenous decisions on both exporting and currency of financing, providing micro-foundations for these observed correlations. Finally, the calibrated model clarifies the contribution of each underlying force to the correlations between export activities and foreign currency borrowing, allowing for a quantification of how these correlations influence the aggregate implications of foreign currency borrowing.

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 trade have a higher intensity of foreign currency borrowing.

To study the underlying driving forces of the observed correlations and quantify the associated aggregate implications, I develop a heterogeneous firm model following Kohn et al. (2020). In this model, a continuum of entrepreneurs own firms that simultaneously make decisions on pricing strategies in both domestic and foreign markets (if they export) as well as on borrowing arrangements, including currency choice 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 use 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 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.

To highlight the contributions of extensive and intensive margin correlations, comparisons are drawn between the benchmark model and two alternative models. First, in an alternative model that disables the *cost complementarity channel*, it shows that failing to accurately capture cost complementarity leads to a misrepresentation of the firm distribution across export and financing activities. Second, an alternative model is considered in which firms price their foreign-market products in home final goods, effectively disabling both the *natural hedge channel* and the *collateral channel*, thereby removing exchange rate exposure for exports. In this model, fewer firms both export and finance in foreign currency, and the correlation between export intensity and foreign currency borrowing decreases. With export revenues now invoiced in home currency, motivations such as hedging and collateral for foreign currency financing dissipate, resulting in a reduced likelihood for exporting firms to borrow in foreign currency.

Using the calibrated benchmark model as a laboratory, I study the aggregate effects of foreign currency borrowing in emerging markets, and discuss how the documented correlations between exports and foreign currency borrowing influence these impacts. The aggregate effect of foreign currency borrowing is evaluated by comparing the benchmark model with an alternative scenario where firms are prohibited from borrowing in foreign currency. Without foreign currency financing, the model underestimates output and capital losses from a depreciation shock by 22.9% and 16.7%, respectively, due to the absence of currency risk from borrowing.

To further highlight the role of correlations with exports, I also compare the aggregate effects of foreign currency borrowing in the benchmark model with those in a counterfactual context where all correlation channels are removed. With these correlations, the trade-off for foreign currency borrowing is not only driven by currency risk and lower borrowing costs, but also the correlations with exports along both extensive

and intensive margins. During a depreciation event, increased exports help mitigate the negative impacts of currency risk in foreign currency borrowing, allowing firms to borrow more in foreign currency and benefit from lower costs. These correlations with exports amplify the aggregate impact of foreign currency borrowing. Specifically, without these correlations, the output losses due to foreign currency borrowing are 32% lower in response to a one-standard-deviation real exchange rate shock.

Related Literature. This paper links firms' export with currency choice of financing, and evaluate the effects of foreign currency financing 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 interactions between trade and financial frictions reshape the evaluation of the aggregate impacts of foreign currency borrowing 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. The quantitative analysis highlights that both the intensive and extensive margin correlations matter for understanding the aggregate implications of foreign currency borrowing.

This project is closely related to Salomao and Varela (2022), which also analyzes the aggregate implications of foreign currency borrowing. Their work can endogenously generates that more productive firms borrow in foreign currency, driven by a trade-off between currency risk and growth, and quantifies the aggregate impact of foreign currency loans. The main departure is that this paper incorporates the observed correlations between exports and foreign currency borrowing across both the extensive and intensive margins. Exporting firms that borrow in foreign currency face reduced fixed costs, adding a selection effect through fixed costs, beyond productivity-based selection, due to the extensive margin correlation. In addition to the trade-off between currency risk and lower interest rate, the motivations for foreign currency borrowing also include hedging, collateral, and reduced cost benefits, driven by the documented correlations with exports. This paper further examines the aggregate impact of foreign currency borrowing and confirms that the newly observed correlations between exports and currency choice of financing are crucial for evaluating the aggregate impact of foreign currency borrowing.

Lastly, 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 aggregate effects of foreign currency borrowing in emerging markets.

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 foreign currency borrowing in emerging markets, and emphasize the critical role of the observed correlations in evaluating the aggregate implications of foreign currency borrowing. 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 allows for a comprehensive study of the relationship between export activities and currency choice of financing. 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 infor-

mation (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[1].

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[2]. Starting from 2017, the vintages include many new small and non-exporting firms into the sample, 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.[3] 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}).

The baseline empirical analysis mainly use three folds information of exports: $\mathcal{I}_{starter}$ for export starters (firms entering the export market for the first time), $\mathcal{I}_{exiter}$ for export exiters (firms that exit the export market without re-entering in future), and export intensity, defined as the ratio of export sales to total sales. Besides, firm size, leverage and fixed asset turnover ratio (FAT) are included as standard variables in the literature. Table 1 shows the summary statistics for the main variables. Conditional

[1]Few firm-level databases include both the currency composition of borrowing and export information. To the best of my knowledge, only India, Hungary, and South Korea have firm-level data on both currency composition of debt and trade.

[2]The firm-level information mainly comes from firms' annual report, prospectus or interim financials.

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

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.

Table 1: Summary Statistics

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

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.

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 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 correlations into the following two facts.

Fact 1. When firms start exporting,

(i) likelihood of financing in foreign currency increases by **1.2-3.7 percentage points**;

(ii) conditional on the firm ever borrowing in foreign currency, the intensity of foreign currency borrowing increases by **0.1-1.5 percentage points**.

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

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

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 and import intensity. The time fixed effects η_t^h account for potential time trend and aggregate dynamics, while 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 the dependent variable after firm j first enters the export market. By controlling for aggregate dynamics through time fixed effects, the cumulative responses α_h mainly reflect the comparison between new exporters and non-exporters.

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 (incumbent 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 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.

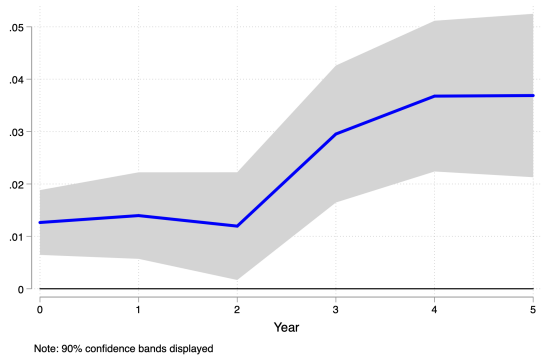
Figure 1 depicts the cumulative responses to firms' first entering the export market. The top left panel plots how probability of holding foreign currency borrowing changes h years after firm j entering the export market (extensive margin of financing in foreign currency). After firms enter the export market at time t, they are 1.2-3.7 percentage points 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 0.1-1.5 percentage points after starting to export, which is 0.8%-11.4% relative to the baseline sample's average foreign currency borrowing intensity of 13.2 percentage points.

Fact 2. When firms stop exporting,

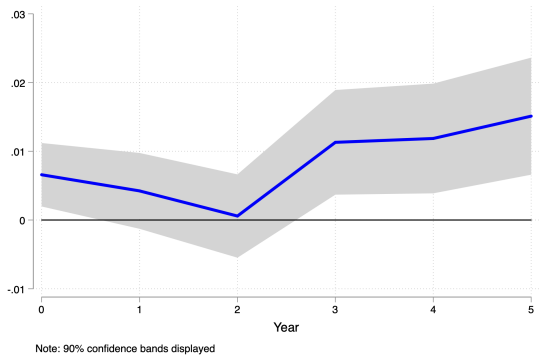
(i) likelihood of financing in foreign currency falls by **0.8-4.3 percentage points**;

(ii) intensity of foreign currency borrowing falls by **0.3-1.9 percentage points**, conditional on firm ever borrowing in foreign currency.

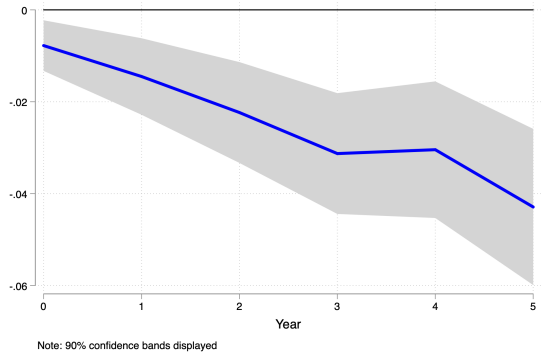
To estimate the effects of firms' exiting the export market, I replace the treatment variable $\Delta D_{jt} = 1$ with an indicator that takes the value 1 if firm j permanently exits the export market in the baseline sample. Figure 1 shows the corresponding cumulative responses to firms' exiting the export market. The bottom left panel shows that the likelihood of holding foreign currency borrowing goes down by 0.8-4.3 percentage points, 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



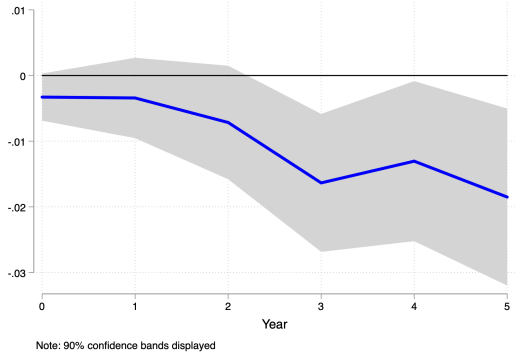
(a) I_{FCB}: starter



(b) S_{FCB}: starter



(c) I_{FCB}: exiter



(d) S_{FCB}: exiter

Figure 1: Responses in Foreign Currency Borrowing to Changes in Export Status

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. Please see Appendix B for the estimation coefficients.

borrowing, as shown in the bottom right panel of Figure 1. The foreign currency borrowing intensity falls by 0.3-1.9 percentage points after exiting the export market.

Following changes in firms' export status, their currency financing decisions respond on both the extensive and intensive margins of foreign currency borrowing. Besides changes in export status, there is also a correlation between how much firms export and their foreign currency borrowing. In the next section, I examine the relationship between export intensity and the 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. Grouping firms by export intensity, among firms that ever borrow in foreign currency, those 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 13.2%. Firms with top 5% of export intensity borrow more heavily in foreign currency, with a conditional average intensity of 19.9%. 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.

Note that the correlation between export intensity and the intensity of foreign currency borrowing is not linear, as small exporters exhibit the lowest average foreign currency borrowing intensity. As a result, the correlation between the two intensities in the baseline sample is relatively low, at 0.091[4].

[4]The simple OLS regression of foreign currency borrowing intensity on export intensity yields an estimated correlation coefficient of 0.03, after controlling for firm-level variables. This suggests that the relationship between the two intensities cannot be captured by a simple linear model.

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

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

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.

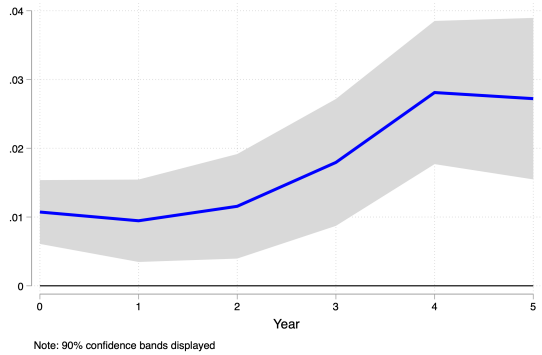
2.3 Extensions and Robustness

This section addresses concerns about specific sample features and robustness checks on the baseline empirical results. First, the baseline results are robust to export dynamics after market entry/exit. Second, the baseline results are not driven by multinational corporations. Third, there is evidence showing that the baseline results are mainly driven by firms that both export and import. Lastly, this section summarizes other robustness checks.

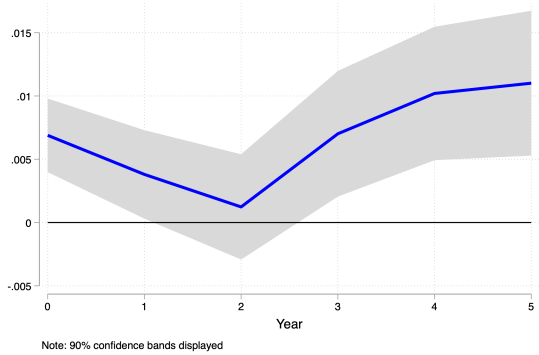
Including Re-entry Exporters. The baseline analysis focuses on "export starters"—firms entering the export market for the first time. However, there is a concern that firms exiting and subsequently re-entering the export market could bias the baseline estimates. Instead of using indicators for export starters and exiters, I use a modified ΔD_{jt}, which is set to 1 if firm j enters the export market, regardless of whether it is a first-time or re-entry. Similarly, for export exiters, this adjustment includes not only permanent exits but also any temporary exits from the export market.

Considering firms' dynamics after their first-time entering the export market, the results remain robust to the baseline. As shown in Figure 2, the likelihood of financing in foreign currency increases by 0.9-2.8 percentage points, and the intensity of foreign currency borrowing rises by 0.1-1.1 percentage points, conditional on firms ever borrowing in foreign currency. This suggests that accounting for firms re-entering the export market does not significantly bias the baseline results.

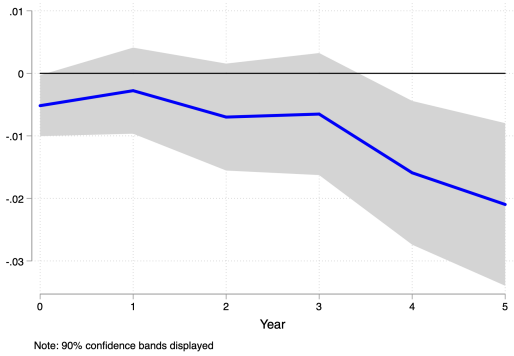
Similarly, I replace the treatment variable ΔD_{jt} with an indicator that takes value 1 if firm j exits the export market, allowing for cases where firms may later re-enter.



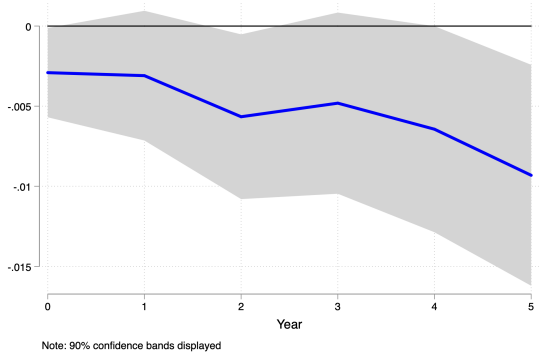
(a) I_{FCB}: starter



(b) S_{FCB}: starter



(c) I_{FCB}: exiter



(d) S_{FCB}: exiter

Figure 2: Response to Changes in Export Status: Including Re-entry 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' entering the export market. Panel (b) plots the response of foreign currency borrowing intensity to firms' 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.

Figure 2 shows that the baseline results remain consistent in this case. The likelihood of foreign currency financing falls by 0.3-2.1 percentage points after exiting the export market, while the intensity of foreign currency borrowing drops by 0.3-0.9 percentage points, conditional on firms ever borrowing in foreign currency. These results confirm that firm export dynamics after entering and exiting the export market do not bias the main conclusions of the baseline analysis.

Driven by Multinational Corporations? Multinational corporations (MNCs) are often believed in the literature as being more exposed to international trade and financing. This raises concerns about whether the baseline results might be driven mainly by MNCs in the Indian economy. This section excludes MNCs from the baseline sample and finds that the baseline extensive and intensive correlations remain robust.

The MNCs are defined as firms with a foreign equity share of 10 percent or more. In the baseline sample, foreign equity share is calculated based on the share of equity held by foreign promoters[5]. Foreign promoters include foreign individuals, corporate bodies, and promoter institutions. Excluding MNCs from the sample reduces the number of firms by approximately 670, or about 2% of the baseline sample. Most of these firms are public limited companies.

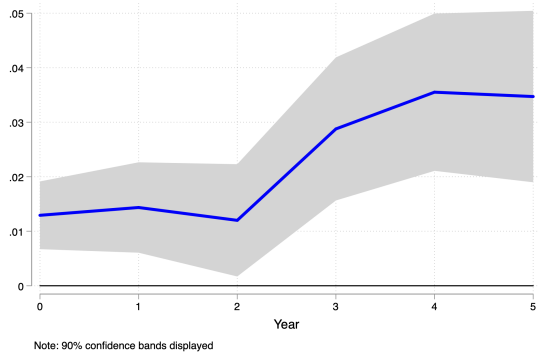
Table 3: Intensive Correlations: No MNCs

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

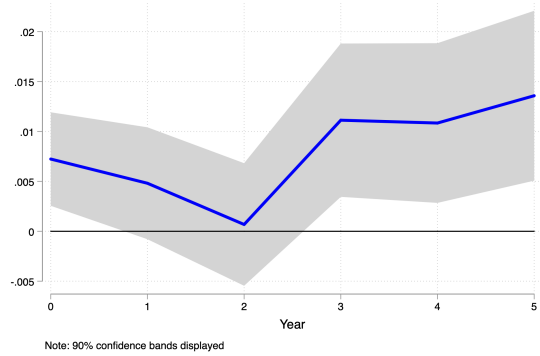
Notes: Export intensity is defined as the ratio of export sales to total sales. The average intensity of foreign currency borrowing, Mean(S_{FCB}), is the average conditional on I_{FCB}=1.

Figure 3 shows patters consistent with those in the baseline sample. The likelihood of financing in foreign currency increases by 1.2-3.6 percentage points, and the in-

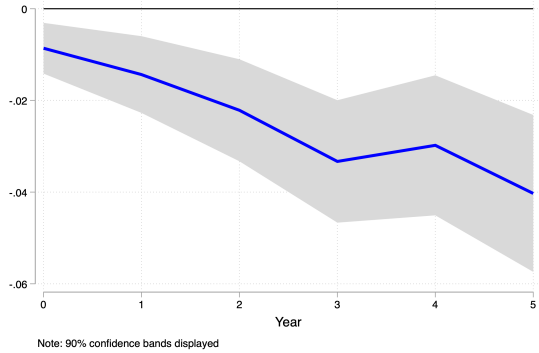
[5]The instruction of CMIE describes a promoter as "the person or persons who are in control of the company, directly or indirectly, whether as share holder, director or otherwise; or person or persons named as promoters in any document of offer of securities to the public or existing shareholders or in the shareholding pattern, disclosed by the company under the provisions of the Listing Agreement".



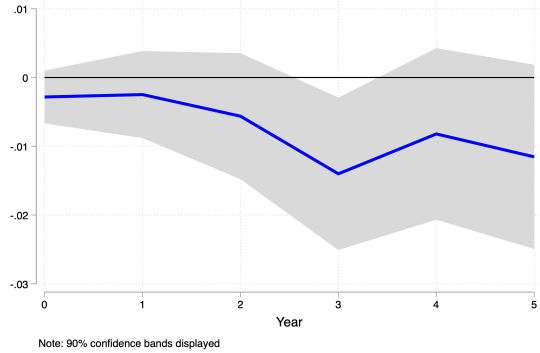
(a) I_{FCB}: starter



(b) S_{FCB}: starter



(c) I_{FCB}: exiter



(d) S_{FCB}: exiter

Figure 3: Response to Changes in Export Status: No MNCs

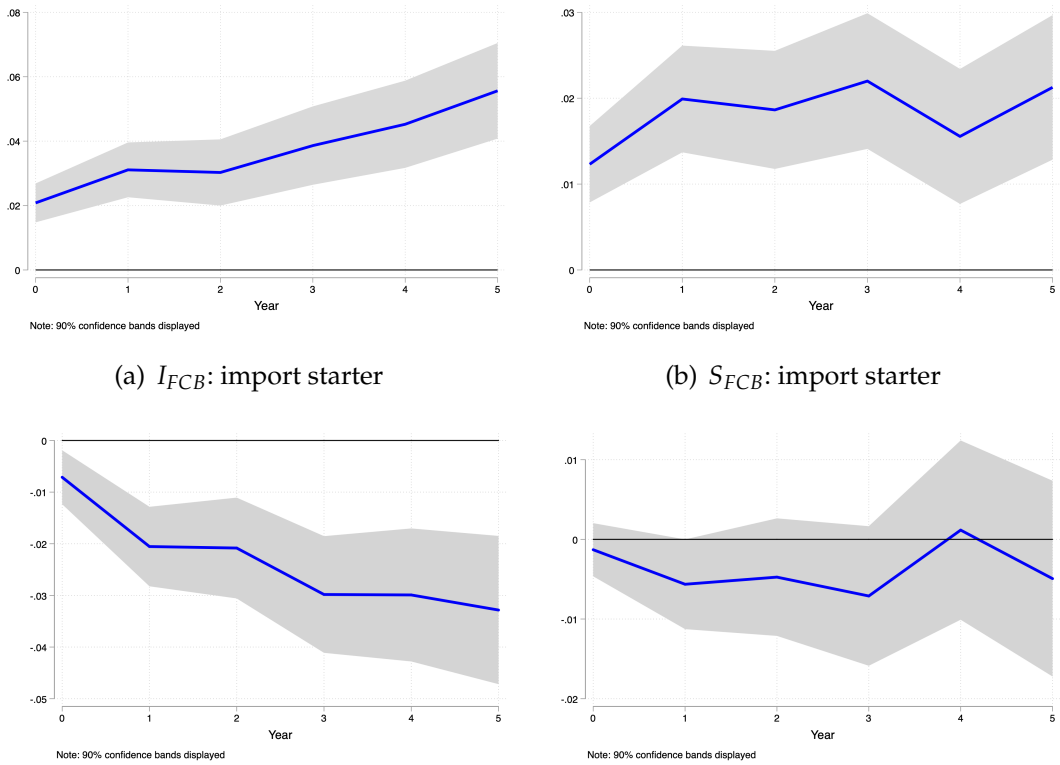
Notes: $\mathcal{I}_{FCB}$ take a value of 1 when firms have positive foreign currency borrowing. S_{FCB} represents the intensity of firms' foreign currency borrowing. Panel (a) shows the responses of extensive margin of foreign currency borrowing to firms' entering the export market. Panel (b) plots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

tensity of foreign currency borrowing rises by 0.1-1.4 percentage points, conditional on firms ever borrowing in foreign currency. When exiting the export market, the likelihood of foreign currency financing falls by 0.9-4.0 percentage points, while the intensity of foreign currency borrowing drops by 0.2-1.4 percentage points, conditional on firms ever borrowing in foreign currency. For the intensive margin correlations shown in Table 3, the top 5% of exporters have a significantly higher intensity of foreign currency borrowing. These findings confirm that MNCs are not the main drivers of the baseline results.

Responses to Changes in Import Status. If firms also import from international markets and invoice their imports in foreign currency, could this drive the dynamic correlations between exports and foreign currency borrowing, given that most exporters are also importers? In the baseline sample, 22% of firms are both exporters and importers, 10% are import-only, and 9% are export-only. This section demonstrates that the response of foreign currency borrowing is primarily driven by firms that both export and import.

First, Equation (2.2.1) is estimated for firms' responses to changes in their import status, with results shown in Figure 4. The key indicator $\Delta D_{jt} = 1$ is replaced by corresponding measures for import market entry and exit. After firms' first entering the import market, the likelihood of holding foreign currency borrowing increases by 2.1-5.6 percentage points, as shown in Panel (a). Panel (b) indicates that the intensity of foreign currency borrowing rises by 1.2-2.2 percentage points. In contrast, after firms exit the import market, the likelihood of holding foreign currency debt declines by 0.7-3.3 percentage points, as illustrated in Panel (c). However, there is no significant change in the intensity of foreign currency borrowing upon firms' exit from the import market.

As noted, foreign currency borrowing is also sensitive to changes in import status. To address concerns that the baseline results might be driven by changes in import status alone, I exclude firms that only import from the sample. The results are presented in Figure 5. When firms enter the export market, the likelihood of financing in foreign currency increases by 0.2-3.7 percentage points, and the intensity of foreign currency borrowing increases by 0.2-1.9 percentage points, conditional on firms issuing foreign currency borrowing previously. After exiting the export market, firms are 0.9-4.7 percentage points more likely to borrow in foreign currency, while the intensity of



(a) I_{FCB}: import starter

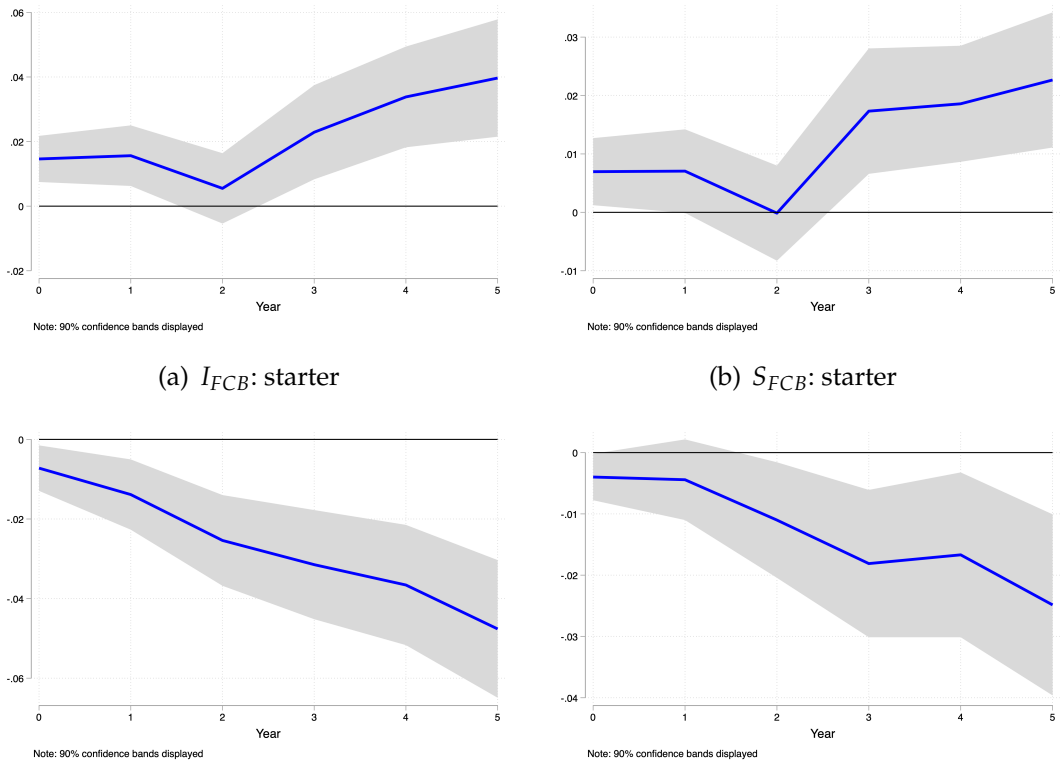
(b) S_{FCB}: import starter

(c) I_{FCB}: import exiter

(d) S_{FCB}: import exiter

Figure 4: Response to Changes in Import Status

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 import market. Panel (b) plots the response of foreign currency borrowing intensity to firms' first entering the import 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 import market. Panel (d) plots the response of foreign currency borrowing intensity to firms' exiting the import 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 5: Response to Changes in Export Status: 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.

foreign currency borrowing falls by 0.5-1.9 percentage points, conditional on ever borrowing in foreign currency. The baseline findings on firms' responses to changes in export status remain robust, indicating that these results are mainly driven by firms that both export and import, rather than by those that only import.

Similarly, I exclude firms that only export (representing 9% of the observations) and re-estimate the responses of foreign currency borrowing to changes in import status. The responses to import status changes remain consistent, as shown in Figure 6. These dynamic correlations following firms' enter and exit from the export and import markets are predominantly driven by firms that both export and import.

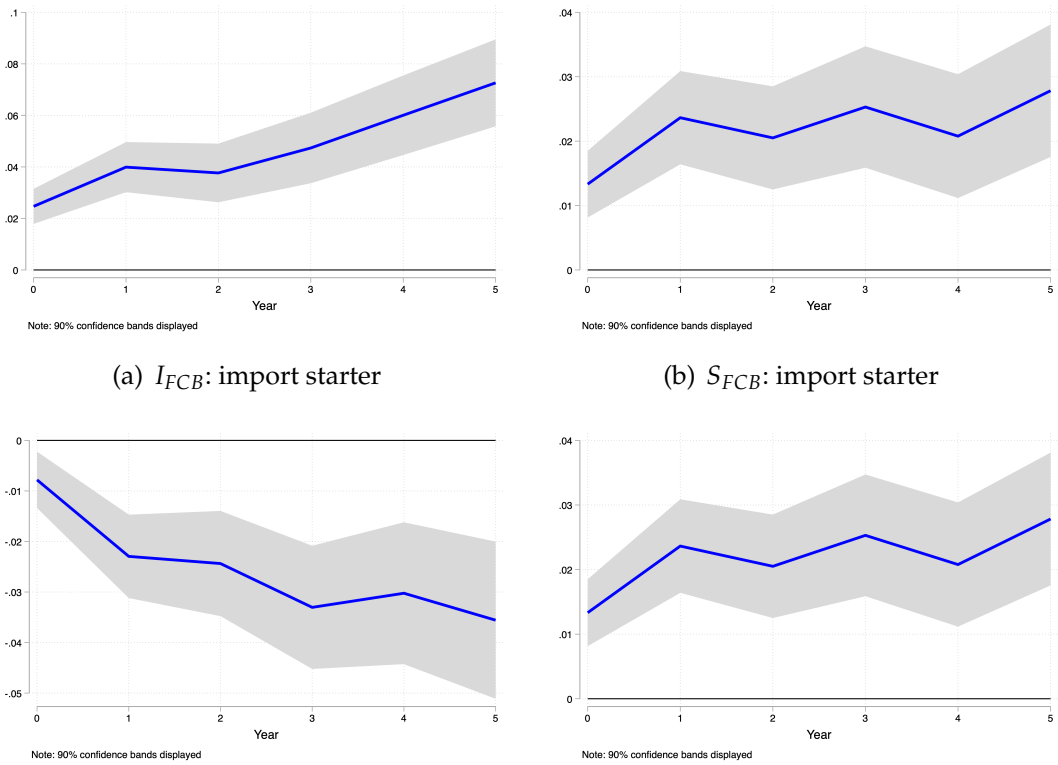
For firms that both export and import, Table 4 presents statistics on the levels of exports, imports, and foreign currency borrowing, using a subsample with available data for these variables within the baseline sample. The table shows that exports and imports are more volatile than foreign currency borrowing. Moreover, foreign currency borrowing does not simply match firms' foreign currency import needs, and exports are substantially larger than foreign currency borrowing levels. This suggests that foreign currency borrowing is not simply used for one-to-one repayment of foreign currency imports. Besides, the dynamic correlations between exports and foreign currency borrowing indicate a more complex relationship beyond merely a one-to-one hedging motive.

Table 4: Statistics of Exports, Imports, Foreign Currency Borrowing

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

Notes: Statistics are calculated based on observations with available data on exports, imports, and foreign currency borrowing within the baseline sample. The levels of exports, imports, and foreign currency borrowing are reported in millions of dollars.

In the data, firms' motivations for borrowing in foreign currency may include meeting foreign currency needs for imports or taking advantage of lower financing costs to expand in size and investment. To better illustrate the correlations between real activities and currency choice of financing, I will simplify the import side of firms' activities and model the motivation for firm borrowing mainly as capital investment. This approach is intended to simplify the theoretical analysis and sheds light on



(a) I_{FCB}: import starter

(b) S_{FCB}: import starter

(c) I_{FCB}: import stopper

(d) S_{FCB}: import stopper

Figure 6: Response to Changes in Import Status: 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 import market. Panel (b) plots the response of foreign currency borrowing intensity to firms' first entering the import 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 import market. Panel (d) plots the response of foreign currency borrowing intensity to firms' exiting the import market, conditional on firms ever financing in foreign currency.

the underlying driving forces behind the correlations between exports and foreign currency borrowing. The baseline model can be easily extended to incorporate firms' import activities. Details of this extended model are provided in Appendix H.

Other Robustness Checks The baseline correlations between exports and foreign currency borrowing are also robust to alternative samples. I construct two alternative samples: one extends the baseline sample to cover the period from 1988 to 2016, which includes the trade liberalization period of India in the 1990s[6]; the other sample focuses on manufacturing firms, which have more intensive export activities. More details on these samples are available in Appendix C.1 and C.2.

To test the robustness of the estimation methods, I estimate a conventional local projection specification following Jordà (2005), without applying the clean control condition. The baseline correlation between changes in export status and the currency of financing remains robust, as shown in Appendix C.3.

Furthermore, I reverse the estimation strategy to estimate how firms' first financing in foreign currency affects their export decisions. As shown in Appendix C.5, firms are responsive in terms of their exports once they start financing in foreign currency, while no significant response is observed after they eliminate their foreign currency borrowing. As about 60% of the foreign currency borrowing are long-term borrowing, it takes years for firms to fully deleverage.

In summary, firms' decisions on currency of financing are closely related to their export status and export intensity. One key follow-up question is what underlying forces drive foreign currency borrowing among exporting firms. In the following section, I provide a micro-foundation for the correlations between exports 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 matter for the aggregate implications of foreign currency borrowing in emerging markets.

[6]The sample coverage is relatively poor before 2000, so the baseline sample uses data from 2000-2016.

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 exports 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 are crucial to assess the aggregate impacts of foreign currency borrowing.

In the model, there is a small open economy with a unit measure of monopolistically competitive entrepreneurs. Entrepreneurs own heterogenous firms that produce differentiated goods and sell them in both domestic and 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. Regarding financial frictions, firms incur fixed costs associated with foreign currency financing and face collateral constraints when borrowing in bonds denominated either in home final goods or foreign final goods.[7].

3.1 Set-up

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.

[7]This model is expressed in real terms, and there are no currency units involved. The terms "home currency borrowing" and "foreign currency borrowing" refer to bonds denominated in home goods and foreign goods, respectively.

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

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

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 $\alpha < 1$.[8] Firm j can sell either to domestic market 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

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

where i_{jt} refers to capital investment of firm j at time t. $\Theta(k_{j,t+1}, k_{jt}) = \frac{\theta_k}{2}(\frac{k_{j,t+1}}{k_{jt}} - 1 + \delta)^2 k_{jt}$ is the convex adjustment cost for capital.

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, 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

[8] 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}.

goods.[9] 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.[10]

Firms are subject to costs of entering and maintaining their export status. When a firm j enters the export market, it must pay f_0^x, 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_1^x. The export entry cost outweighs the continuation cost, $f_0^x > f_1^x$. The part, $f_0^x - f_1^x$, 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

$$F\left(x_{j,t-1}, x_{jt}, b_{j,t+1}^* = 0\right) = \begin{cases} 0 & \text{for } x_{jt} = 0, \\ x_{j,t-1} f_1^x + \left(1 - x_{j,t-1}\right) f_0^x & \text{for } x_{jt} = 1. \end{cases} \tag{4}$$

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

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

where ζ governs the degree of cost complementarity between export fixed costs and fixed cost of financing by issuing bonds denominated in foreign final good. This cost complementarity can be rationalized by several factors. Firstly, there are common foreign exchange settlement costs for both trade invoiced in foreign currency and borrowing denominated in foreign currency. If firms are already exposed to exports

[9] Emerging markets extensively use dominant currencies, such as the U.S. dollar or the euro, for trade invoicing, which is known as dominant currency pricing (DCP). For example, approximately 90% of Indian exports are invoiced in U.S. dollars. More details can be found in Appendix D.2. Therefore, the model assumes that all foreign revenues are denominated in foreign final goods. While incorporating the choice of trade invoicing currencies into the analysis would be interesting, it would significantly complicate the model solution. This paper will reserve the analysis of trade invoicing currencies for future research.

[10] 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.

invoiced in foreign currency, they have incurred costs associated with foreign currency settlement. Once they start borrowing in foreign currency, part of these settlement costs have already been paid. Secondly, if firm j is involved in exports, it sends a positive signal to foreign investors, making it less costly for them to verify the firm's financial conditions. Additionally, specific to India, Indian private firms are required to report their foreign currency positions to authorities periodically, including their foreign currency exposure and hedging positions[11]. In the model case, this involves both real activities (exports) and foreign currency financing. Firms that engage in both exports and borrow by issuing bonds denominated in foreign currency can save on shoe leather costs.

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[12], respectively. This budget constraint is represented by

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

Firm j generates revenues from both domestic markets and foreign markets, if it exports. The currency risk arises when firm j borrows under the current period exchange rate e, while the repayment occurs in the next period, subject to the exchange rate e'. This budget constraint implies that exports provide a natural hedge: if firm j exports, it can use the foreign currency revenues to repay its foreign currency borrowing, thus mitigating the currency risk.

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

[11] According to the RBI's guidelines, firms must submit details of their foreign currency exposure and hedging positions through various returns, such as the Foreign Currency Exposure (FCE) returns and the Annual Return on Foreign Liabilities and Assets (FLA).

[12] In this small open economy model, entrepreneurs take the domestic and foreign interest rates r_t and r^*_t as given. We assume a constant interest rate differential, $r > r^*$, which aligns with the literature on interest rate differentials between borrowing in home and foreign currencies. To simplify the analysis, the interest rates are treated as exogenous because the model primarily focuses on examining how firms' foreign currency borrowing is correlated with their exports and how these correlations matter for the aggregate implications of foreign currency financing. This approach isolates the effects of these correlations without the added complexity of modeling interest rate determination. The assumption of an exogenous interest rate gap can be relaxed in future research by incorporating a reduced-form function of the real exchange rate.

schedules. The domestic demand schedule is given by

$$y_{jt} = \left(p_{jt}/P_t\right)^{-\sigma} Y_t = \left(e_t p_{jt}\right)^{-\sigma} Y_t, \tag{6}$$

and the foreign demand by the rest of the world is

$$y^*_{jt} = \left(p^*_{jt}/P^*_t\right)^{-\sigma} Y^*_t = \left(p^*_{jt}\right)^{-\sigma} Y^*_t \tag{7}$$

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

3.2 Stationary Competitive Equilibrium

First, I rewrite the entrepreneur's problem in recursive form. Assume that the aggregate productivity A_t and interest rate r^*_t, r_t are constant in a stationary equilibrium. Let $V(z,k,b,b^*,x_{-1},e)$ denote the value function for an entrepreneur with idiosyncratic productivity z, capital stock k, bonds denominated in home final goods b, bonds denominated in foreign final goods b^*, export status in time $t-1$, facing exogenous real exchange rate e. Monopolistically competitive entrepreneurs choose the consumption, pricing plans, export status, borrowing schemes, subject to their budget constraints, collateral constraints and demand schedules. We omit the time subscript t and use x_{-1} to denote a variable x in the previous period, x' to denote a variable x in the next period. The entrepreneur's problem can be given as

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

Let $\mathcal{S} := \mathcal{Z} \times \mathcal{K} \times \mathcal{B} \times \mathcal{B}^* \times \mathcal{X} \times \mathcal{E}$ denote the state space of entrepreneurs, where

$\mathcal{Z} = \mathbb{R}^+, \mathcal{K} = \mathbb{R}^+, \mathcal{B} = \mathbb{R}_0^+, \mathcal{B}^* = \mathbb{R}_0^+, \mathcal{X} = \{0,1\}$ and $\mathcal{E} = \mathbb{R}^+$ denote the set of possible values of productivity, capital stock, bonds denominated in home good, bonds denominated in foreign good, export status in the previous period and exogenous real exchange rate shock, respectively. Denote $s \in \mathcal{S}$ be an element of the state space. Assume that aggregate variables A_t, r_t, and r_t^* are constant, and then the stationary competitive equilibrium in the economy can be defined. A **recursive stationary competitive equilibrium** consists of policy functions $\{c, p, y, p^*, y^*, k', b', b^{*\prime}, x\}$, and a value function $V(s)$, such that policy and value functions solve the entrepreneurs' problem.

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 goods 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

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

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. (8).

$$\text{export intensity} = \frac{ep^* y^*}{py + ep^* y^*} = 1 - \frac{1}{1 + \tau^{1-\sigma} e^{2\sigma} Y^*/Y}. \tag{8}$$

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. Moreover, exporters can use their foreign currency revenues as more stable collateral for foreign currency borrowing, allowing them with more accessible lower-cost financing compared to nonexporters.

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 flexible 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 the aggregate impacts of foreign currency borrowing in emerging markets.

4 Quantitative Analysis

This section calibrates the benchmark model using data from India to quantify how each mechanism contributes to the observed correlations between export activities and currency choice of financing, with implications for evaluating the aggregate impact of foreign currency borrowing in emerging markets.

First, the model is parameterized to match Indian macro- and micro-economic evidence from the sample period. Second, the correlations between export and financing choices are studied by plotting the impulse responses of firm borrowing and exports to an exchange rate depreciation shock. Third, to assess the relative importance of each mechanism, the benchmark model is compared with two counterfactual models that separately shut down extensive and intensive margin correlations, isolating their roles in driving the correlations between exports and foreign currency borrowing. Finally, using the benchmark model as a laboratory, aggregate implications of foreign currency borrowing are derived by comparing it with an alternative model that prohibits firms from foreign currency borrowing. To highlight the importance of the correlations between exports and foreign currency borrowing, an alternative model that removes these correlations is used to compare aggregate impacts of foreign currency borrowing. This comparison shows how the correlations between exports and foreign currency borrowing shape the impacts of foreign currency borrowing.

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 5 lists all the parameter values.

Fixed Parameters. The fixed parameters are $\{\gamma, \alpha, \delta, \sigma, r^*, \rho_e, \sigma_e, \rho_z\}$. 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

$$\log(z_{jt}) = \rho_z \log(z_{j,t-1}) + \sigma_z \varepsilon_{jt}, \quad \varepsilon_{jt} \sim N(0,1). \tag{9}$$

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

$$\log(e_t) = \rho_e \log(e_{t-1}) + \sigma_e \varepsilon_t, \quad \varepsilon_t \sim N(0,1). \tag{10}$$

The persistence and volatility of the exchange rate shock are estimated, using real exchange rate series at annual frequency.[13]

[13]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 5: Parameters

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

Fitted Parameters. The rest of the parameters in the model include parameters for the preference β, the volatility of firm productivity shock σ_z, parameters governing the collateral requirements for bonds denominated in both home and foreign final good $\{\theta, \theta^*\}$, parameters related to the adjustment cost of capital θ_k, interest rate for bonds denominated in home final good r, 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 eleven Indian micro moments that reflect companies' joint decisions on export and currency of financing. The moments include the total leverage, the volatility of sales, average intensive responses of foreign currency borrowing to changes in export status (entering and exiting), the intensity of foreign currency borrowing conditional on firms having foreign currency borrowing and the corresponding intensity of foreign currency borrowing for exporting firms, 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 eleven sample moments by minimizing the sum of the distance between the moments in the model and their corresponding counterparts in the data.

Table 6: Targeted Moments

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

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 G.

Though the parameters are jointly pinned down, there is still implicit connection between the parameters and the targeted moments. The total leverage and the volatility of sales are mainly responsive to the discount factor β and the volatility of firm productivity shock σ_z. Note that the sales includes both home and foreign currency revenues. The parameters related to collateral constraints $\{\theta, \theta^*\}$, the parameters governing the adjustment cost of capital, and domestic interest rate r are jointly targeted at 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. The fixed cost of foreign currency borrowing f^* is mainly related to the mass of firms 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 6 shows the moments in the data and in the model. The model can generate similar statistics as the ones in the data.

Table 7: Untargeted Moments

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

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 G.

The baseline model is flexible in evaluating the relative importance of each channel driving the overall correlations. In other words, the model allows the data to determine the extent to which each channel affects the correlations on both the extensive and intensive margins. In the benchmark calibration, the degree of cost complementarity, ζ, is set to 0.65, mainly driven by the extensive margin correlations between exporting and foreign currency financing. This implies that a firm involved in both exporting and foreign currency borrowing faces a 35% lower total costs. This reduction in overall cost indicates an additional selection margin for exporting firms, beyond the selection based on productivity, known as selection through fixed costs.

Table 8: Intensive Margin Correlations

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

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

Moreover, the untargeted moments also match well in the model, as shown in Table

7. These moments are a little off in terms of the average responses of extensive margin of foreign currency borrowing. Table 8 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 borrowing, but it captures that firms highly involved in export market borrow more intensively in foreign currency.

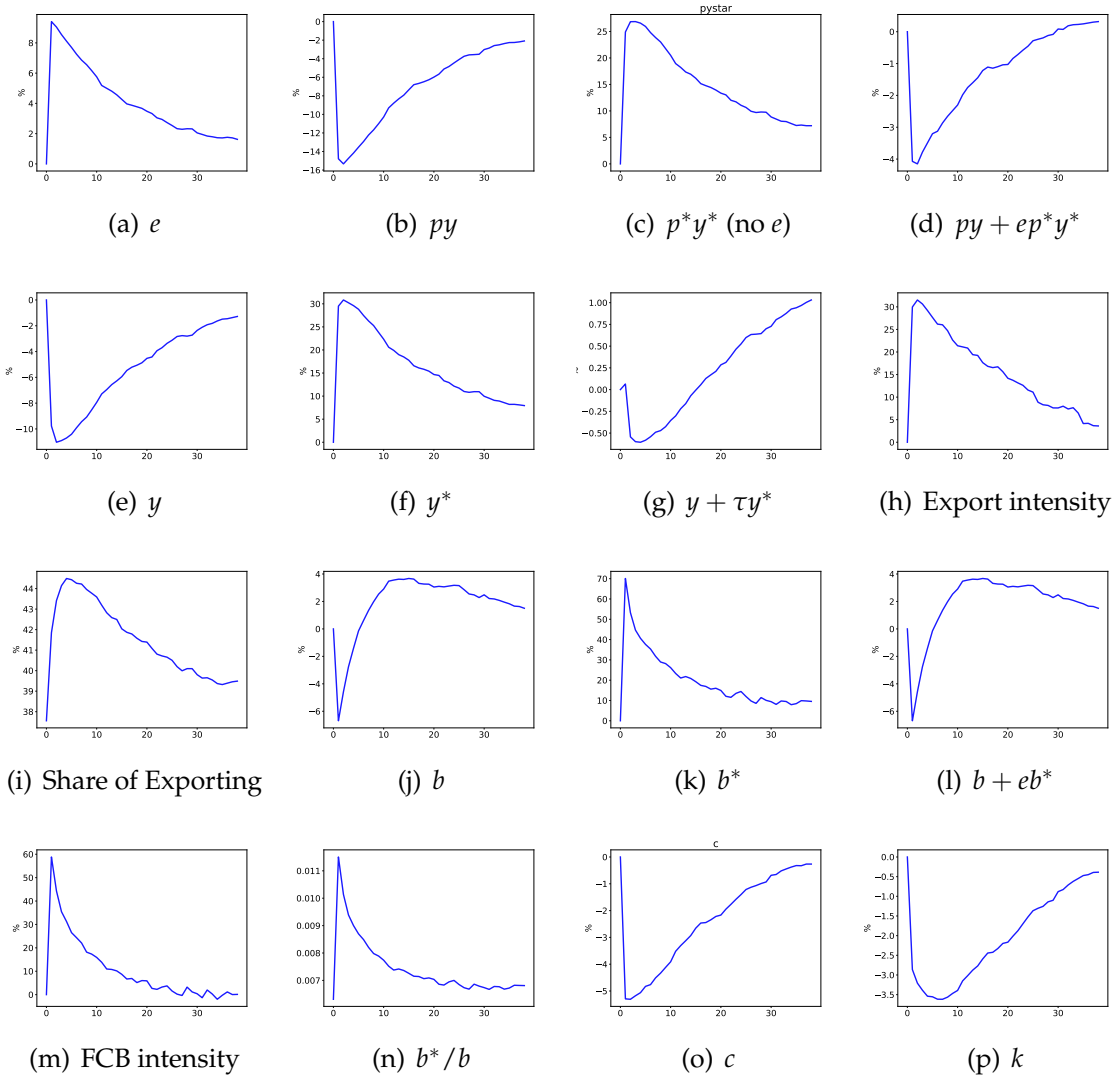
4.2 Mechanism: Correlations between Export and Financing

This section presents the interaction between export activities and currency choice of financing in the benchmark model by illustrating firms' impulse response functions (IRFs) to an exchange rate depreciation shock. A depreciation of the exchange rate negatively impacts firms' holding of foreign currency borrowing, as they need to repay more to service the outstanding borrowing, a phenomenon known as the balance-sheet effects[14]. In the benchmark model, balance-sheet effects are mitigated when considering correlations between exports and foreign currency borrowing.

The shock to the real exchange rate goes up by one standard deviation. Since the exchange rate is the same across firms, I simulate 7,000 rounds with different exchange rate series. For each simulated exchange rate series, I run 1,000 model paths over 210 periods. For the first 100 periods, the real exchange rate follows a Markov chain process. At period 101, a positive shock raises the real exchange rate e by one standard deviation. From period 101 onward, real exchange rate shocks across all paths continue to follow the underlying Markov process. The IRFs plot the average responses over the 40 periods following the exchange rate shock, first averaged across 1,000 paths per series, then across all exchange rate rounds.

Figure 7 plots firms' impulse responses to a one standard deviation increase in the real exchange rate. Panel (a) shows the exchange rate shock. When there is a depreciation shock, domestic sales decline (Panel (b)), while foreign sales, denominated in foreign goods, increase due to the export-expansion effect of depreciation (Panel (c)). Note that this increase in foreign sales is net of the exchange rate increase. Overall, total sales decrease in response to the depreciation shock (Panel (d)). This shift in sales is mainly driven by market reallocation toward foreign market, as reflected in

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



(a) e (b) py (c) p^*y^* (no e) (d) $py + ep^*y^*$

(e) y (f) y^* (g) $y + \tau y^*$ (h) Export intensity

(i) Share of Exporting (j) b (k) b^* (l) $b + eb^*$

(m) FCB intensity (n) b^*/b (o) c (p) k

Figure 7: Correlations 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.

the rising relative ratios of y^*/y (Panel (e) and (f)). The total output also decreases, as shown in Panel (g). As a result, export intensity rises by 30% in response to the real exchange rate shock (Panel (h)), where foreign sales, adjusted by the exchange rate, are included in the numerator. Besides, on the extensive margin, more firms enter the export market in response to the shock, as shown in Panel (i).

In response to a depreciation shock, it's more costly to repay existing foreign currency borrowing. Without a correlation between exports and currency choice of financing, the share of foreign currency borrowing would typically decrease due to negative balance-sheet effects. However, as both the export entry rate and export intensity increase, the economy sees a rise in foreign currency borrowing (Panel (k)). Total borrowing decreases (Panel (l)), mainly driven by a reduction in home currency borrowing (Panel (j)). Even without including the exchange rate fluctuations, the ratio of foreign currency borrowing to home currency borrowing rises (Panel (n)). With reduced production and lower borrowing, both consumption and capital investment also decline in response to the depreciation shock (Panels (o) and (k)).

The impulse response functions help clarify the model's main mechanisms. First, the natural hedge channel indicates that foreign currency revenues can be directly used to repay foreign currency debt on a one-to-one basis. Second, foreign currency revenues can serve as collateral for foreign currency borrowing, often at a ratio different from one-to-one. Following the exchange rate shock, export intensity rises by 30%, while foreign currency borrowing intensity increases by 58%. These disproportionate responses suggest the presence of both the natural hedge and collateral channels. Furthermore, as more firms enter export markets, foreign currency borrowing also increases, reflecting a correlation on the extensive margin, which is the cost complementarity channel.

To better visualize how the correlations along the extensive and intensive margins work in the benchmark model, the following section will compare the benchmark model with two alternative models. One will exclude the extensive margin correlation mechanism (the cost complementarity channel), while the other will shut down the intensive margin correlation mechanisms (the natural hedge and collateral channels).

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 highlights the role of cost complementarity.

Table 9: Role of Correlations

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

Notes: No-cost complementarity ($\zeta = 1$) refers to an alternative model where there is no cost complementarity. PCP refers to an alternative model where firms price their products in foreign market with home final good.

Column *Benchmark* in Table 9 presents the moments in the benchmark model, while Column *No-cost-complementarity* shows the key moments for the model without the cost complementarity mechanism. In the *No-cost-complementarity model*, without discounts on the fixed cost structure, no firms both export and hold foreign currency debt. Even highly productive exporters find foreign currency borrowing too costly, despite its lower borrowing rate.

Role of Natural Hedge and Collateral Constraints. This section compares the benchmark model with an alternative model in which exporters price their exports in the producer's currency (PCP), meaning prices are denominated in home final goods. It's challenging to isolate each intensive margin mechanism-natural hedge or collateral channel; however, this alternative model with PCP shuts down both the natural hedge and collateral channels. In this alternative model with PCP, export sales are also invoiced in home final goods, so there is no exchange rate exposure on the export side. Therefore, export revenues cannot serve as a hedge or collateral for bonds

denominated in foreign final goods. The entrepreneur's problem in this alternative model with PCP can be written as

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

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

Column *PCP* in Table 9 compares the benchmark model with the alternative model under PCP. In this alternative model with PCP, where there is no exchange rate exposure on the export side, more firms engage in exporting. However, fewer firms both export and finance in foreign currency. Less firms borrow in foreign currency, and conditional intensity of foreign currency borrowing decreases.

With export revenues invoiced in home final goods, exporters can't hedge their foreign currency borrowing with their foreign currency revenues, nor is there a stable value of collateral for borrowing in foreign currency. Therefore, exporting firms exhibit a lower likelihood of engaging in foreign currency borrowing in this alternative model under PCP.

4.3 Aggregate Implications of Foreign Currency Borrowing

This section quantifies the aggregate impact of foreign currency borrowing by comparing the benchmark model with a counterfactual model that restricts firms from borrowing in foreign currency. To further highlight the role of correlations between exports and foreign currency borrowing, I also derive the aggregate implications in an alternative context that removes all three correlation channels. Comparing this result with the aggregate impact observed in the benchmark model highlights the role of these correlations in evaluating the overall implications of foreign currency

borrowing.

4.3.1 Aggregate Impact of Foreign Currency Borrowing When Depreciation

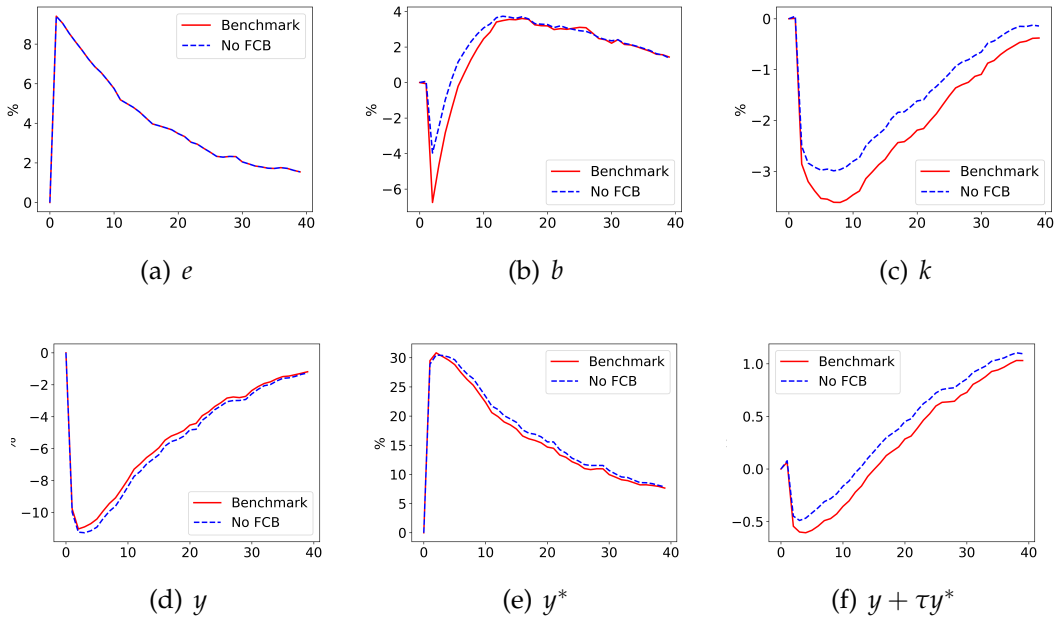
In the benchmark model, firms can choose between bonds denominated in either home or foreign final goods and decide on the amount to borrow in each financing method. To examine the aggregate impacts of foreign currency borrowing, this section compares the benchmark model with an alternative economy where firms cannot borrow in foreign currency, referred to as the *No-FCB* model. In this alternative model, firms are restricted to borrowing only in home currency. As a result, the entrepreneur's decision problem degenerates to selecting their consumption, investment, home currency borrowing, and export status, based on their expectations for future productivity and exchange rate shocks.

Intuitively, the absence of foreign currency borrowing gets rid of the currency risk in firms' financing. However, it directly raises the borrowing costs, as home currency borrowing features higher interest rates. Besides, exporting no longer provides the advantage of accessing lower-cost financing through foreign currency borrowing. Table 10 presents a comparison of total leverage between exporters and non-exporters. Without access to foreign currency borrowing, higher financing costs lead to a reduction in overall leverage, with exporters experiencing a more pronounced decrease.

Table 10: Average Leverage

	Benchmark	No-FCB
Full sample	0.35	0.32
Exporters	0.48	0.43
Nonexporters	0.29	0.27

To compare these two economies, I apply an identical shock to the real exchange rate in both models, following the same procedure as in Section 4.2. The results are displayed in Figure 8. With a one-standard-deviation increase in the real exchange rate (Panel (a)), the *No-FCB* model shows a 2-percentage-point smaller decline in home currency borrowing (Panel (b)). Market reallocation is more pronounced in the *No-FCB* model as it adjusts to mitigate the exchange rate fluctuations. Besides, the benchmark model experiences a larger output decline, leading to greater capital losses. This indicates that currency risk predominates, resulting in higher losses from



(a) e (b) b (c) k

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

Figure 8: Aggregate Impact of Foreign Currency Borrowing

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.

exchange rate depreciation than the gains from export expansion in response to the depreciation shock. Without foreign currency financing, the absence of currency risk from borrowing would underestimate the output and capital losses from the depreciation shock by 22.9% and 16.7%, respectively.[15]

4.3.2 Role of Correlations between Exports and Foreign Currency Borrowing

Besides the trade-off between currency risk and lower interest rates, foreign currency borrowing can be hedged or collateralized by firms' foreign currency revenues. Firms can also reduce fixed costs by simultaneously exporting and borrowing in foreign currency. This section studies how these correlations with exports influence the evaluation of the aggregate impact of foreign currency borrowing by comparing the benchmark model with a counterfactual model that removes all correlation channels. The difference in aggregate impacts of foreign currency borrowing highlights the role of these correlations with exports in evaluating foreign currency borrowing in emerging markets.

In this counterfactual model, firms' exports are invoiced in the producer's currency, which is the same as the Section 4.2, and remove the cost-complementarity channel by applying $\zeta = 1$. This counterfactual model is re-calibrated to match the key moments related to financing decisions, to keep the total leverage and share of foreign currency borrowings comparable with the benchmark model. The results of calibrated parameters and targeted moments as shown in Table 11.

To compensate for removing the reduced cost, now the *No-correlations* model has much lower fixed cost of foreign currency borrowing to generate similar share of foreign currency borrowing for both the full sample and the exporter groups. To keep the comparable level of total leverage, the interest rate in the *No-correlations* model is also lower, that is to say the interest rate differentials is smaller in the *No-correlations* model.

Following the approach in Section 4.3.1, I apply an identical exchange rate shock to both the *No-correlations* model and its counterpart model without foreign currency borrowing. In the *No-correlations* model, the aggregate impacts of foreign currency borrowing are smaller than those in the benchmark model. Specifically, without

[15] These figures represent the difference at the trough of both series.

foreign currency financing, the model that incorporates export correlations underestimates output and capital losses from the depreciation shock by 15.6% and 12.4%, respectively. In other words, the correlations with exports amplify the trade-off of foreign currency borrowing. During a depreciation event, increased exports mitigate the negative balance sheet effects, allowing firms to continue benefiting from the lower interest rates of foreign currency borrowing, thereby amplifying its aggregate impact. Without these correlations, the aggregate output and capital losses due to foreign currency borrowing during the depreciation event are underestimated by 31.9% and 25.7%, respectively.

Table 11: Role of Correlations between Exports and Foreign Currency Borrowing

Parameters	Benchmark	No-correlations
θ_k	0.01	0.01
τ	1.4	1.4
σ_z	0.12	0.12
β	0.88	0.9
θ	0.9	1.9
θ^*	0.34	0.3
r	0.09	0.07
f_1^x	0.35	0.25
f_0^x	1	1.2
f^*	0.29	0.025
ζ	0.65	**1**
Moments		
Std(sales)	0.30	0.33
Leverage	**0.35**	**0.30**
FCB intensity, conditional on with FCB	**0.08**	**0.07**
FCB intensity, conditional on with FCB and exports	**0.08**	**0.06**
Average response of S_{FCB} after entering	0.02	0.01
Average response of S_{FCB} after exiting	-0.02	-0.002
Export intensity, conditional on exporting	0.33	0.15
Export enter rate	0.04	0.02
Share of exporting firms	0.19	0.34
Share of firms holding FCB	0.07	0.04
Share of firms both exporting and holding FCB	0.05	0.03

5 Conclusion

This paper studies the interaction between firms' export and currency of financing, empirically, theoretically and quantitatively. Firms' currency choice of financing is correlated with 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 foreign currency borrowing 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 trade-off for foreign currency borrowing is the trade-offs between currency risk and the lower borrowing cost, compared to home currency borrowing. During a depreciation event, the increase in exports mitigate the negative impacts of foreign currency borrowing arising from the currency risk, firms can borrow more in foreign currency, enjoy the benefits of lower cost. The correlation with exports amplify the aggregate impact of foreign currency borrowing, in the sense that without these correlations, the aggregate implications of foreign currency borrowing is smaller. Without these correlations, only the trade-off between currency risk and lower interest rate is associated with 32% lower output losses arising from foreign currency borrowing for an increase in real exchange rage shock by one standard deviation.

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 foreign currency borrowing 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 quantification of aggregate effects of foreign currency borrowing. 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.[16]

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

[16]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

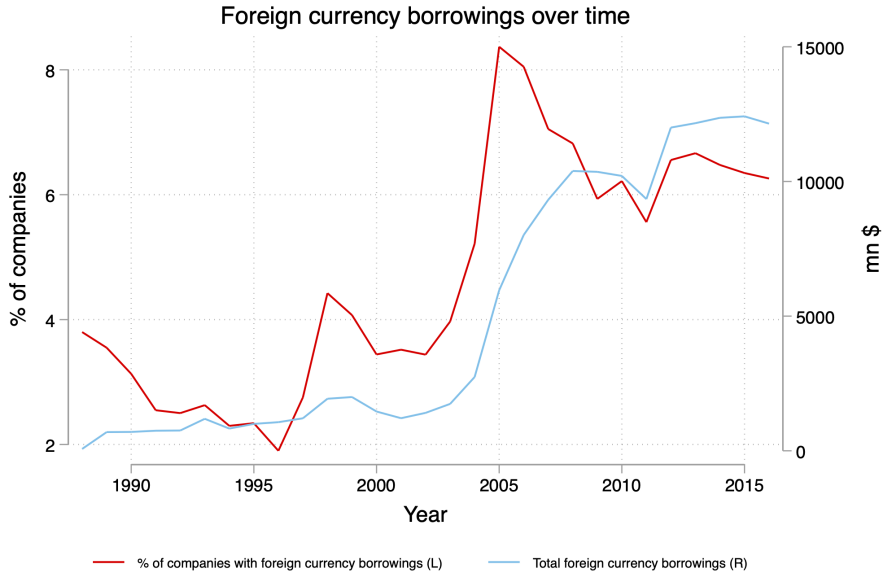


Figure 9: Foreign Currency Borrowing Over Time

For the baseline sample from 2000-2016, there is a growing trend in holding foreign currency borrowing, as shown in Figure 9. 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.[17]

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

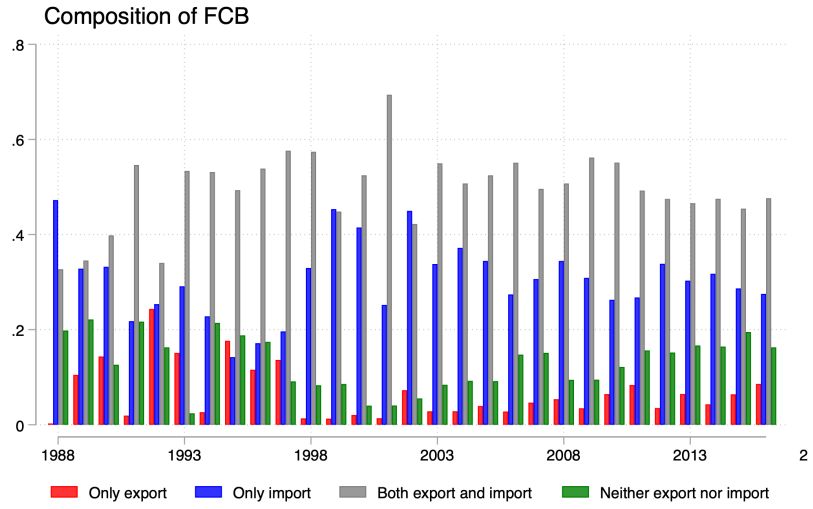


Figure 10: Foreign Currency Borrowing by Export Groups

[17]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.

B Baseline estimation results

This sector delivers the estimation results for the empirical results in Section 2.

Table 12: Responses in Foreign Currency Borrowing to Changes in Export Status

	h=0	h=1	h=2	h=3	h=4	h=5
Starter						
I_{FCB}	0.013***	0.014***	0.012*	0.030***	0.037***	0.037***
	(0.004)	(0.005)	(0.006)	(0.008)	(0.009)	(0.009)
S_{FCB}	0.007**	0.004	0.001	0.011**	0.012**	0.015***
	(0.003)	(0.003)	(0.004)	(0.005)	(0.005)	(0.005)
Exiter						
I_{FCB}	-0.008**	-0.015***	-0.022***	-0.031***	-0.030***	-0.043***
	(0.003)	(0.005)	(0.007)	(0.008)	(0.009)	(0.010)
S_{FCB}	-0.003	-0.003	-0.007	-0.016**	-0.013*	-0.019**
	(0.002)	(0.004)	(0.005)	(0.006)	(0.007)	(0.008)

Notes: Results from estimating Eq. (2.2.1) for new exporters and exiters, respectively. This table is the counterpart to Figure 1. Robust standard errors are in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 13: Response to Changes in Export Status: Including Re-entry Exporters

	h=0	h=1	h=2	h=3	h=4	h=5
Starter						
I_{FCB}	0.011***	0.009***	0.012**	0.018***	0.028***	0.027***
	(0.003)	(0.004)	(0.005)	(0.006)	(0.006)	(0.007)
S_{FCB}	0.007***	0.004*	0.001	0.007**	0.010***	0.011***
	(0.002)	(0.002)	(0.003)	(0.003)	(0.003)	(0.003)
Exiter						
I_{FCB}	-0.005*	-0.003	-0.007	-0.007	-0.016**	-0.021***
	(0.003)	(0.004)	(0.005)	(0.006)	(0.007)	(0.008)
S_{FCB}	-0.003*	-0.003	-0.006*	-0.005	-0.006*	-0.009**
	(0.002)	(0.002)	(0.003)	(0.003)	(0.004)	(0.004)

Notes: Results from estimating Eq. (2.2.1) for new exporters and exiters, respectively. This table is the counterpart to Figure 2. Robust standard errors are in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 14: Response to Changes in Export Status: No MNCs

	h=0	h=1	h=2	h=3	h=4	h=5
Starter						
I_{FCB}	0.013***	0.014***	0.012*	0.029***	0.036***	0.035***
	(0.004)	(0.005)	(0.006)	(0.008)	(0.009)	(0.010)
S_{FCB}	0.007**	0.005	0.001	0.011**	0.011**	0.014***
	(0.003)	(0.003)	(0.004)	(0.005)	(0.005)	(0.005)
Exiter						
I_{FCB}	-0.009**	-0.014***	-0.022***	-0.033***	-0.030***	-0.040***
	(0.003)	(0.005)	(0.007)	(0.008)	(0.009)	(0.010)
S_{FCB}	-0.003	-0.002	-0.006	-0.014**	-0.008	-0.012
	(0.002)	(0.004)	(0.006)	(0.007)	(0.008)	(0.008)

Notes: Results from estimating Eq. (2.2.1) for new exporters and exiters, respectively. This table is the counterpart to Figure 3. Robust standard errors are in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 15: Responses in Foreign Currency Borrowing to Changes in Import Status

	h=0	h=1	h=2	h=3	h=4	h=5
Import Starter						
I_{FCB}	0.021***	0.031***	0.030***	0.039***	0.045***	0.056***
	(0.004)	(0.005)	(0.006)	(0.007)	(0.008)	(0.009)
S_{FCB}	0.012***	0.020***	0.019***	0.022***	0.016***	0.021***
	(0.003)	(0.004)	(0.004)	(0.005)	(0.005)	(0.005)
Import Exiter						
I_{FCB}	-0.007**	-0.021***	-0.021***	-0.030***	-0.030***	-0.033***
	(0.003)	(0.005)	(0.006)	(0.007)	(0.008)	(0.009)
S_{FCB}	-0.001	-0.006*	-0.005	-0.007	0.001	-0.005
	(0.002)	(0.003)	(0.004)	(0.005)	(0.007)	(0.007)

Notes: Results from estimating Eq. (2.2.1) for new importers and exiters, respectively. This table is the counterpart to Figure 4. Robust standard errors are in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 16: Responses to Changes in Export Status: Drop Only-importers

	h=0	h=1	h=2	h=3	h=4	h=5
Starter						
I_{FCB}	0.015***	0.016***	0.006	0.023***	0.034***	0.040***
	(0.004)	(0.006)	(0.007)	(0.009)	(0.009)	(0.011)
S_{FCB}	0.007**	0.007	-0.000	0.017***	0.019***	0.023***
	(0.003)	(0.004)	(0.005)	(0.007)	(0.006)	(0.007)
Exiter						
I_{FCB}	-0.007**	-0.014***	-0.025***	-0.031***	-0.037***	-0.048***
	(0.003)	(0.005)	(0.007)	(0.008)	(0.009)	(0.011)
S_{FCB}	-0.004*	-0.004	-0.011*	-0.018**	-0.017**	-0.025***
	(0.002)	(0.004)	(0.006)	(0.007)	(0.008)	(0.009)

Notes: Results from estimating Eq. (2.2.1) for new exporters and exiters, respectively. This table is the counterpart to Figure 5. Robust standard errors are in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 17: Response to Changes in Import Status: Drop Only-exporters

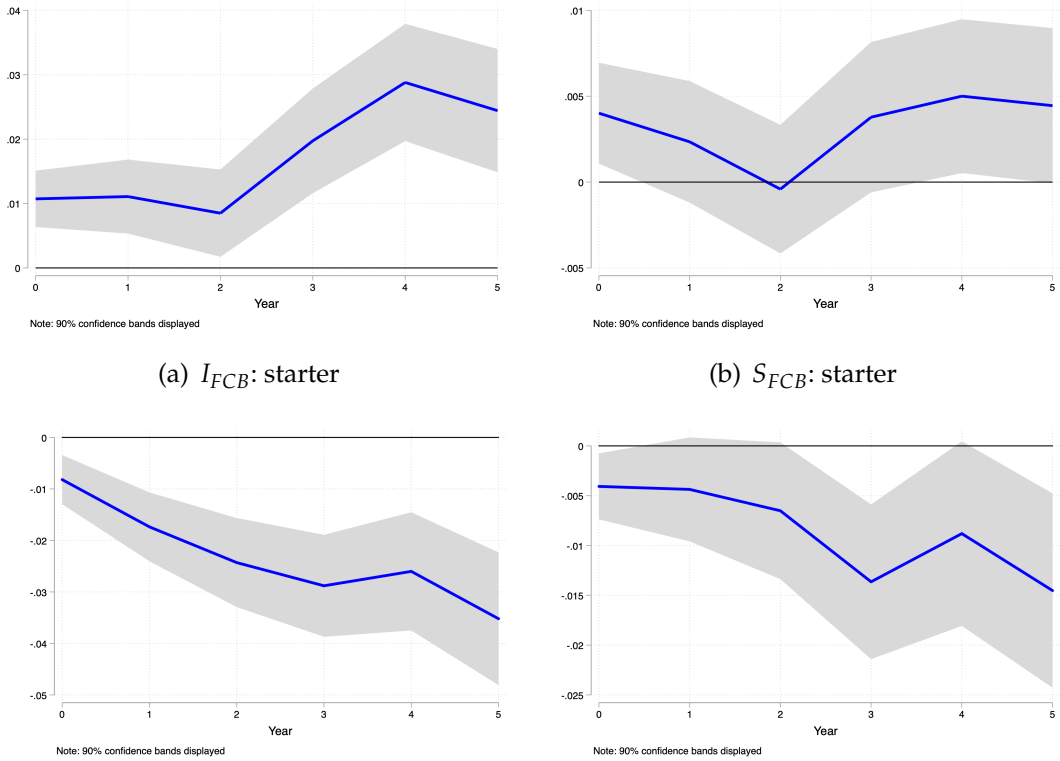
	h=0	h=1	h=2	h=3	h=4	h=5
Import Starter						
I_{FCB}	0.025***	0.040***	0.038***	0.047***	0.060***	0.073***
	(0.004)	(0.006)	(0.007)	(0.008)	(0.009)	(0.010)
S_{FCB}	0.013***	0.024***	0.021***	0.025***	0.021***	0.028***
	(0.003)	(0.004)	(0.005)	(0.006)	(0.006)	(0.006)
Import Exiter						
I_{FCB}	-0.008**	-0.023***	-0.024***	-0.033***	-0.030***	-0.036***
	(0.003)	(0.005)	(0.006)	(0.007)	(0.009)	(0.009)
S_{FCB}	-0.001	-0.007*	-0.007	-0.007	-0.001	-0.007
	(0.002)	(0.004)	(0.005)	(0.006)	(0.007)	(0.008)

Notes: Results from estimating Eq. (2.2.1) for new importers and exiters, respectively. This table is the counterpart to Figure 4. Robust standard errors are in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

C Robustness

C.1 Alternative Sample: 1988-2016

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



(a) I_{FCB}: starter

(b) S_{FCB}: starter

(c) I_{FCB}: stopper

(d) S_{FCB}: stopper

Figure 11: Response to Changes in Export Status: 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.

As shown in Figure 11, after firms' first entering the export market, likelihood of

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

C.2 Sample of Manufacturing Industry

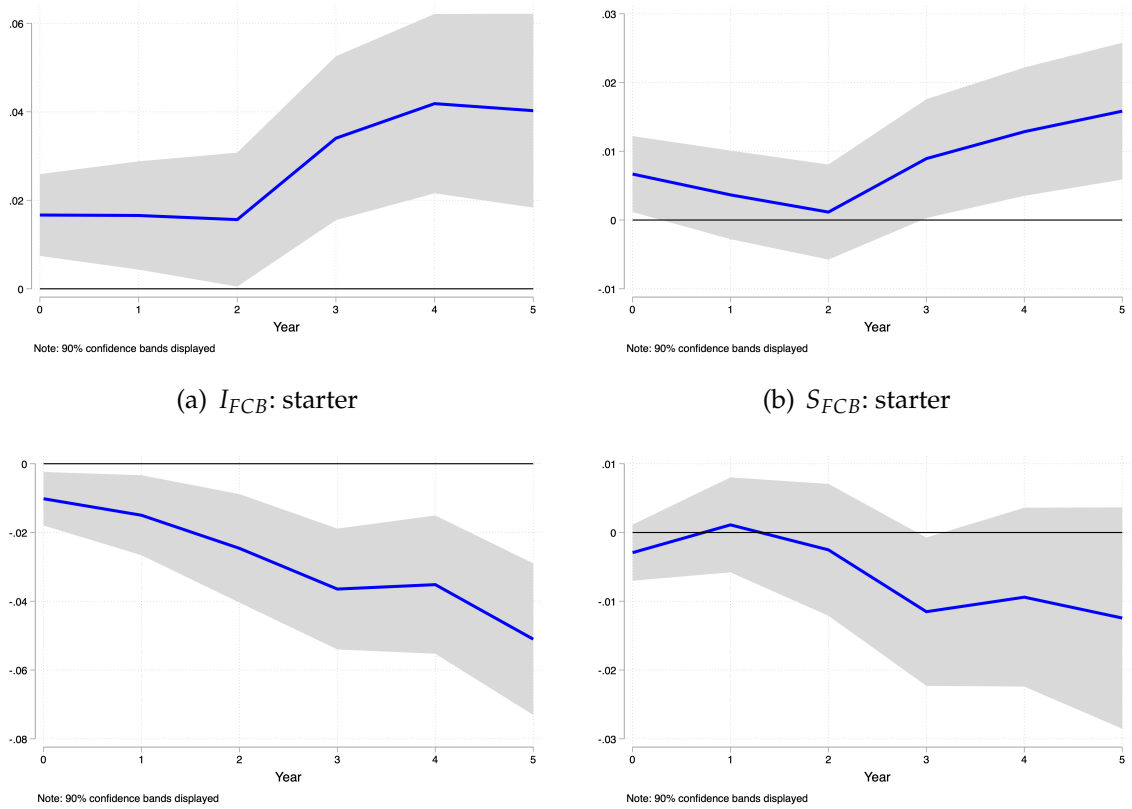
The baseline sample incorporates manufacturing, mining, electricity, non-financial services and construction firms. In this section, I restrict the baseline sample to just manufacturing firms, which are relatively more tradable than firms in other industries.

The results are shown in Figure 12. After firms' first entering the export market, likelihood of financing in foreign currency increases by 1.7-4.2 percentage points. Intensity of foreign currency borrowing increases by 0.1-1.6 percentage points, 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 1.0-5.1 percentage points. The intensity of foreign currency borrowing falls by 0.1-1.2 percentage points, 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.

C.3 Local Project without Clean-control Condition

A local projection specification with a clean control condition is estimated in the baseline empirical analysis to draw a clearer conditional correlation between export status and financing decisions. This section presents results using a conventional local projection method without the clean control condition.

Table 13 shows the estimation results, which remain robust compared to the baseline. Once entering the export market, firms' likelihood of financing in foreign currency rises by 1.1-3.4 percentage points, and their foreign currency borrowing intensity increases by up to 1.4 percentage points, conditional on ever borrowing in foreign currency. In contrast, after firms exit the export market, the likelihood of foreign



(a) I_{FCB}: starter

(b) S_{FCB}: starter

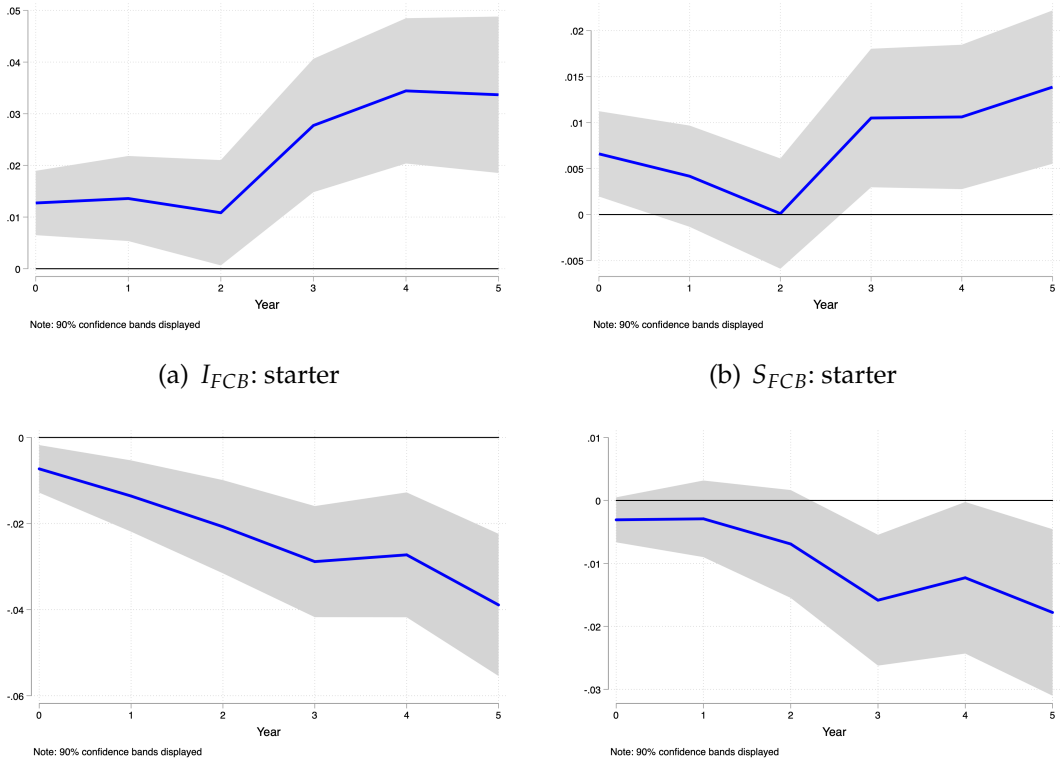
(c) I_{FCB}: stopper

(d) S_{FCB}: stopper

Figure 12: Responses to Changes in Export Status: 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.

currency financing decreases by 0.7-3.9 percentage points, and the intensity falls by 0.3-1.8 percentage points, conditional on previous foreign currency borrowing.



(a) I_{FCB}: starter

(b) S_{FCB}: starter

(c) I_{FCB}: stopper

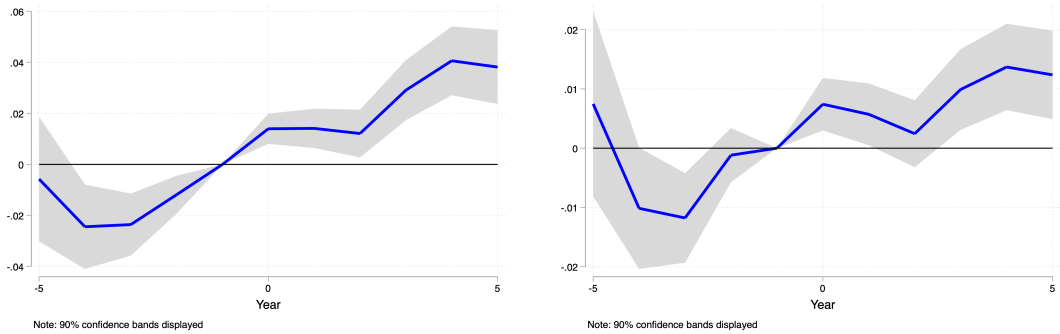
(d) S_{FCB}: stopper

Figure 13: Responses to Changes in Export Status: 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.

C.4 Pre-trend before Entering Export Market

While causality is not claimed in the baseline results, this section provides firms' financing decisions prior to their first export or exit. Figure 14 shows that pre-treatment effects on the extensive margin of foreign currency borrowing are not exactly zero, though no pre-trend is observed along the intensive margin.



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

Figure 14: Response to Changes in Export Status: 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.

C.5 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

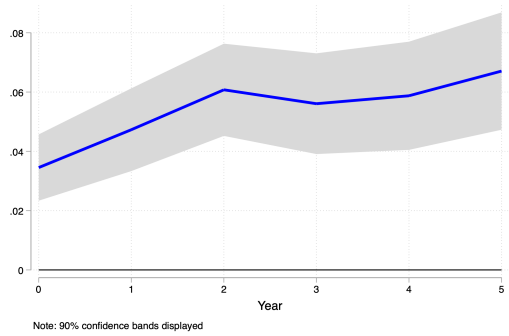
$$y_{j,t+h} - y_{j,t-1} = \alpha^h \Delta D_{jt} + Z'_{j,t-1}\beta + \eta_t^h + e_{jt}^h,$$

restricting sample to observations that are either

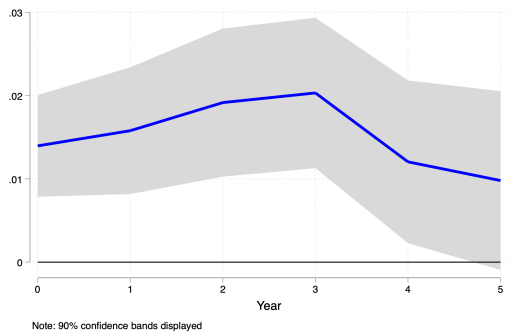
$$\begin{cases} \text{firms that newly borrow in foreign currency} & \Delta D_{jt} = 1, \\ \text{or never borrow in foreign currency before (clean control)} & D_{j,t+h} = 0. \end{cases}$$

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.

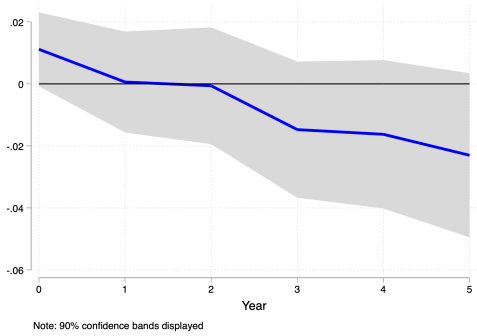
As shown in Figure 15, after firms start holding foreign currency borrowing, likelihood of exporting increases by 3.5-6.7 percentage points, and export intensity increases by 1.2-2.0 percentage points, conditional on firms' ever exporting. Panel (c) and (d) indicate that there is no significant response in export activities after firms' completely deleveraging their holding of foreign currency borrowing.



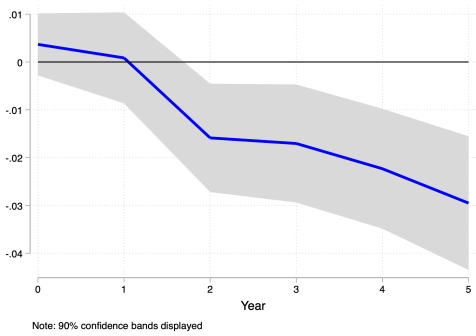
(a) I_{exp}: FCB starter



(b) S_{exp} : FCB starter



(c) I_{exp}: FCB stopper



(d) S_{exp} FCB stopper

Figure 15: 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.

D 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.

D.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 16 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.

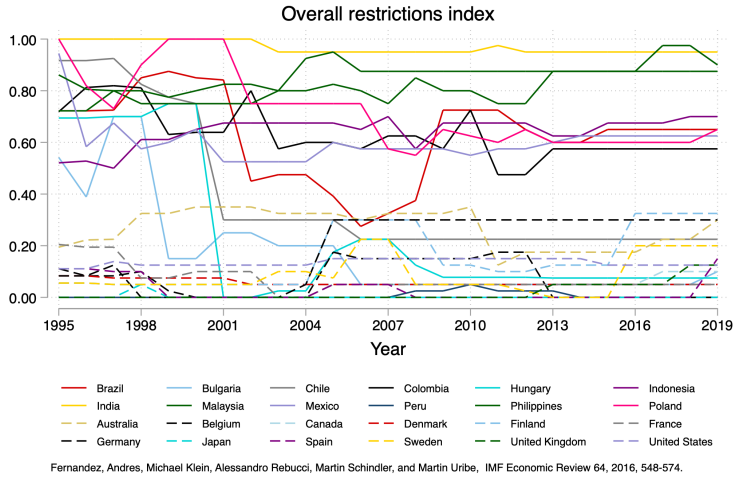
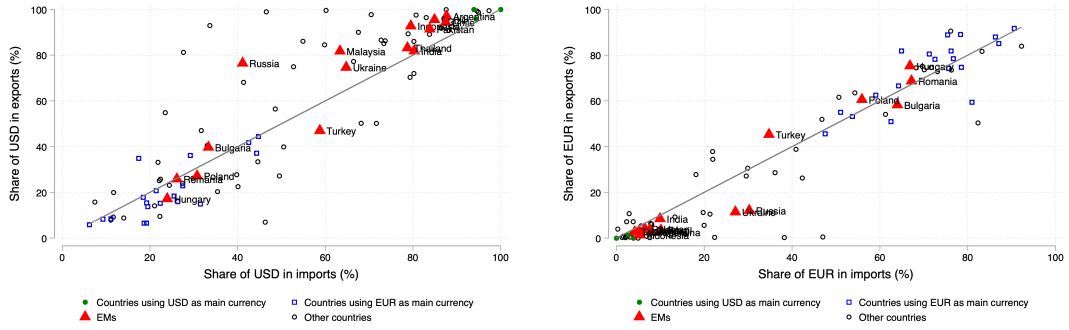


Figure 16: Capital Control Index Across Countries

D.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 17 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, as illustrated in Figure 18.



(a) Share of USD (b) Share of EUR

Figure 17: Cross-country Currency of Trade Invoicing

Notes: The left panel displays the average share of U.S. dollars used in each country's imports and exports over time. Green solid dots represent countries that use the U.S. dollar as their official currency. Blue squares indicate countries that primarily use the Euro. Emerging markets are marked with red triangles, while other countries not fitting into these categories are shown as black circles. The right panel presents the corresponding average share of Euros used in each country's imports and exports.

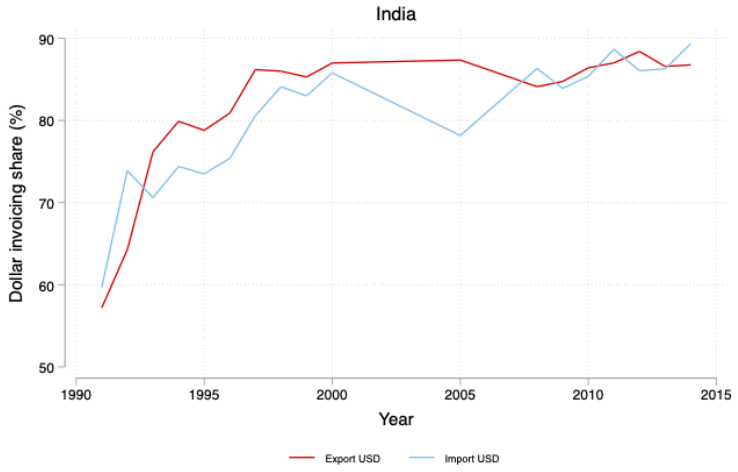


Figure 18: Currency of Trade Invoicing: India

Notes: The red line shows the dynamics of the share of Indian exports invoiced in U.S. dollars. The blue line represents the corresponding dynamics for Indian imports.

E 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.

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

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

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

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

E.1 Exporters

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

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

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

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

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

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

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

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

$$\tau = e^2 \left(\frac{y^*/y}{Y^*/Y} \right)^{-\frac{1}{\sigma}} \tag{11}$$

$$c^{-\gamma} = \beta E \left[(1-\delta) \left(c'\right)^{-\gamma} + \alpha A z' \left(k'\right)^{\alpha-1} \frac{1-\frac{1}{\sigma}}{e'} \left(\frac{y'}{Y'} \right)^{-\frac{1}{\sigma}} \left[\left(c'\right)^{-\gamma} + \lambda_3' \theta + \lambda_4' \theta^* \right] \right], \tag{12}$$

$$c^{-\gamma} = \beta(1+r) E \left(c'\right)^{-\gamma} + (1+r)\lambda_3, \tag{13}$$

$$c^{-\gamma} = \beta(1+r^*) E \left(\frac{e'}{e} \left(c'\right)^{-\gamma} \right) + (1+r^*)\lambda_4, \tag{14}$$

$$c + k' - \frac{b'}{1+r} - e\frac{b^{*\prime}}{1+r^*} = \frac{y^{1-\frac{1}{\sigma}}}{e(Y)^{-\frac{1}{\sigma}}} + e\frac{(y^*)^{1-\frac{1}{\sigma}}}{(Y^*)^{-\frac{1}{\sigma}}} + (1-\delta)k - b - eb^* - F \tag{15}$$

$$y + \tau x y^* = A z k^{\alpha}, \tag{16}$$

$$b' \leq \theta \left(\frac{y^{1-\frac{1}{\sigma}}}{e(Y)^{-\frac{1}{\sigma}}} + e\frac{(y^*)^{1-\frac{1}{\sigma}}}{(Y^*)^{-\frac{1}{\sigma}}} \right), \tag{17}$$

$$eb^{*\prime} \leq \theta^* \left(\frac{y^{1-\frac{1}{\sigma}}}{e(Y)^{-\frac{1}{\sigma}}} + e\frac{(y^*)^{1-\frac{1}{\sigma}}}{(Y^*)^{-\frac{1}{\sigma}}} \right). \tag{18}$$

where unknowns are $y, y^*, c, k', b, b^{*\prime}, \lambda_3, \lambda_4$. From Eq. (13) and (14), UIP condition only holds if both collateral constraints are slack.

E.2 Non-exporters

When $x = 0$, the FOCs are:

$$\begin{aligned}
&[c]: \quad c^{-\gamma} = \lambda_1, \\
&[y]: \quad \frac{1-\frac{1}{\sigma}}{e} \left(\frac{y}{Y} \right)^{-\frac{1}{\sigma}} \left[\lambda_1 + \lambda_3 \theta + \lambda_4 \theta^* \right] = \lambda_2, \\
&\left[k'\right]: \quad \beta E V_{k'} = \lambda_1 \quad \Rightarrow \quad \beta E \left[\lambda_1'(1-\delta) + \lambda_2' \alpha A z' \left(k'\right)^{\alpha-1} \right] = \lambda_1, \\
&\left[b'\right]: \quad \beta E V_{b'} + \frac{\lambda_1}{1+r} - \lambda_3 = 0 \Rightarrow \beta E \left(-\lambda_1'\right) + \frac{\lambda_1}{1+r} - \lambda_3 = 0, \\
&\left[b^{*\prime}\right]: \quad \beta E V_{b^{*\prime}} + \frac{\lambda_1 e}{1+r^*} - \lambda_4 e = 0 \Rightarrow \beta E \left(-\lambda_1' e'\right) + \frac{\lambda_1 e}{1+r^*} - \lambda_4 e = 0.
\end{aligned}$$

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

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

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

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

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

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

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

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

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

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

F 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.

G Data Moments

G.1 Targeted Moments

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

Sales for each firm are log-linearly detrended, and the moment is calculated as the average standard deviation across firms, which takes the value 0.33.

2. ***Total leverage***

Total leverage is defined as the ratio of total borrowing to total assets. I first calculate the mean total leverage for each firm, then compute the average total leverage across firms, which is 0.42.

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

The fraction of firms with foreign currency borrowing is 6.5%.

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 as the ratio of foreign currency borrowing to total outside liabilities, with an average value of 13.2%.

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

Exporting firms constitute 30.6% of the total sample.

6. ***Export intensity, conditional on exporting***

Export intensity is defined as the ratio of total export earnings to total sales. The average export intensity among exporting firms is 29.1%.

7. ***Exporter enter rate***

The fraction of firms entering the export market is 3.1%.

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

The fraction of firms that both export and borrow in foreign currency is 4.2%.

G.2 Untargeted Moments

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

The raw correlation between export intensity and intensity of foreign currency borrowing is 0.11 in the baseline sample. This moment is informative for the estimated correlation between exports and foreign currency borrowing in the baseline empirical analysis.

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

For all firms, the average intensity of foreign currency borrowing is 0.6%.

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

The mean export intensity for the whole sample is 7.5%.

H Model: Including Imports

Entrepreneurs make decisions on consumption, borrowing, pricing, exports, and imports. Imports now enter both the budget constraint and the collateral constraint, as they require foreign currency payments and are incorporated into the fixed cost structure. This introduces an interaction between imports and financial frictions, complicating the analysis of the underlying stories behind the dynamic correlations between exports and foreign currency borrowing. Specifically, it requires separating the export-side and import-side stories at the same time. Note that if $x^m = 0$, $M = 0$, then this extended model reduces to the benchmark model.

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