International Pecking Order*

Egemen Eren† Semyon Malamud‡ Haonan Zhou§

February 21, 2022

Abstract

We document that corporates in emerging markets borrow more in foreign currency when the local currency provides a better hedge in downturns. We develop an international corporate finance model in which firms facing adverse selection choose the foreign currency share of their debt. In the unique separating equilibrium, good firms optimally expose themselves to currency risk to signal their type. The nature of this equilibrium crucially depends on the co-movement between cash flows and the exchange rate. We provide extensive empirical evidence for this signalling channel using micro data for firms in multiple emerging markets and event studies of local currency depreciation episodes.

Keywords: Foreign currency debt, corporate debt, signalling, exchange rates, pecking order

JEL Classification Numbers: D82, F34, G01, G15, G32

*We thank Mark Aguiar, Markus Brunnermeier, Stijn Claessens, John Cochrane, Bryan Hardy, Victoria Ivashina, Juliana Salomao, Philip Wooldridge, Motohiro Yogo for helpful comments and suggestions. Anamaria Illes provided excellent research assistance. Semyon Malamud acknowledges the financial support of the Swiss National Science Foundation (Grant "International Macroeconomics with Financial Frictions") and the Swiss Finance Institute. Parts of this paper were written when Malamud and Zhou visited the BIS. The views in this article are those of the authors and do not necessarily represent those of the BIS. All errors are our own.

†Bank for International Settlements (BIS); Email: egemen.eren@bis.org

‡Swiss Finance Institute, EPF Lausanne, and CEPR; E-mail: semyon.malamud@epfl.ch

§Princeton University; E-mail: haonan@princeton.edu

1 Introduction

Many emerging market firms finance themselves with foreign currency denominated debt. Yet foreign currencies, especially safe haven currencies, appreciate against the local currency during downturns. Many firms that borrow in foreign currency are not exporters nor do they employ currency hedges (e.g. Bräuning and Ivashina, 2020; Alfaro, Calani and Varela, 2021). The resulting currency mismatches amplify the impact of exchange rate shocks on firms, especially those that are in distress. The materialization of risks arising from currency mismatches has been a major feature of financial crises in emerging market economies. Moreover, corporate leverage and foreign currency borrowing, especially in dollars, have increased in recent years (Alfaro, Asis, Chari and Panizza, 2019; Eren and Malamud, 2021), making the reasons for borrowing in foreign currency and associated risks all the more important to understand.

Despite risks, foreign currency debt also a potentially important source of funds for firms to grow, especially those that are more productive (Salomao and Varela, 2022). While the literature on how foreign currency debt contributes to financial crises is large, analyzing micro-level trade-offs that firms face and the resulting cross-sectional allocations provides a promising new avenue for research. Our paper makes a theoretical and empirical contribution to this nascent literature.

We first document that, among 19 emerging market economies, corporates for which borrowing in local currency would provide greater hedging benefits actually borrow more in foreign currency. This observation is more puzzling than the question of why emerging market economy firms have currency mismatch on their balance sheets as it suggests that firms, for which foreign currency borrowing is riskier, borrow even more in foreign currency. In particular, we show that in countries for which the co-movement of the returns on the local currency sovereign bond and the stock market is greater (i.e. local currency provides a better hedge against downturns),[1] the average foreign currency share is larger. Similarly, we also show that in countries where the stock market tends to fall more when the local currency currency depreciates against the dollar (i.e. foreign currency tends to appreciate when the marginal utility of consumption is high, hence the local currency provides a better hedge), the average foreign currency share is also larger.

This puzzling fact mimicks the borrowing pattern of sovereigns as documented in Du, Pflueger and Schreger (2020). In the case of sovereigns, they explain this by the presence of risk-averse international lenders and the lack of monetary policy commitment of the sovereign. However, corporates in emerging markets mostly borrow from domestic banks and do not have power over monetary policy, which necessitates a different explanation of our findings.

We develop an international corporate finance model in which firms facing adverse selection choose the composition of their debt in local currency and foreign currency. Our model is set up as a one-dimensional signalling game. A firm with private information about its future cash flows needs to finance investment with debt that can be denominated in two currencies, local currency and foreign currency. The only choice variable of the firm is the fraction of foreign currency debt. Risk-neutral, rational creditors offer price schedules conditional on firms' choice of foreign currency debt share.

We show that, under natural conditions, there exists a unique separating equilibrium: the relationship between the foreign currency share and the hidden type is monotonic. As a result, the fraction of foreign currency debt perfectly reveals the firm's hidden ability to generate earnings. In this equilibrium, good firms expose themselves to currency risk to signal their type to investors.[2] The intuition behind this result is similar to that in the standard pecking order theory: A default due to an adverse foreign currency appreciation

[1] Given data limitations, constructing measures of local currency corporate bond return is difficult. Nevertheless, the literature has found considerable co-movement between sovereign yields and corporate yields (e.g. Mendoza and Yue, 2012; Bedendo and Colla, 2015; Bevilaqua, Hale and Tallman, 2020).

[2] Anecdotally, Ivashina, Kostas and Zogbi (2018) report a statement by Advent LatAm managers, a global private equity firm: "We [Advent] have never hedged; it is too expensive. The only hedge we have is growth."

shock is less likely for good firms. By voluntarily taking on currency risk, lenders understand these firms have higher repayment probabilities and price the debt accordingly. The benefit in revealing the hidden type thus outweighs the need to hedge against adverse exchange rate movement through reducing currency mismatches.

We further show that the nature of this equilibrium depends crucially on the co-movement between the foreign currency/local currency exchange rate and firm's cash flows: If the foreign currency exchange rate is negatively related to firm's cash flows, that is cash flows fall when the local currency depreciates, then higher foreign currency debt signals a good type, *and vice versa*. While the former is the case for many emerging market economy firms, the case of positive co-movement between cash flows and the foreign currency yields a distinctive prediction of our model which we test empirically.

We find strong empirical support for the predictions of our model that links exchange rate/cash flow co-movements, foreign currency share in borrowing, and performance. Using a detailed dataset on the debt structure of firms in multiple emerging market economies, we show that the foreign currency share predicts earnings, in line with model predictions, in a number of event studies including the Global Financial Crisis, the COVID-19 crisis, and other local currency depreciation episodes.

For our empirical analysis, we use a firm-level dataset that we construct using Capital IQ, S&P Global Market Intelligence. This database includes detailed information at the individual debt instrument level that a firm has on its balance sheet, which includes bank loans and bonds. We aggregate this data to generate our main variable of interest, the foreign currency share, and match it to balance sheet data and income statements. This exercise gives us a firm-level yearly panel dataset comprising a long time series component for firms in multiple emerging market economies.

We first focus on firms for which cash flows co-move negatively with the dollar (i.e.

The statement fits well with the mechanism in our model, where firms expose themselves to currency risk to signal their quality or growth potential to investors.

"negative beta" firms). This is the case for a large majority of firms in our sample and this is the case which matters during local currency depreciation periods, since the appreciation of safe haven currencies would in principle adversely affect these firms. We show that foreign currency share predicts higher earnings for these firms both in normal times and during crisis periods in line with the predictions of our model. First, using the rich panel structure of our dataset, we show that a higher foreign currency share at a given year predicts higher earnings for the subsequent two years. Second, we show that foreign currency share in 2007 positively predicts earnings in 2008 during the Global Financial Crisis. Third, we show that foreign currency share in 2019 predicts higher earnings in 2020 during the COVID-19 crisis. Finally, we study a broader set of local currency depreciation episodes, including the depreciation of the Turkish lira in 2018 and other depreciation episodes where the local currency depreciated more than 20% against the dollar. Foreign currency share the year before a large local currency depreciation episode predicts higher earnings in the year of the large depreciation.

We rule out alternative explanations through a number of robustness checks using different specifications and sub-samples. Across all specifications, we use $Country * Industry * Year$ fixed effects (or $Country * Industry$ dummies in cross-sectional regressions), which allows us to compare firms in the same country, which operate in the same industry, and at a given year. Moreover, we use a set of firm-year level controls to rule out other firm specific factors. Our results are robust to the exclusion of firms without access to markets for foreign currency borrowing, which we report as our baseline results. The concern that our results might be driven by exporting firms is alleviated since we focus exclusively on firms with a negative co-movement between stock price and the dollar exchange rate. As a further robustness check to rule this out completely, we restrict our attention only to non-tradable sectors and the results are similar. We also rule out the possibility that home-currency bias (Maggiori, Neiman and Schreger, 2020) or risk aversion of international lenders might be driving the results. With home-currency bias or risk aversion, international lenders would mainly lend in foreign currency. Hence, firms would have to borrow in foreign currency in order to tap into more markets, potentially diminishing the effect signalling channel. Our results are unchanged when we use an alternative measure of foreign currency share using bank loans only as they are predominantly domestic. We also show that our results are robust to the use of alternative outcome variables.

Two additional tests provide further evidence in support of the distinctive predictions of our model. First, in our model higher foreign currency share predicts higher earnings for firms whose cash flows co-move negatively with the foreign currency (the dollar in our empirical setup), while it predicts lower earnings for firms whose cash flows positively with the foreign currency. Most of our empirical analysis focuses on the former, but we also show evidence in favor of the latter. For negative beta firms, a higher foreign currency share predicts significantly higher earnings one and two years later. On the other hand, for positive beta firms, a higher foreign currency share predicts significantly lower earnings three to five years later. Second, comparing maturities for firms with cash flows with negative co-movement with the foreign currency, a conjecture arising from the model is that the riskier portion of the foreign currency debt should predict higher earnings. Indeed, short-term foreign currency share of debt predicts earnings better than long-term foreign currency share of debt.

All in all, our results point toward a new channel of why firms borrow in foreign currency despite the inherent riskiness of doing so. In the presence of adverse selection, firms have incentives to signal their quality to their creditors by taking on exchange rate risks arising from currency mismatches. Our results also highlight a more nuanced view on the risks arising from foreign currency borrowing. Firms that take on exchange rate risks might indeed be better placed to have these risks on their balance sheets. That said, however, since they are exposed to currency risk, large exchange rate shocks might nevertheless put them in distress. Our results also suggest that policies that aim at reducing information asymmetries and adverse selection, such as more transparency or better disclosure requirements would mitigate corporate risk taking through currency mismatches in emerging market economies.

Related literature Our paper mainly contributes to two strands of literature, both theoretically and empirically. First, there is a nascent literature on the cross-sectional heterogeneity in firms' choices leading to currency mismatches, which can have implications in the aggregate (Salomao and Varela, 2022). We explore a signalling channel in the face of adverse selection and provide broad evidence for many emerging market economies through a number of event studies. In doing so, we also contribute to strands of literature that analyze firm borrowing in foreign currencies and risks arising from resulting currency mismatches. Second, we contribute to the literature on pecking order theory (Myers and Majluf, 1984), by considering two types of debt in an international setting and providing an empirical investigation of the channels outlined.[3]

The closest papers to ours are by Salomao and Varela (2022), Du, Pflueger and Schreger (2020), and Eren and Malamud (2021). We describe how our paper differs from these papers and how it complements them in detail below.

Salomao and Varela (2022) build a model with heterogeneous firms to analyze the trade-offs in firms' currency debt decisions and assessing the distribution of foreign loans and its aggregate consequences. Though some mechanisms in their paper are similar to ours, there are three major differences between our approaches. First, without assuming cost advantages associated with currency borrowing, the key mechanism that affects currency mismatches in our model is signalling. In their paper, firms have an incentive to borrow in foreign currency

[3]Numerous papers investigate the validity of pecking order theory in dynamic corporate finance models. See, for example, Hennessy et al. (2010), Morellec and Schuerhoff (2011), Grenadier and Malenko (2009), Townsend (1979), Milgrom and Weber (1982), Holmstrom and Milgrom (1987), Boot and Thakor (1993), Nachman and Noe (1994), Demarzo and Duffie (1999), Fulghieri and Lukin (2001), Biais and Mariotti (2005), Demarzo (2005), Inderst and Mueller (2006), Axelson (2007), Hennessy (2013), Dang et al. (2015a), Dang et al. (2015b), Hebert (2017), Yang (2020), Antic (2019). Empirical evidence on the validity of the pecking order theory is mixed. See, for example, Franck and Goyal (2003), Helwege and Liang (1996), and Leary and Roberts (2010). None of these papers study the currency composition of debt.

to exploit UIP differentials. Second, in their model currency risk affects firm profitability as noise that doesn't co-move with firms' cash flows, whereas in our setup firms whose cash flows negatively correlate with the dollar take on the additional risk to signal to investors, and vice versa. Second, our empirical analysis covers a number of emerging market economies while theirs focus on Hungary, but with more granular data. Hence, we believe our analysis is complementary to theirs.

Du, Pflueger and Schreger (2020) show that governments tend to borrow in currencies that tend to appreciate in bad times rather than borrowing in local currency which provides a hedge. They argue that governments resort to foreign currency borrowing to alleviate the moral hazard problem of deflating their local currency debt through inflation. While the mechanisms that drive their results, such as lack of commitment in setting monetary policy, apply to sovereigns, they do not apply to corporates. Our signalling model offers a different but closely related mechanism applied to corporates similarly rooted in information asymmetries.

Eren and Malamud (2021) develop a capital structure model in which firms choose currency composition of their debt in a symmetric information setting where debt is issued for its tax benefits. They derive conditions under which all firms issue debt in a dominant currency which depends on the co-movement of the exchange rate and cash flows. This statistic also plays a crucial role in our paper. The tradeoff theory in Eren and Malamud (2021) applies to large, established international firms with diversified cash flows and minimal adverse selection costs (see also Nikolov, Schmid and Steri (2021)). By contrast, the theory developed in the current paper is better suited for emerging market firms with a significant degree of informational asymmetry.

Our paper is also related to the literature that studies currency mismatch on corporate balance sheets and its impact on during severe emerging market currency depreciations. Several theoretical models study the emergence and implications of currency mismatch (e.g. Jeanne (2003), Caballero and Krishnamurthy (2003), among others). Our paper provides information on how cross-sectional firm heterogeneity could impact emergence and consequences of currency mismatches with empirical applications from a number of emerging market currency depreciation episodes and a broad dataset covering multiple emerging market economies. This relates us to other papers in the literature that study such episodes. For example, Aguiar (2005) shows that during the Mexican peso crisis, Mexican firms with higher foreign currency debt were more likely to reduce investment. Kim, Tesar and Zhang (2015) show that during the Asian crisis, Korean firms with more foreign currency debt were more likely to exit. Niepmann and Schmidt-Eisenlohr (2021) show that the probability of being past due on loans is larger during depreciation episodes. Kohn, Leibovici and Szkup (2020) show that financially constraint exporters reallocate sales across markets to mitigate the negative effects. Du and Schreger (2022) show that a higher reliance on foreign currency debt by the corporate sector is associated with higher sovereign default risk. Our results suggest a more nuanced view of local currency depreciation episodes. Firms with foreign currency debt are actually better positioned to weather these shocks since they are firms with greater quality. A similar result is also present in Salomao and Varela (2022). However, the channels through which the results arise are different, and we focus on a broader set of emerging market economies and local currency depreciation episodes.

Another strand of the literature studies the reasons why firms, especially in emerging markets, borrow in safe haven currencies, especially the dollar at the first place. Jiang, Krishnamurthy and Lustig (2021) and Koijen and Yogo (2020) estimate a dollar convenience yield arising from investor safety demand, lowering borrowing costs in dollars. Gopinath and Stein (2020) argue that dollar invoicing creates a demand for dollar deposits, which leads to dollar loans being cheaper. Using data from Peru, Gutiérrez, Ivashina and Salomao (2021) show that investor demand for safety lowers the dollar deposit rate which banks pass through to loans making them cheaper for borrowers (see also di Giovanni, Kalemli-Ozcan, Ulu and

Baskaya (2017) for evidence from Turkey). Taking dollar discount as given, Bruno and Shin (2017), Caballero, Panizza and Powell (2016), and Acharya and Vij (2020) show that the propensity to borrow in dollars increases when carry trade is more profitable.[4] In our model, firms borrow in safe haven currencies in order to signal their quality, and voluntarily expose themselves to currency risks. Therefore, currency mismatches can still arise in the absence of a motive for carry trade or cost advantages.

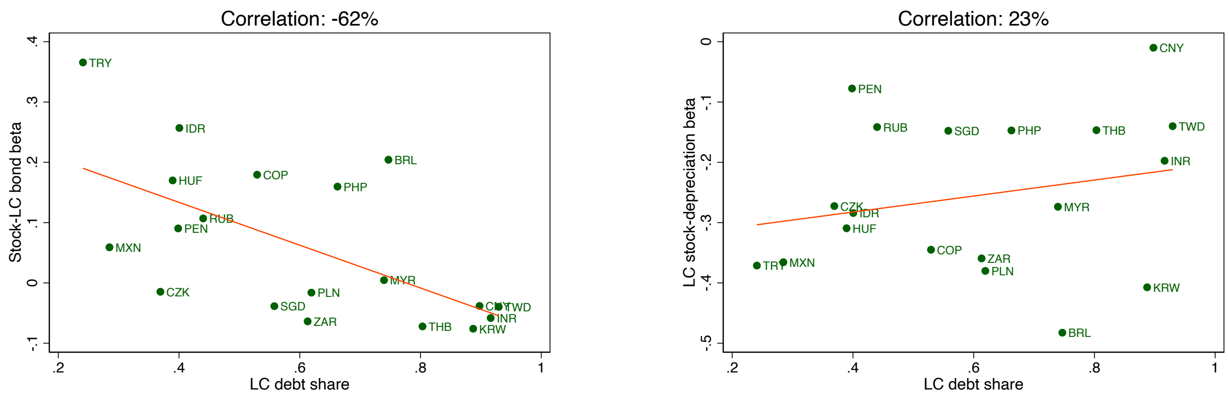
2 Corporate local currency debt share and local currency debt risk

We start by documenting empirical relationships between corporate local currency debt share and two measures of hedging benefits of local currency debt. First, we use the government local currency bond-stock beta, computed as in Du, Pflueger and Schreger (2020), and show the correlation of local currency share in the aggregate corporate borrowing and the government local currency bond-stock beta. Our results are similar to those of Du, Pflueger and Schreger (2020) for government debt. Given data limitations, constructing measures of local currency corporate bond return is difficult. Nevertheless, the literature has found considerable co-movement between sovereign yields and corporate yields (Mendoza and Yue, 2012; Bedendo and Colla, 2015; Bevilaqua, Hale and Tallman, 2020). As a result, we believe government local currency bond-stock beta is a good proxy for the hedging properties for local currency corporate debt. Next, we show an alternative, but closely related empirical relationship. We show that in countries which have a negative relationship between index-level stock returns and the bilateral dollar exchange rate, firms tend to borrow more in

[4]Other papers study firms' choice in borrowing in dollars versus euros. Eren and Malamud (2021) show that the dollar provides a better hedge than the euro during global downturns. Caramichael, Gopinath and Liao (2021) compare borrowing costs in the dollar and the euro with and without currency hedges.

foreign currency, effectively forgoing the hedging benefits of issuing debt denominated in local currency.

Figure 1: Corporate local currency debt shares and FX risk



(a) Stock-local currency bond beta

(b) Stock-FX beta

Panel 1(a) shows the local currency stock-local currency bond beta of the central government debt versus average corporate local currency debt share for 19 emerging market economies over the sample period 2005-2019. Panel 1(b) shows the stock market-exchange rate beta versus average corporate local currency debt share over the sample period 2005-2019. Source for corporate local currency debt share: Capital IQ. Source for stock price and bond returns: Bloomberg.

Bond-stock beta and corporate local currency share First, we examine the relationship between corporate local currency bond issuance and the hedging benefits of a local currency bond. Following Du, Pflueger and Schreger (2020), we define the country i-specific local-currency bond-stock beta as the coefficient β of the following regression:

$$xr^{LC}_{i,n,t} = \alpha_i + \beta(bond_i, stock_i) \times xr^{m}_{i,t} + \varepsilon_{i,t}$$

In this equation, $xr^{LC}_{i,n,t}$ is the log quarterly excess return on local currency long-term bond over domestic short rate (3-month T-bill):

$$xr^{LC}_{i,n,t+1} = r^{LC}_{i,n,t+1} - y^{LC}_{i,1,t}/4\,,$$

and $r^{LC}_{i,n,t+1}$ is the quarterly log holding period return on local currency long-term bond:

$$r^{LC}_{i,n,t+1} \approx \tau_{i,n,t} y^{LC}_{i,n,t} - (\tau_{i,n,t} - 1/4) \underbrace{y^{LC}_{i,n-1,t+1}}_{\approx y^{LC}_{i,n,t+1}} .$$

On the right-hand side, the excess local-currency stock market return is defined as the log quarterly return on local equity market over log local currency T-bill:

$$xr^m_{i,t+1} = \underbrace{(p^m_{i,t+1} - p^m_{i,t})}_{r^m_{i,t+1}} - y^{LC}_{i,1,t}/4 .$$

We obtain local currency government bond yields and stock market indices from Bloomberg. Following Du, Pflueger and Schreger (2020), we focus on 5-year tenor for local currency bond, so that $\tau_{i,n,t} = 5$ and $n = 20$.

local currency bond excess return over T-bill captures cost of government financing. In bad times, stock market return is low (SDF/marginal utility of consumption is high). A *positive* beta corresponds to the case in which local currency bond excess return goes down in bad times, reducing the value of debt repayments for domestic borrowers, so that local currency bonds are good hedging instruments.

Figure 1(a) compares local currency bond-stock beta and local currency share in total corporate debt (from Capital IQ), averaged from 2005 to 2020. Compared to DPS, we restrict attention to EM countries, but we also find a strong negative correlation. Corporates whose home countries' government debt has a better hedging property during downturns issue relatively less local currency-denominated debt.

Stock-FX beta and local currency share of corporate debt Next, we examine the relationship between local currency share and betas related to local currency depreciation. Our stock-FX beta corresponds to the β coefficients from the following regressions using overlapping one-quarter returns as in Du, Pflueger and Schreger (2020):

$$\Delta s_{t+1} = \alpha_i + \beta(stock_i, FX_i) r^m_{i,t+1} + \varepsilon_{i,t} \, ,$$

where $\Delta s_{t+1} = s_{t+1} - s_t$ and s denotes LC-USD exchange rate in units of local currency (an increase in s indicates local currency depreciation against USD). $\beta(stock_i, FX_i)$ captures the comovement of domestic SDF with local currency. A *negative* $\beta(stock_i, FX_i)$ (true for all countries in the sample) suggest that local currency tends to depreciate when marginal utility of consumption is high (bad times). Figure 1(b) shows a similar relationship as the local currency bond-stock beta. Firms in countries, whose stock markets depreciate more when the dollar appreciates, tend to issue more dollar debt forgoing the hedging properties of the local currency.

3 Model

In order to explain the empirical relationships documented in Section 2, we develop an international corporate finance model in which firms facing adverse selection choose the composition of their debt in local and foreign currency. In such an environment, if firms' cash flows are lower during local currency depreciation episodes, borrowing in foreign currency debt is risky, and vice versa. We show that, under natural conditions, there exists a unique separating equilibrium in which the fraction of foreign currency debt is a signal that perfectly reveals firm's type. Instead of hedging against currency depreciation by reducing currency mismatches, better firms effectively take on the FX risk in order to reveal their quality to investors and obtain greater amount of funding. Other firms do not find it optimal to take this risk given the quality of their investment projects.

3.1 Setup

There are two time periods, $t = 0, 1$. A cash-poor firm has an investment project with a fixed investment cost I. It can only finance this project with nominal debt, denominated either in local currency or in foreign currency. In the sequel, we refer to foreign currency as Dollars (USD). At time $t = 1$, when the cash flows X of the firm and the dollar exchange rate $\varepsilon = LC/USD$ are realized, the firms pays out its debt if cash flows are sufficient. Otherwise, it defaults. For simplicity, we assume that the recovery rate in default is zero. We also assume that the dollar exchange rate at $t = 0$ is equal to 1.

Debt markets suffer from a standard adverse selection problem: The firm has a hidden type $\mu \in \mathbb{R}$ that is known to the firm at time $t = 0$, but not to the creditors. The creditors then try to filter firm's type from its debt issuance policy. We denote by B and $B_\$$, respectively, the face values of local currency and dollar-denominated debt issued by the firm. Then, the total face value in local currency to be paid back to debt-holders is given by $B + \varepsilon B_\$$. We use $\alpha = B_\$/B$ to denote the quotient of the face values. Similarly, P and $P_\$$ denote the prices of local currency- and USD-denominated debt of the firm with face value equal to one unit of the respectively currency. Since the firm issues debt to finance its investment, the budget constraint takes the form

$$I \;=\; B\,P \;+\; B_\$\,P_\$ \;=\; B\,(P \;+\; \alpha\,P_\$)\,.$$

Defining $\bar{P} \;\equiv\; P \;+\; \alpha\,P_\$$, we get

$$B \;=\; I/\bar{P}\,.$$

Since the face value B is pinned down by the budget constraint, the only information available to creditors is that in α, the foreign currency-share of total debt face value. Hence, the interest rates $1/P$ and $1/\bar{P}$ offered by creditors only depend on this single variable. In the sequel, we therefore use the notation $P(\alpha)$, $P_\$(\alpha)$, $\bar{P}(\alpha)$, $B(\alpha)$, $B_\$(\alpha)$. We will need the following technical assumption.

Assumption 1 *The random vector (X, μ, ε) of firm cash flows, hidden type, and USD exchange rate have a joint densify $\rho(x, \mu, \varepsilon)$ on $(0, +\infty) \times [\mu_0, \bar{\mu}] \times [\varepsilon_*, \varepsilon^*]$, where ε^* could be infinite.*

We will also use $\eta(x|\mu, \varepsilon)$ to denote the density of X conditional on μ, ε. We assume that η is log-concave in x and has the standard monotone likelihood property: $(\log \eta)_\mu = \frac{\eta_\mu}{\eta}$ is monotone increasing in x. That is, firms' of higher type μ have higher cash flows.

Monotone likelihood property guarantees that an increase in μ leads to a first order stochastic dominance shift in the distribution of X, so that higher μ means a better firm. See Lemma B.2 in the Appendix. We will use

$$\Phi(x, \mu, \varepsilon) = \int_0^x \eta(y|\mu, \varepsilon) dy$$

to denote the cumulative distribution function of firm's cash flows conditional on (μ, ε), and

$$\Psi(x, \mu, \varepsilon) = \int_x^\infty (y - x)\eta(y|\mu, \varepsilon) dy$$

to the expected cash flows in excess of a level x, conditional on (μ, ε).

Lenders offer firms with price schedules based on α. We assume that all market participants are risk neutral and fully rational and discount future at zero rate. Under this assumption, bond prices are given by

$$P(\alpha) = E[(1 - \Phi(Z(\alpha, \varepsilon), \mu, \varepsilon))|\alpha], \; P_\$(\alpha) = E[\varepsilon(1 - \Phi(Z(\alpha, \varepsilon), \mu, \varepsilon))|\alpha]$$

because the firm defaults if and only if cash flows X are below the total debt face value, as given by

$$Z(\alpha,\varepsilon) \;\equiv\; B(\alpha)+\varepsilon B_{\$}(\alpha) \;=\; (1+\alpha\varepsilon)B(\alpha) \;=\; (1+\alpha\varepsilon)I/\bar{P}(\alpha)\,,$$

with $\bar{P}(\alpha) = P(\alpha) + \alpha P_{\$}(\alpha)$. As we do not put restrictions on the exchange rate a priori, we do not assume foreign currency borrowings have an inherent cost advantage.

Furthermore, conditional on α, shareholders' expected profits (equity value) are given by

$$E[\Psi(Z(\alpha,\varepsilon),\mu,\varepsilon)]\,.$$

3.2 Characterization of equilibrium

We focus our analysis on fully revealing, separating equilibria.[5] In this class of equilibria, lenders internalize the issuance decision of the firms by offering price schedules $P(\alpha)$ and $P_{\$}(\alpha)$ based on firms' type. In other words, α perfectly signals firm's hidden type μ for those firms that are able to raise enough funds to finance I. To allow for rationing, we study monotone threshold rationing equilibria in which all firms of type μ above an equilibrium threshold μ_* get financing.[6]

Definition 3.1 *A separating monotone equilibrium (henceforth, equilibrium) is given by*

- *a rationing threshold* $\mu_* \geq \mu_0$*;*
- *a strictly monotone, continuously differentiable function* $A(\mu):\ [\mu_*,\bar{\mu}] \rightarrow \mathbb{R}_+$ *defining the fraction of dollar debt issued by the firm of type* μ *with the inverse function* $\mu(\alpha)$ *such that:*

[5] As is well-known, signaling models often feature multiple equilibria. We focus on the class of separating equilibria, following Demarzo and Duffie (1999). Our empirical analysis in Section 4 confirms that the separating equilibrium is indeed the relevant equilibrium in the data.

[6] We only consider equilibria in which all pricing functions are continuously differentiable with respect to α.

– *if* A *is monotone increasing, then* $\mu(\alpha): \; [\alpha^*, +\infty] \; \rightarrow \; [\mu_*, \bar{\mu})$ *such that* $\mu(\alpha_*) = \mu_*, \; \mu(\infty) = \; \bar{\mu}$

– *if* A *is monotone decreasing, then* $\mu(\alpha): \; [0, \; \alpha^*] \; \rightarrow \; [\mu_*, \bar{\mu})$ *such that* $\mu(0) = \bar{\mu}, \; \mu(\alpha^*) = \; \mu_*$

- *out-of-equilibrium beliefs: for firms that choose* $\alpha < \alpha^*$ *in the increasing equilibrium or* $\alpha > \alpha^*$ *in the decreasing equilibrium, creditors believe that they have a type* $\mu = \mu_*$.[7]

- *debt pricing functions are rational and satisfy*

$$P(\alpha) \;=\; E[(1 - \Phi(Z(\alpha,\varepsilon), \mu(\alpha), \varepsilon))], \;\; P_\$(\alpha) \;=\; E[\varepsilon(1 - \Phi(Z(\alpha,\varepsilon), \mu(\alpha), \varepsilon))]\,, \quad (1)$$

where $\mu(\alpha) \;=\; A^{-1}(\alpha)$ *if the inverse of* $A(\mu)$*;*

- *the fraction* $A(\mu)$ *is optimal for the firm given the debt pricing functions* (1)*:*

$$A(\mu) \;=\; \arg\max_{\alpha > 0} E[\Psi((1 + \alpha\varepsilon)I/\bar{P}(\alpha), \mu, \varepsilon)]\,. \qquad (2)$$

and

$$\max_{\alpha > 0} E[\Psi((1 + \alpha\varepsilon)I/\bar{P}(\alpha), \mu, \varepsilon)] \;\geq\; I$$

if and only if $\mu \geq \mu_*$.

Note that there is a complete symmetry between the dollar and local currency in our model. Indeed, instead of ε, consider $\tilde{\varepsilon} \;\equiv\; \varepsilon^{-1}$, the USD/LC exchange rate, and let $\tilde{X} \;\equiv\; X/\varepsilon$ be the firm cash flows denominated in US dollars. By direct calculation, the conditional density of $\tilde{X}$ is given by $\tilde{\eta}(\tilde{x}|\mu, \tilde{\varepsilon}) \;=\; \tilde{\varepsilon}^{-1}\eta(\tilde{\varepsilon}^{-1}\tilde{x}|\mu, \tilde{\varepsilon})$ and we can similarly define the functions $\tilde{\Phi}$ and $\tilde{\Psi}$:

$$\tilde{\Phi}(\tilde{x}, \mu, \tilde{\varepsilon}) \;=\; \int_0^{\tilde{x}} \tilde{\eta}(y|\mu, \tilde{\varepsilon})dy$$

[7] This assumption ensures that it is never optimal for a firm to choose α outside the respective interval.

and

$$\tilde{\Psi}(\tilde{x},\mu,\tilde{\varepsilon}) \;=\; \int_{\tilde{x}}^{\infty}(y-\tilde{x})\tilde{\eta}(y|\mu,\tilde{\varepsilon})dy\,.$$

We can also define

$$P_*(\tilde{\alpha}) \;=\; E[(1-\tilde{\Phi}(Z(\alpha,\tilde{\varepsilon}),\mu,\tilde{\varepsilon}))|\tilde{\alpha}],\;\; P_{\$,*}(\tilde{\alpha}) \;=\; E[\tilde{\varepsilon}^{-1}(1-\Phi(Z(\tilde{\alpha},\tilde{\varepsilon}),\mu,\tilde{\varepsilon}))|\tilde{\alpha}]$$

and

$$\tilde{P}(\tilde{\alpha}) \;=\; P_{\$,*}(\tilde{\alpha}) \;+\; \tilde{\alpha}P_*(\tilde{\alpha}) \;=\; E[\tilde{\varepsilon}^{-1}(1+\tilde{\alpha}\tilde{\varepsilon})(1-\tilde{\Phi}(\tilde{B}_{\$}(\tilde{\alpha})(1+\tilde{\alpha}\tilde{\varepsilon})))]\,,$$

with

$$Z(\tilde{\alpha},\tilde{\varepsilon}) \;=\; \tilde{B}_{\$}(\tilde{\alpha})(1+\tilde{\alpha}\tilde{\varepsilon})\,.$$

In particular, $\tilde{P}(\tilde{\alpha})=\tilde{\alpha}\bar{P}(\tilde{\alpha}^{-1})$. Furthermore,

$$I \;=\; \tilde{B}(\tilde{\alpha})P_*(\tilde{\alpha}) \;+\; \tilde{B}_{\$}(\tilde{\alpha})P_{\$,*}(\tilde{\alpha}) \;=\; \tilde{B}_{\$}(\tilde{\alpha})\tilde{P}(\tilde{\alpha})\,,$$

so that

$$\tilde{B}_{\$}(\tilde{\alpha}) \;=\; I/\tilde{P}(\tilde{\alpha})$$

Then, we can rewrite firm's objective as

$$\max_{\tilde{\alpha}>0} E[\tilde{\varepsilon}^{-1}\tilde{\Psi}((1+\tilde{\alpha}\tilde{\varepsilon})I/\bar{P}(\tilde{\alpha}),\mu,\tilde{\varepsilon})]\,.$$

This symmetry will allow us to always have a local currency counterpart for every result about dollar debt.

We construct a candidate equilibrium using first order conditions, and then verify that the candidate equilibrium satisfies all the necessary technical conditions. First, we note that

(1) immediately implies that

$$\bar{P}(\alpha) \;=\; E[(1+\varepsilon\alpha)(1-\Phi((1+\alpha\varepsilon)I/\bar{P}(\alpha),\mu(\alpha),\varepsilon))\,. \tag{3}$$

Define $F(x,y)$ implicitly to be the unique[8] solution to

$$x \;=\; E[(1+\varepsilon y)(1-\Phi((1+\varepsilon y)I/x,\; F(x,y),\; \varepsilon))]$$

Then, (3) immediately yields the following result.

Lemma 3.2 *In a separating equilibrium, the inverse $\mu(\alpha)=A^{-1}(\alpha)$ is given by*

$$\mu(\alpha) \;=\; F(\bar{P}(\alpha),\,\alpha)\,.$$

Now we need to derive an equation for $\bar{P}(\alpha)$. To this end, we use the first order conditions for the firm in (2) : At an interior optimum of

$$\max_{\alpha} E[\Psi(B(\alpha)(1+\varepsilon\alpha),\mu,\varepsilon)]\,,$$

we get that the first order condition defining the candidate optimum $\alpha = A(\mu)$ is given by

$$-E[(1-\Phi(B(\alpha)(1+\varepsilon\alpha),\mu,\varepsilon))(B'(\alpha)(1+\varepsilon\alpha)+B(\alpha)\varepsilon)] \;=\; 0\,,$$

and, in equilibrium, this condition must hold for $\mu \;=\; F(\bar{P}(\alpha),\,\alpha)$. Substituting $B(\alpha) \;=\; I/\bar{P}(\alpha)$ and using (3), we can characterize the equilibrium price of the debt.

Proposition 3.3 *In any candidate equilibrium, the price $\bar{P}(\alpha)$ satisfies the ordinary differ-*

[8] Uniqueness follows because, by the monotone likelihood property, Φ is monotone decreasing in μ.

ential equation

$$\bar{P}'(\alpha) \; = \; E[\varepsilon(1 - \Phi((I/\bar{P}(\alpha))(1+\varepsilon\alpha), F(\bar{P}(\alpha),\, \alpha), \varepsilon))]\,, \tag{4}$$

and the corresponding candidate equilibrium $\mu(\alpha)$ *is given by* $\mu(\alpha) \; = \; F(\bar{P}(\alpha),\, \alpha)\,.$

With Equation (4), we can now derive sufficient conditions for monotone equilibria. Intuitively, a firm's decision to issue dollar debt will depend on the risk profile of ε – whether dollar appreciation is associated with higher (respectively, lower) expected cash flows. Reducing currency mismatches is consistent with the traditional hedging motive – doing so would reduce the probability of default due to debt revaluation. However, in the separating equilibrium, taking on currency mismatches potentially leads to better financing conditions as creditors respond to the revealed types of higher-quality firms. The following proposition confirms that the signaling motive could dominate in equilibrium.

Proposition 3.4 *The following is true.*

- *if* $(\log\tilde{\eta})_{\tilde{\varepsilon}\tilde{x}} < 0$, *then any candidate equilibrium* $\mu(\alpha)$ *from Proposition 3.3 is monotone decreasing in* α*;*
- *if* $(\log\eta)_{\varepsilon x} < 0$, *then any candidate equilibrium* $\mu(\alpha)$ *from Proposition 3.3 is monotone increasing in* α*.*

Furthermore, in any equilibrium, firm equity value

$$E(\mu) \; \equiv \; E[\Psi((1 + A(\mu)\varepsilon)I/\bar{P}(A(\mu)), \mu, \varepsilon)] \tag{5}$$

is monotone increasing in μ*.*

Condition $(\log\tilde{\eta})_{\tilde{\varepsilon}\tilde{x}} < 0$ ensures the monotone likelihood property: Dollar appreciation is associated with higher expected cash flows in the sense of first order stochastic dominance.

This could be the case for an emerging market firm that derives most of its profits from exporting. These firms, according to Proposition 3.4, would choose to voluntarily forgo their natural hedges and borrow in local currency if their hidden types allow them to generate higher cash flows. By contrast, condition $(\log \eta)_{\varepsilon x} < 0$ implies that a dollar appreciation is associated with lower local-currency cash flows. For these firms, a higher foreign currency share signals a better type.

Lemma 3.5 provides a method to construct the equilibrium we characterized:

Lemma 3.5 *The unique candidate monotone decreasing equilibrium is constructed as follows. First, using $\mu(0) = \bar{\mu}$ we find $\bar{P}(0)$ as the unique solution to*

$$\bar{P}(0) \;=\; E[(1 - \Phi(I/\bar{P}(0), \bar{\mu}, \varepsilon)\,.$$

Then, $\bar{P}(\alpha)$ is defined as the unique solution to the ODE (4). And then, α^* is defined as the unique solution to

$$E(\mu(\alpha^*)) \;=\; I\,,$$

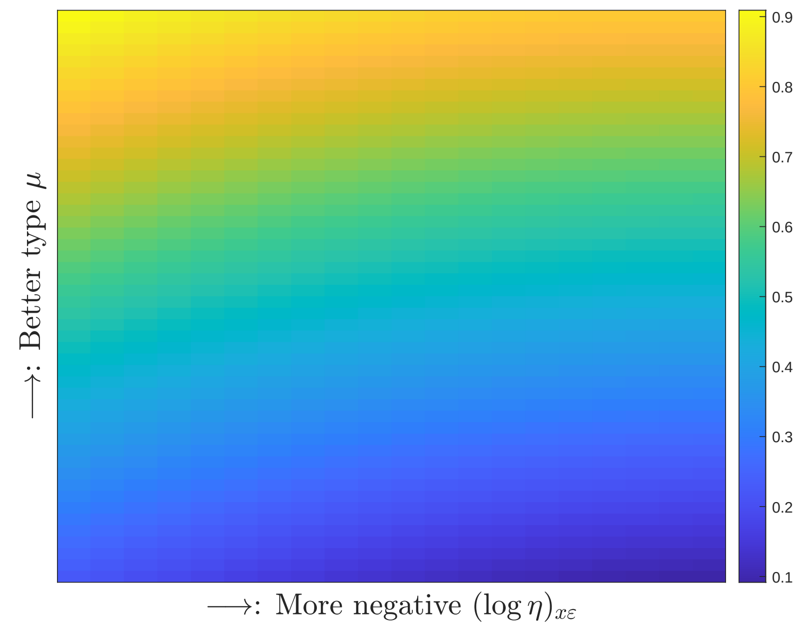
where $E(\mu)$ is defined in (5). In the monotone increasing equilibrium, we first do the transformation $\alpha \to 1/\alpha$ and then proceed as above.

Guided by Lemma 3.5, Figure 2 plots the equilibrium fraction of foreign currency as a function of both the hidden types of the firms, and firms' cash flow sensitivity to exchange rate. For the purpose of illustration, we focus on the increasing equilibrium and assume the conditional cash flow is log-normally distributed with condition mean given by $f(\mu, \varepsilon) = \mu - \delta \log \varepsilon$ with $\delta > 0$. A higher value of δ thus leads to a more negative covariance between cash flow and local currency depreciation.

Figure 2 displays the equilibrium forces at work. The traditional hedging motive still exists in our model: all firms, regardless of hidden types, would like to reduce borrowing in foreign currency if local currency depreciation leads to a larger decline in future cash flows.

However, with adverse selection, firm's hedging motive is outweighed by the incentive to signal a high repayment ability, as doing so effectively reduces the debt burden on the firm ex ante.

Figure 2: Foreign-currency share, sensitivity to depreciation, and firm type



Note: This figure numerically illustrates the equilibrium foreign currency share as a function of hidden type and cash flow sensitivity to exchange rate. The colors on the heatmap represent equilibrium foreign-currency share chosen by firms of type μ under different values of $(\log \eta)_{x\varepsilon}$. We focus on an increasing equilibrium and assume cash flows are conditionally log-normal with parameters $(\mu_\varepsilon, \sigma_\varepsilon)$: $\eta(x|\mu, \varepsilon) = \frac{1}{\sqrt{2\pi}\sigma x} e^{-(\log x - f(\mu,\varepsilon))^2/(2\sigma^2)}$. with the conditional mean function given by $f(\mu, \varepsilon) = \mu - \delta \log(\varepsilon), \delta \in [5, 6]$. A higher δ corresponds to a more negative $(\log \eta)_{x\varepsilon}$, and thus a larger sensitivity of cash flow to local currency depreciation. The unconditional distribution of the exchange rate is also assumed to be log-normal. Foreign-currency share is expressed as a fraction by transforming the face value ratio α using the transformation $(\alpha^{-1} + 1)^{-1}$. Parameter values are given by: $\varepsilon_* = e^{-0.25}, \varepsilon^* = e^{0.25}, \mu_\varepsilon = 0.5, \sigma_\varepsilon = 0.5, \sigma = 0.1, I = 0.5$.

To complete the analysis, we need to verify the second order conditions of the firm. We impose mild restrictions to ensure that the candidate optimum satisfying the first order conditions is indeed the true global optimum.

Proposition 3.6 *The following is true.*

- *if* $(\log \eta)_{x\varepsilon} \leq 0$ *and* $(\log \tilde{\eta})_{\tilde{x}\tilde{\varepsilon}} \geq 0$ *and* $(\log \tilde{\eta})_{\mu\tilde{\varepsilon}} \geq 0$, *then any candidate equilibrium is monotone increasing in* α *and is a true equilibrium;*

- *if* $(\log \tilde{\eta})_{\tilde{x}\tilde{\varepsilon}} \leq 0$ *and* $(\log \eta)_{x\varepsilon} \geq 0$ *and* $(\log \eta)_{\mu\varepsilon} \geq 0$, *then any candidate equilibrium is monotone decreasing in* α *and is a true equilibrium.*

Finally, to connect the model with our empirical analysis, we prove a theoretical result about the link between ex-ante and ex-post sensitivity of the stock price to the exchange rate. Consider the expected equity value conditional on the realization of the exchange rate shock ε. It is given by $\Psi(B(\alpha)(1 + \varepsilon\alpha), \mu(\alpha), \varepsilon)$. The following result shows that the sign of the co-movement between equity value and ε coincides with that of the cash flows, as captured by the sign of $\log \eta_{x\varepsilon}$.

Proposition 3.7 *If* $\log \eta_{x\varepsilon} > 0$ *then*

$$\frac{\partial}{\partial \varepsilon} \Psi(B(\alpha)(1 + \varepsilon\alpha), \mu(\alpha), \varepsilon) \;>\; 0\,,$$

and the sign changes to negative when $\log \tilde{\eta}_{\tilde{x}\tilde{\varepsilon}} > 0$.

4 Empirical evidence

In this section, we provide extensive empirical evidence for the main prediction of the theory. Firms with negatively correlated cash flows with the foreign currency/local currency exchange rate (the dollar in this section), which also have a higher foreign currency share in their borrowing, are "better-quality" firms. We implement this empirically in predictive regressions, where the foreign currency share of debt predicts earnings. In our model, firms borrow in foreign currency if their future operational profits are large (which is hidden information), so that they are better placed to take on the currency risk. To follow the model closely, we focus on earnings before interest, taxes, depreciation and amortization (EBITDA) as the main outcome variable in the regressions.

We proceed as follows. We first provide a description of the dataset and summary statistics. Next, we use the richness of our panel data structure, in order to provide evidence for predictions of the model in a dynamic setting. Finally, we provide evidence using the Global Financial Crisis, the COVID-19 crisis, and emerging market economy local currency depreciation episodes. Taken together, our results suggest that the foreign currency share of corporate debt predicts earnings during normal times, crises and local currency depreciation episodes. These results are not driven by firms' exporting status, access to FX borrowing or other firm characteristics, which we rule out through a number of control variables and a series of robustness checks.

4.1 Data and summary statistics

We obtain firm-level balance sheet information from S&P Capital IQ database. In its debt capital structure module, Capital IQ reports outstanding debt instruments issued by a global set of firms and provides information on the type, principal due, coupon rate, maturity and repayment currency of each security. Compared with other firm-level datasets on global debt issuance, Capital IQ tracks the stock of outstanding debt on each firm's balance sheet, and include a wide range of securities beyond external bond issuance and syndicated borrowing.[9]

We focus on non-financial firms. The empirical counterpart to α in Section 3 is foreign-currency debt outstanding as a share of total outstanding debt reported in the debt capital structure module. Before computing the foreign-currency share, we drop securities with zero principal and missing information on currency denomination and year of maturity. We drop debt securities maturing in the same quarter as the reporting date, as well as securities with implausibly high days until maturity. For firm f in year t, the foreign-currency share of its

[9] Kim (2019), Kim, Mano and Mrkaic (2020) and Du and Schreger (2022) also use Capital IQ data to construct currency breakdown of outstanding corporate debt.

outstanding debt, $FC\_Share_{f,t}$, is defined as

$$FC\_Share_{f,t} = \frac{\sum_{i \neq LC} Debt\ Outstanding_{i,f,t}}{\sum_i Debt\ Outstanding_{i,f,t}}$$

where $Debt\ Outstanding_{i,f,t}$ is firm f's outstanding debt denominated in currency i, and LC denotes local currency.

We further merge the foreign-currency debt share variable with information on firm characteristics and cash flow correlation with exchange rate fluctuations. We obtain from Capital IQ important operating metrics for each firm. This set of variables include total assets and liabilities, capital expenditures, earnings (measured using EBITDA), and financial health variables such as current ratio and Altman z-score. Panel (a) of Table 1 reports summary statistics of firms' financial variables and foreign-currency shares. In particular, for an average firm in a given year, around 12 percent of the outstanding debt is denominated in foreign currency. The average levels of hard currency share and foreign currency share in bank loans are similar.

Our model establishes a strong link between cash flow sensitivity of firms to exchange rate shocks and firms' foreign-currency borrowing. Proposition 3.7 furthers shows that the direction of the co-movement between cash flows and the exchange rate in the model can be measured by the sensitivity of stock prices to exchange rate shocks. To calculate firm-level β between stock return and local currency depreciation, we merge our sample with monthly firm-level stock price information obtained from Thompson Reuters Worldscope (via ISIN) and country-level bilateral exchange rate against U.S. dollar from BIS. We compute firm-level stock return-depreciation β by regressing the overlapping three-month stock return on three-month local currency depreciation at monthly frequency. Our baseline β measure is time-invariant, spanning the sample period 2005-2019. In some subsequent analysis, we also employ a β measure computed from firm-specific rolling regressions with recursive window of at least 4 years of observations. Panel (b) of Table 1 reports summary statistics for the stock return-depreciation β. In our sample, nearly 90% of firms have a negative static β. Interpreted through the lens of our model, most firms in the data generate low cash flows during episodes of local currency depreciation.

As the financial variables are of annual frequency, we take year-end data to form our final sample for regressions, which contains 59,559 firm-year observations for 6855 firms from 9 countries spanning 2005 to 2020.[10] We also winsorize the financial variables at 2.5% and 97.5% to alleviate the impact of outliers. Table 2 checks if the firms in our sample differ along the dimension of foreign-currency borrowing (α) and cash flow sensitivity to exchange rate (β). Consistent with prior literature, Panel (a) suggests that on average, firms that borrow in foreign currency tend to be larger (measured by total assets or earnings). Meanwhile, however, they are financially less stable compared to their peers that only borrow in local currency. While these ex-ante comparison may suggest that firms may be gambling for resurrection by borrowing in foreign currency, our subsequent analysis reveals the working of the signaling channel. Panel (b) compares an average firm with a positive stock return-depreciation β to an average firm with a negative β. Firms with a negative β are on average slightly larger than positive-β firms but have relatively smaller current ratio and z-score. Positive-β firms on average has a larger foreign-currency share out of total debt, consistent with the idea that these firms may have operational hedges.

[10]The sample of countries are major emerging market economies, including Brazil, China, Indonesia, India, South Korea, Mexico, Russia, Turkey and South Africa.

Table 1: Summary statistics

Panel (a): Financial variables and foreign-currency share

Variable	Obs	Mean	Std. Dev.	Min	Max	P50
foreign currency share (%)	59559	12.094	28.223	0	100	0
hard currency share (%)	59559	11.257	27.222	0	100	0
fc share (bank loan, %)	55037	12.116	28.704	0	100	0
EBITDA (mil. USD)	59235	110.136	226.57	-12.1	1025.233	21.604
total assets (mil. USD)	59541	1291.077	2406.193	6.131	10623.24	329.648
total liabilities (mil. USD)	59544	740.697	1465.773	2.644	6499.284	152.096
current ratio	59541	1.628	1.151	.301	6.074	1.31
z-score	56377	3.065	2.648	-.792	12.434	2.37
CAPEX (mil. USD)	58627	69.319	145.304	.037	664	12.533

Panel (b): Stock return-depreciation beta for each firm

Variable	Obs	Mean	Std. Dev.	Min	Max	P50
stock return-depreciation beta (05-19, negative)	5941	-1.624	1.366	-37.516	0	-1.408
stock return-depreciation beta (05-19, positive)	774	1.32	2.775	0	33.834	.575
rolling beta	52046	-1.208	18.812	-3610.308	1190.61	-1.138

Note: This table reports summary statistics for the key variables used in the empirical analysis. Panel (a) focuses on firm-level balance sheets. Foreign-currency share is the share of outstanding debt denominated in currencies other than a firm's local currency. Hard currency is defined as one of CHF, EUR, JPY, or USD. Bank loan contains two types of instruments: term loans and credit lines. Current ratio is defined as the ratio between current assets and current liabilities. The financial variables are winsorized at 2.5% and 97.5%. Panel (b) reports summary statistics for the stock return-depreciation betas. For each firm, monthly data is used to regress overlapping quarter-over-quarter stock return on quarter-over-quarter local currency depreciation against U.S. dollar. The time-invariant betas (first two rows) are generated using the sample from 2005 to 2019. The rolling betas are generated using all available information from 2000 and a recursive window with a minimum number of observations of 48 months. The first row covers all 6084 firms with negative betas and the second row covers the remaining 811 firms with positive betas.

Table 2: Firm characteristics by foreign-currency share or sign of β

Panel (a): by zero or positive foreign-currency share

	zero fc share		**non-zero fc share**		**mean diff.**
	mean	sd	mean	sd	t
EBITDA (mil. USD)	82.18	(182.10)	195.83	(311.95)	-53.85
total assets (mil. USD)	1028.49	(2027.42)	2098.78	(3176.70)	-47.58
current ratio	1.64	(1.17)	1.59	(1.08)	5.14
z-score	3.21	(2.73)	2.63	(2.32)	22.47
CAPEX (mil. USD)	53.33	(120.49)	118.24	(195.25)	-47.50
β (05-19, negative)	-1.64	(1.20)	-1.59	(1.90)	-1.02
β (05-19, positive)	1.19	(2.29)	1.78	(3.96)	-2.50
Observations	44946		14612		59558

Panel (b): By sign of β

	$\boldsymbol{\beta < 0}$		$\boldsymbol{\beta > 0}$		**mean diff.**
	mean	sd	mean	sd	t
EBITDA (mil. USD)	111.56	(227.24)	97.63	(220.25)	-4.54
total assets (mil. USD)	1314.20	(2420.29)	1088.20	(2268.91)	-6.95
current ratio	1.62	(1.15)	1.66	(1.19)	2.56
z-score	3.05	(2.62)	3.18	(2.87)	3.53
CAPEX (mil. USD)	70.14	(145.61)	62.11	(142.41)	-4.04
foreign currency share (%)	11.72	(27.63)	15.34	(32.78)	9.49
Observations	53463		6096		59559

Note: Panel (a) compares balance sheet indicators between firms with zero or positive foreign-currency borrowings. Foreign-currency share is the share of outstanding debt denominated in currencies other than a firm's local currency. Panel (b) makes the comparison between firms with positive stock return-depreciation βs versus firms with negative βs. The βs are computed using monthly data on overlapping three-month stock return (obtained from Worldscope) and three-month local currency depreciation (obtained from BIS).

4.2 Panel data analysis

In the first part of this section, we use the panel structure of our dataset and test whether the foreign currency share of liabilities of a firm at a given period can predict earnings in future periods. We first provide evidence on negative beta firms using different specifications and sub-samples. We focus mostly on firms with a negative co-movement of cash flows and the dollar exchange rate, that is firms with incentives to signal by borrowing more in foreign currency.

In the second part, we test a distinctive prediction of our model comparing negative beta firms with positive beta firms. In particular, our model predicts that while negative beta firms borrow in foreign currency to signal their quality, positive beta firms would do the opposite (Proposition 3.4). We find that indeed a higher foreign currency share statistically significantly predicts higher earnings for negative-beta firms for one and two years out, and higher foreign currency share predicts significantly lower earnings even five years ahead.

4.2.1 Panel data analysis for negative beta firms

We test whether foreign currency share predicts future earnings focusing on negative beta firms (i.e. those whose cash flows co-move negatively with the dollar) using the specification below:

$$EBITDA_{f,t+1} = \beta_1 FC\_share_{f,t} + \beta_2 Firm\ Controls_{f,t} + \eta_{c,i,t} + \epsilon_{f,t}$$

Our panel dataset is at the firm-year level (f, t). We predict $EBITDA_{f,t+1}$ (and also $\left(\frac{EBITDA_{f,t+1}}{TotalAssets_{f,t+1}}\right) * 100$ in some specifications) with the $FC\_share_{f,t}$ variable constructed using the Capital IQ debt structure dataset. In every specification, we use $Country * Industry * Year$ fixed effects, which strip out yearly variation at the industry level within a country, which controls for a host of factors that could impact results as well as controls at the firm-year level, $TotalAssets_{f,t}$, $TotalLiabilities_{f,t}$, $z\text{-}score_{f,t}$ and $CurrentRatio_{f,t}$. All variables (except current ratio and z-score) are measured in millions of U.S. dollars to make them comparable across countries. We restrict the sample to 2005-2019. In Table 3, we restrict our sample to firms which have a negative beta in the 2005-2019 period. We cluster the standard errors at the industry level.

Foreign currency share of debt positively and statistically significantly predicts one-year ahead earnings for negative beta firms.[11] This holds true across different specifications and sub-samples. In terms of magnitudes, controlling for observable firm-level characteristics, a 10 percentage point increase in foreign currency share in year t predicts around $2 million increase in EBITDA (column 1) in year $t+1$ and similar magnitudes in the subsamples in other columns.

We present the results in Table 3. In column (1), we include all observations. In column (2), we restrict the sample to firms that have access to foreign currency borrowing (i.e. firms that have borrowing in foreign currency at least once during the sample period). We take the sample restriction in column (2) as the baseline.[12] Note that most firms in the sample do not have access to FX borrowing and the sample reduces by more than a half. In column (3), we further restrict the sample to firms in the non-tradable sectors.[13] In column (4), we restrict attention to the hard currency (USD, EUR, CHF, JPY) borrowing of firms with market access. In column (5), we provide a robustness check restricting the sample to those firms for which the aggregate debt reported in the Capital IQ debt capital structure dataset is within +/- 25% of total debt reported in financial statements.[14] In column (6), we create

[11] The sign of beta is stable throughout the sample period. We also repeat the same exercise using a rolling beta only including observations prior to the given period. The results are reported in Appendix C , Table C2 and are robust. We prefer using the full sample beta as the baseline, which increases the number of observations.

[12] In Appendix C, Table C2 presents robustness check restricting the sample only to firms that have borrowed in foreign currency at a given period and the results are similar. Table C3 show that the results are largely robust if we replace the dependent variable with EBIT, or if we use a dummy of positive foreign-currency share to account for the extensive margin of foreign-currency borrowing.

[13] We follow Aguiar and Gopinath (2005) and classify industries with SIC codes 2000-3999 as tradable.

[14] Aggregate outstanding debt reported in the debt capital structure module of Capital IQ do not always

a measure of foreign currency share in bank loans only as opposed to a combination of bank loans and bonds and run the regression for firms with market access. Finally, in column (7), we rerun the regression for firms with market access to predict normalized earnings, $\left(\frac{EBITDA_{f,t+1}}{TotalAssets_{f,t+1}}\right) * 100$.

We rule out potential alternative explanations through a number of robustness checks using different specifications and sub-samples. First, across all specifications, we use $Country * Industry * Year$ fixed effects, which allows us to compare firms in the same country, which operate in the same industry, and at a given year. This rules out any potential differences across countries or industries driving our results. Utilizing only within country-industry-year variation is conceptually closer to the key mechanism of firm-level asymmetric information highlighted in our model. Second, it could be that firms select into foreign currency borrowing and the characteristics which allow them to generate higher returns. To address this concern, we restrict the sample to firms who have access to FX borrowing during the whole sample, or during each period in an alternative setup. Moreover, we include firm controls and $Country * Industry * Year$ fixed effects in each specification and also normalize earnings by total assets in column (7), which should further alleviate such concerns. Third, foreign currency share of debt could positively predict earnings if a firm is an exporter, and exporting firms could have higher earnings than non-exporters (see, for example, Melitz (2003)). Since we restrict the sample to negative beta firms (firms whose cash flows move negatively with the dollar appreciation), this is unlikely to be a large concern for us, since we would expect exporters to have a positive beta. To further alleviate this concern, we restrict our attention to firms in non-tradable sectors in column (3) and the results go through. Also note that

match total debt reported in financial statements. Since our main interest lies in measuring the foreign currency share of borrowing and we don't have a reason to believe the omission or addition of instruments on Capital IQ would present a bias either towards local currency or foreign currency, we use the full sample as a baseline. We are aware that this creates an attenuation bias through measurement error, which would in principle work against us since our theory predicts a positive relationship. Appendix C, Table C1 report results restricting the sample to within 1%, 5%, 10% of the sample and the results are very similar to the unrestricted sample or the restricted sample with 25%.

Table 3: Signaling channel of foreign-currency debt: Full panel analysis

VARIABLES	(1) all $EBITDA_{f,t+1}$	(2) with market access $EBITDA_{f,t+1}$	(3) non-tradable with access $EBITDA_{f,t+1}$	(4) hard currency with access $EBITDA_{f,t+1}$	(5) consistency with access $EBITDA_{f,t+1}$	(6) bank loan with access $EBITDA_{f,t+1}$	(7) normalized with access $EBITDA_{f,t+1}$ / $Asset_{f,t+1}$ (%)
foreign currency $share_{f,t}$	0.198***	0.150***	0.215**		0.153***		0.008***
	(0.038)	(0.041)	(0.103)		(0.040)		(0.003)
hard currency $share_{f,t}$				0.137***			
				(0.043)			
fc share (bank $loan)_{f,t}$						0.116**	
						(0.044)	
current $ratio_{f,t}$	-10.115***	-14.251***	-19.109***	-14.156***	-14.260***	-15.062***	-0.813***
	(1.350)	(2.643)	(5.079)	(2.632)	(2.803)	(2.776)	(0.146)
$z\text{-}score_{f,t}$	8.347***	12.703***	15.032***	12.692***	13.003***	12.987***	1.226***
	(0.755)	(1.263)	(2.778)	(1.264)	(1.455)	(1.350)	(0.095)
$CAPEX_{f,t}$	0.442***	0.402***	0.358***	0.402***	0.392***	0.394***	0.007***
	(0.046)	(0.059)	(0.103)	(0.059)	(0.065)	(0.060)	(0.001)
total $assets_{f,t}$	0.099***	0.097***	0.099***	0.097***	0.096***	0.096***	0.000**
	(0.006)	(0.007)	(0.010)	(0.007)	(0.008)	(0.007)	(0.000)
total $liabilities_{f,t}$	-0.066***	-0.055***	-0.052***	-0.055***	-0.052***	-0.054***	-0.001**
	(0.009)	(0.011)	(0.013)	(0.011)	(0.013)	(0.012)	(0.000)
Observations	45,304	20,935	5,740	20,935	12,735	19,539	20,900
R-squared	0.841	0.854	0.866	0.854	0.853	0.849	0.409
Country*Industry*Year FE	✓	✓	✓	✓	✓	✓	✓
No. clusters	60	56	37	56	56	56	56
No. FEs	3756	2934	1437	2934	2199	2780	2931

Note: This table reports panel regressions relating foreign currency share of outstanding debt to future earnings of firms. The sample period is 2005 to 2019, focusing on firms with a negative stock return-depreciation beta over the same period. The independent variables are year-t financial variables and foreign-currency shares. The dependent variables are earnings (proxied by EBITDA) over year $t+1$. Column (1) reports results for the entire sample of firms. Column (2) to (7) focus on firms with access to foreign-currency funding. They are defined as firms who borrowed in foreign currency at least once over the sample period. Column (3) further restricts the analysis to non-tradable firms, following the classification of Aguiar and Gopinath (2005). Column (4) use hard-currency share (CHF, EUR, JPY, USD). Column (5) checks if the results are robust to restricting the analysis to firms whose total outstanding debt recorded in the debt capital structure dataset is consistent with the main financial statements (with a maximum absolute deviation of 25%). Column (6) looks at foreign-currency share of bank loans (credit lines and term loans), and column (7) uses EBITDA normalized by total assets as the dependent variable. Standard errors are clustered at the industry level. *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

previous literature suggests that most firms that borrow in foreign currency are non-exporters (Ranciere, Tornell and Vamvakidis (2014), Kim, Tesar and Zhang (2015), Salomao and Varela (2022)). Fourth, borrowing via bonds might only be possible via foreign currency due to the home-currency bias documented in Maggiori, Neiman and Schreger (2020) diminishing the channels for signalling in borrowing from international investors by issuing bonds. We rule out this explanation in column (6) by measuring the foreign currency share in bank loans only.[15]

4.2.2 Comparing negative versus positive beta firms

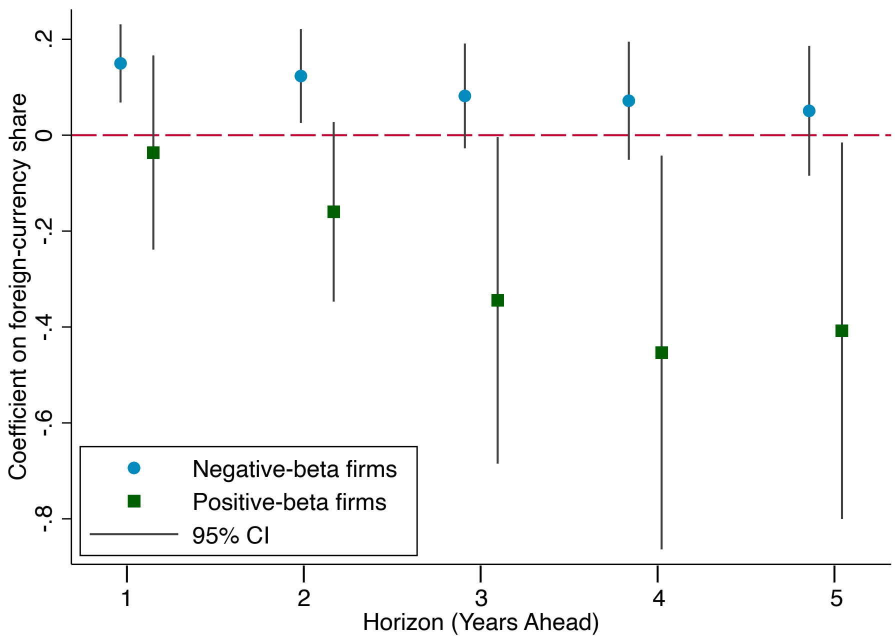
Next, we report evidence on the distinctive feature of our theory. Firms with a signalling motive would take on risk to reveal their type to their investors. In our model, this risk depends crucially on the co-movement of cash flows with the bilateral exchange rate of the foreign currency (the dollar in our empirical setup) and the local currency. This leads to a counter-intuitive prediction in the presence of signalling: firms whose cash flows are negatively affected by the local currency depreciation would signal via higher foreign currency borrowing. Higher foreign currency borrowing, in turn, predicts higher earnings (since good firms reveal their type via higher foreign currency borrowing). This mechanism works in the exact opposite way for positive beta firms. Firms, whose cash flows are positively affected by a local currency appreciation, signal to investors by taking on more risk through increasing their local currency borrowing. This prediction is unique to our theory and is different from Salomao and Varela (2022), since in their model foreign currency debt only adds noise to cash flows and firms have no signalling motive and as a result no distinction exists between positive and negative beta firms.

We compare five-years ahead earnings predictions of foreign currency share of debt for negative and positive beta firms in Figure 3. We follow the specification in the column (2) of Table 3 and focus on firms with access to foreign currency borrowing. While the independent variables are the same as in column (2), we use $EBITDA_{f,t+i}$ as the dependent variable where $i \in \{1, 2, 3, 4, 5\}$ in order to predict 1, 2, 3, 4, and 5-year ahead earnings. We run these regressions for negative beta firms and positive beta firms separately.

[15] The fact that the results go through when we measure the foreign currency share using bank loans only is reassuring since we expect information asymmetries to be present regardless of whether the lender is a bank or not. However, the coefficient when we use bank loans only is slightly smaller, which could be due to information asymmetries/incentives for signalling being arguably more important when it comes to bonds than bank loans.

The empirical evidence is in line with our theoretical predictions. For negative beta firms, higher foreign currency share predicts higher earnings one and two years ahead. On the other hand, for positive beta firms, higher foreign currency share in their borrowing predicts significantly negative earnings three to five years ahead.

Figure 3: foreign currency share and future earnings: Positive- and negative-beta firms



Note: This figure reports regression coefficients associated with foreign-currency share, estimated using the same specification as Table 3, but extending the forecast horizon of EBITDA from one year ahead to 1–5 years ahead and comparing against firms with positive stock return-depreciation beta over 2005 to 2019. The regression coefficients associated with foreign-currency share at year t are plotted using blue dots (negative-beta firms) or green squares (positive-beta firms), along with 95% confidence interval. Standard errors are clustered at the industry level.

4.3 Evidence from the Global Financial Crisis and the COVID-19 crisis

Our model operates through the channel that negative beta firms take on additional FX risk which would be relevant especially during foreign currency appreciation episodes. However, they are able to weather these episodes better compared to firms with lower foreign currency debt because they have a hidden quality which they signal to investors. In our case, they are able to generate higher earnings through their operations.

In this section, we focus on two major global financial crises as event studies in order to study this channel presented in our model. Both of these episodes led to major depreciations of emerging market economy currencies against the dollar and other hard currencies. Due to the episodes being local currency depreciation episodes and also due to sample size considerations, we only focus on negative beta firms. We test whether the foreign currency share of debt predicts higher earnings in a cross-section of firms across multiple emerging market economies. We fix the independent variables to their 2007 values for the Global Financial Crisis, and to their 2019 values for the COVID-19 crisis, and predict earnings in 2008 and 2020, respectively. Similar to Table 3, we use the same firm-year control variables as well as $Country * Industry$ dummy variables (since both regressions are at the cross-section of firms in a given year, there is no year interaction). We also report robust standard errors.

We follow the same structure in reporting the results in different columns with different specifications and sub-samples and report the results in Table 4 with Panel (a) showing the results for the Global Financial Crisis and the Panel (b) showing the results for the COVID-19 crisis.

In the Global Financial Crisis event study, the sign and the magnitude of the coefficients are similar to the results from the panel regression, if anything slightly higher. In some specifications the coefficients are not statistically significant (though they have the predicted sign), but we suspect this is due to our lack of statistical power in these regressions as we have relatively few firms compared to the control variables.

Table 4: Event studies: The Global Financial Crisis and the COVID-19 crisis

Panel (a): Global Financial Crisis (2008)

VARIABLES	(1) all $EBITDA_{f.08}$	(2) with market access $EBITDA_{f.08}$	(3) non-tradable with access $EBITDA_{f.08}$	(4) hard currency with access $EBITDA_{f.08}$	(5) consistency with access $EBITDA_{f.08}$	(6) bank loan with access $EBITDA_{f.08}$	(7) normalized with access $EBITDA_{f.08}$ / $Asset_{f.08}$ (%)
foreign currency share$_{f,07}$	0.260***	0.258**	0.465		0.107		0.029***
	(0.099)	(0.128)	(0.288)		(0.346)		(0.010)
hard currency share$_{f,07}$				0.256**			
				(0.129)			
fc share (bank loan)$_{f,07}$						0.252**	
						(0.115)	
Observations	1,735	840	233	840	194	767	840
R-squared	0.834	0.844	0.848	0.844	0.846	0.848	0.406
Country*Industry FE	✓	✓	✓	✓	✓	✓	✓
Firm-level controls	✓	✓	✓	✓	✓	✓	✓
No. FEs	177	143	63	143	57	127	143

Panel (b): COVID-19 crisis (2020)

VARIABLES	(1) all $EBITDA_{f.20}$	(2) with market access $EBITDA_{f.20}$	(3) non-tradable with access $EBITDA_{f.20}$	(4) hard currency with access $EBITDA_{f.20}$	(5) consistency with access $EBITDA_{f.20}$	(6) bank loan with access $EBITDA_{f.20}$	(7) normalized with access $EBITDA_{f.20}$ / $Asset_{f.20}$ (%)
foreign currency share$_{f,19}$	0.190**	0.144	0.462*		0.041		-0.000
	(0.076)	(0.090)	(0.262)		(0.088)		(0.006)
hard currency share$_{f,19}$				0.099			
				(0.089)			
fc share (bank loan)$_{f,19}$						0.058	
						(0.092)	
Observations	4,278	1,747	483	1,747	1,332	1,653	1,744
R-squared	0.827	0.865	0.865	0.865	0.866	0.863	0.393
Country*Industry FE	✓	✓	✓	✓	✓	✓	✓
Firm-level controls	✓	✓	✓	✓	✓	✓	✓
No. FEs	285	222	116	222	190	215	222

Note: This table reports firm-level event study results, focusing on the Global Financial Crisis and the COVID-19 pandemic. For the Global Financial Crisis (Panel (a)), financial variables and foreign-currency share in year 2007 is used to predict earnings (EBITDA) in 2008. For the COVID pandemic (Panel (b)), year-2019 variables are used to predict earnings in 2020. Columns and sample restrictions correspond to the configuration in Table 3. Robust standard errors are reported. *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

The results for the COVID-19 crisis event study are also broadly consistent with our theory. However, the results are somewhat weaker compared to the Global Financial Crisis and are more pronounced for larger firms (column (7) with normalized dependent variable is insignificant). This is not entirely surprising given the prompt and massive policy response by government and central banks, mitigating the adverse effects of the shock.

4.4 Evidence from local currency depreciation episodes

In this section, we focus on local currency depreciation episodes which were idiosyncratic to individual countries and did not coincide with global crises. We first present results for Turkish firms in 2018, a large depreciation episode for the Turkish lira in the Panel (a) of Table 5. Next, we provide results from a larger set of firms pooling all observations in which an emerging market economy currency lost its value against the dollar by more than 20% in a given year, yielding 13 unique country-year pairs (reported in the Panel (b) of Table 5). In both cases, the results are in line with the predictions of our theory in these event studies as well.

Turkish lira lost 40% of its value against the dollar in 2018 after a relatively stable year in 2017. The depreciation was largely idionsyncratic to Turkey, resulting mainly from political tensions with the United States, especially during the summer. During 2018, other emerging market economy currencies depreciated by only 5.5%, according to the nominal emerging market economies US dollar index (taken from the FRED). We repeat the same exercise for a sample of Turkish firms for 2018, again restricting our attention to negative beta firms (with beta measured using data until 2017). We use a similar specification as before and predict earnings in 2018 using the foreign currency share of debt in 2017 and vary the samples similarly as before for robustness checks. Note that we are unable to perform all robustness checks due to a much smaller sample size. Overall, the results suggest that among negative beta firms, those with greater foreign currency borrowing in 2017 generated higher earnings in 2018, allowing them to weather the exchange rate depreciation shock better.

Next, we focus on other local currency depreciation episodes outside of the two major global downturns. We restrict our attention to years between 2010 and 2019 (both included) and define large depreciation episodes as years in which the local currency depreciated by more than 20% year-on-year against the dollar. This yields 13 unique country-year pairs. We repeat our analysis with the same way of presenting columns as in the panel data analysis (again focusing only on negative beta firms) using firm-year level controls and $Country * Industry * Year$ fixed effects. The results are again in line with our model predictions. Again, since our sample size is not very large compared to the number of control variables we use, we suspect the lack of statistical significance is driven by low statistical power. However, in all columns, the point estimates are positive.

Table 5: Signaling through major depreciation episodes

Panel (a): Turkey 2018

VARIABLES	(1) all $EBITDA_{f.18}$	(2) with market access $EBITDA_{f.18}$	(3) hard currency with access $EBITDA_{f.18}$	(4) bank loan with access $EBITDA_{f.18}$	(5) normalized with access $EBITDA_{f.18}$ / $Asset_{f.18}$ (%)
foreign currency $share_{f,17}$	0.283***	0.282***			0.005
	(0.095)	(0.099)			(0.015)
hard currency $share_{f,17}$			0.282***		
			(0.101)		
fc share (bank $loan)_{f,17}$				0.153*	
				(0.078)	
Observations	127	108	108	99	108
R-squared	0.976	0.978	0.978	0.982	0.674
Industry FE	✓	✓	✓	✓	✓
Firm-level controls	✓	✓	✓	✓	✓
No. FEs	27	25	25	24	25

Panel (b): More countries

VARIABLES	(1) all $EBITDA_{f.18}$	(2) with market access $EBITDA_{f.18}$	(3) non-tradable with access $EBITDA_{f.18}$	(4) hard currency with access $EBITDA_{f.18}$	(5) consistency with access $EBITDA_{f.18}$	(6) bank loan with access $EBITDA_{f.18}$	(7) normalized with access $EBITDA_{f.18}$ / $Asset_{f.18}$ (%)
foreign currency $share_{f,17}$	0.134*	0.141*	0.388		0.136		0.004
	(0.071)	(0.080)	(0.255)		(0.094)		(0.006)
hard currency $share_{f,17}$				0.142*			
				(0.076)			
fc share (bank $loan)_{f,17}$						0.119	
						(0.076)	
Observations	1,199	924	299	924	623	867	924
R-squared	0.916	0.925	0.914	0.925	0.929	0.920	0.573
Country*Industry*Year FE	✓	✓	✓	✓	✓	✓	✓
Firm-level controls	✓	✓	✓	✓	✓	✓	✓
No. FEs	264	209	93	209	162	203	209

Note: This table reports regressions relating foreign-currency share and future earnings during major local-currency depreciation episodes. Panel (a) restrict the sample to Turkish firms from 2017 to 2018. Panel (b) looks at firms from more countries. Major depreciation episodes are defined as country-year pairs after 2010 in which local currency depreciates by more than 20 percent yearly. Columns and sample restrictions correspond to the configuration in Table 3 and Table 4. Robust standard errors are reported. *** p<0.01, ** p<0.05, * p<0.1.

4.5 Maturity structure of foreign currency debt

The signalling channel of foreign currency debt in our model works through firms tilting their liabilities towards foreign currency borrowing, especially when foreign currency borrowing is risky for them, in order to reveal their hidden type to investors. Our model is designed for two types of debt. In our applications, we compare local currency and foreign currency debt. However, main intuitions would also apply in other applications. For example, comparing short-term versus long-term foreign currency debt through the lens of our model, we would expect "good" firms to be signalling their type through taking on the additional risk by borrowing short-term. In this section, we test this counterintuitive prediction both in the panel setting (columns 1 to 5) and during the Global Financial Crisis (column 6) and the COVID-19 crisis (column 7) using a similar specification (controls and fixed effects as before). We run the following specification across a number of sub-samples:

We test whether foreign currency share predicts future earnings using the specification below:

$$EBITDA_{f,t+1} = \beta_1 Short\text{-}Term\_FC\_share_{f,t} + \beta_2 Long\text{-}Term\_FC\_share_{f,t} + \beta_3 Firm\ Controls_{f,t} + \eta_{c,i,t} + \epsilon_{f,t}$$

We predict $EBITDA_{f,t+1}$ (and also $\left(\frac{EBITDA_{f,t+1}}{TotalAssets_{f,t+1}}\right) * 100$ in some specifications) with the $Short\text{-}Term\_FC\_share_{f,t}$ and $Long\text{-}Term\_FC\_share_{f,t}$ variables constructed using the Capital IQ debt structure dataset. Short-term debt refers to a maturity of one year or less at origination and long-term debt is greater than one year. $\eta_{c,i,t}$ denotes $Country * Industry * Year$ fixed effects. In every specification in columns (1) to (5), we use $Country * Industry * Year$ fixed effects as well as controls at the firm-year level as before. We restrict the sample to 2005-2019 and to firms which have a negative beta in the 2005-2019 period. We cluster the standard errors at the industry level. We vary the samples and specifications in columns

(1) to (5) to rule out alternative explanations as before. In column (1), we use the entire sample. In column (2), we restrict the sample to firms that have at least once borrowed in foreign currency. In column (3), we further restrict the sample to non-tradable sectors. In column (4), we focus on firms whose total Capital IQ borrowing is within +/- 25% of total liabilities in their financial statements. In column (5), we use the sample in column (2), but predict EBITDA normalized by assets. In column (6), we use the sample of firms with market access, and run a cross-sectional analysis for the Global Financial Crisis using firm controls and $Country * Industry$ dummy variables, predicting earnings in 2008 with short-term and long-term foreign currency debt share in 2007. In column (7), we repeat the same analysis for the COVID-19 crisis, predicting 2020 earnings with 2019 short-term and long-term foreign currency debt share.

Table 6: Signaling mainly works through short-term debt

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
			non-tradable	consistency	normalized	GFC	COVID
	all	with market access	with access	with access	with access	with access	with access
VARIABLES	$EBITDA_{f.t+1}$	$EBITDA_{f.t+1}$	$EBITDA_{f.t+1}$	$EBITDA_{f.t+1}$	$EBITDA_{f.t+1}$ / $Asset_{f.t+1}$ (%)	$EBITDA_{f.08}$	$EBITDA_{f.20}$
short-term fc $share_{f,19}$	0.238***	0.262***	0.299	0.511***	0.007	0.541	0.479*
	(0.082)	(0.093)	(0.205)	(0.161)	(0.005)	(0.390)	(0.281)
long-term fc $share_{f,19}$	-0.052	-0.111	-0.155	-0.268	0.004	-0.177	-0.244
	(0.088)	(0.105)	(0.307)	(0.210)	(0.009)	(0.408)	(0.371)
Observations	3,467	1,806	410	779	1,806	122	159
R-squared	0.840	0.864	0.898	0.870	0.504	0.821	0.939
Country*Industry FE	-	-	-	-	-	✓	✓
Country*Industry*Year FE	✓	✓	✓	✓	✓	-	-
Firm-level controls	✓	✓	✓	✓	✓	✓	✓
No. clusters	54	48	28	38	48	0	0
No. FEs	789	544	161	265	544	42	40

Note: This table revisits the panel and cross-sectional regressions presented in Table 3 to Table 5, but splitting the foreign-currency share into short-term and long-term shares. Short-term foreign-currency borrowing include all instruments with tenor less than 4 quarters (1 year), and long-term borrowing corresponds to debt with a tenor more than 1 year. Column (1) reports results for the entire sample of firms. Column (2) to (7) focus on firms with access to foreign-currency funding. They are defined as firms who borrowed in foreign currency at least once over the sample period. Column (3) further restricts the analysis to non-tradable firms, following the classification of Aguiar and Gopinath (2005). Column (4) checks if the results are robust to restricting the analysis to firms whose total outstanding debt recorded in the debt capital structure dataset is consistent with the main financial statements (with a maximum absolute deviation of 25%). Column (5) uses EBITDA normalized by total assets as the dependent variable. Column (6) reports event study results for the Global Financial Crisis years (2007-08) and column (7) focuses on the COVID pandemic period (2019-20). Standard errors are clustered at the industry level for columns (1) to (5) and robust standard-errors are used for columns (6) and (7). *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

Results in Table 6 clearly show that in line with our conjectures, firms that took on more short-term foreign currency debt as a share of their total liabilities, which is riskier, actually have higher earnings. Once short-term foreign currency share of debt is accounted for, the coefficient on the long-term foreign currency share of debt is statistically insignificant, and if anything, negative. The fact that short-term foreign currency share of debt can better predict earnings in line with another distinctive prediction of the signalling channel of foreign currency borrowing compared to other theories.

5 Conclusion

In this paper, we set out to explain the puzzling observation that corporates in emerging market economies, for which borrowing in local currency would provide greater hedging benefits, actually borrow more in foreign currency. We provide an explanation based on an international corporate finance model where firms facing adverse selection choose the composition of the debt structure between local currency and foreign currency to signal their quality to investors. The signalling game in our model has a unique separating equilibrium, in which good firms optimally expose themselves to currency risk to reveal their type. A distinct feature of our theory is that the co-movement between the firm's cash flows and the foreign currency/local currency exchange rate is key: if the firm's cash flows tend to fall when the foreign currency appreciates, higher foreign currency share of debt signals a good type, *and vice versa*.

Evidence using panel data analysis and event studies including the Global Financial Crisis, the COVID-19 crisis, and other local currency depreciation episodes provide evidence for the signalling channel in our model. Two additional tests provide further evidence in support of the distinctive predictions of our mechanism. First, in our model higher foreign currency share predicts higher earnings for firms whose cash flows co-move negatively with the foreign currency (the dollar in our empirical setup), while it predicts lower earnings for firms whose cash flows positively with the foreign currency. We show evidence in favor of this prediction. Second, comparing maturities for firms with cash flows with negative co-movement with the foreign currency, the riskier portion of the foreign currency debt should predict higher earnings. Indeed, short-term foreign currency share of debt predicts earnings better than long-term foreign currency share of debt.

Our model has important implications for assessing vulnerabilities in emerging market economies arising from currency mismatch in the corporate sector. Our findings suggest that in the presence of information asymmetries, good firms signal their quality by exposing themselves to currency risk. As a result, firms that take on this risk are actually better placed to weather foreign currency appreciation shocks. That said, large shocks could nevertheless cause distress. Therefore, our model suggests that reducing information asymmetries would be an important policy tool to mitigate corporate risk taking in emerging market economies. However, our results also suggest that currency mismatches alone need not be a cause for concern as previously thought. Our work could also be extended to measure the relative importance of the signalling channel to all other channels and the aggregate implications arising from this channel and information asymmetries in general.

References

Acharya, Viral V and Siddharth Vij, "Foreign Currency Borrowing of Corporations as Carry Trades: Evidence from India," Working Paper 28096, National Bureau of Economic Research November 2020.

Aguiar, Mark, "Investment, Devaluation, and Foreign Currency Exposure: The Case of Mexico," *Journal of Development Economics*, 2005, *78* (1), 95–113.

___ **and Gita Gopinath**, "Fire-Sale FDI and Liquidity Crises," *Review of Economics and Statistics*, 2005, *87* (3), 439–452.

Alfaro, Laura, Gonzalo Asis, Anusha Chari, and Ugo Panizza, "Corporate debt, firm size and financial fragility in emerging markets," *Journal of International Economics*, 2019, *118*, 1–19.

___ **, Mauricio Calani, and Liliana Varela**, "Currency Hedging: Managing Cash Flow Exposure," Working Paper 28910, National Bureau of Economic Research June 2021.

Antic, Nemanja, "Contracting with Unknown Technologies," Working Paper, Northwestern University 2019.

Axelson, Ulf, "Security Design with Investor Private Information," *Journal of Finance*, 2007, *62*, 2587–2632.

Bedendo, Mascia and Paolo Colla, "Sovereign and corporate credit risk: Evidence from the Eurozone," *Journal of Corporate Finance*, 2015, *33*, 34–52.

Bevilaqua, Julia, Galina B. Hale, and Eric Tallman, "Corporate yields and sovereign yields," *Journal of International Economics*, 2020, *124*, 103304. NBER International Seminar on Macroeconomics 2019.

Biais, Bruno and Thomas Mariotti, "Strategic Liquidity Supply and Security Design," *Review of Economic Studies*, 2005, *72*, 615–649.

Boot, Arnoud W. A. and Anjan V. Thakor, "Security Design," *Journal of Finance*, 1993, *48*, 1349–1378.

Bruno, Valentina and Hyun Song Shin, "Global Dollar Credit and Carry Trades: A Firm-Level Analysis," *The Review of Financial Studies*, 02 2017, *30* (3), 703–749.

Bräuning, Falk and Victoria Ivashina, "U.S. monetary policy and emerging market credit cycles," *Journal of Monetary Economics*, 2020, *112*, 57–76.

Caballero, Julián, Ugo Panizza, and Andrew Powell, "The Second Wave of Global Liquidity: Why Are Firms Acting Like Financial Intermediaries?," IDB Publications (Working Papers) 7638, Inter-American Development Bank May 2016.

Caballero, Ricardo J. and Arvind Krishnamurthy, "Excessive Dollar Debt: Financial Development and Underinsurance," *The Journal of Finance*, 2003, *58* (2), 867–893.

Caramichael, John, Gita Gopinath, and Gordon Y. Liao, "U.S. Dollar Currency Premium in Corporate Bonds," IMF Working Paper 2021/185 2021.

Dang, Tri Vi, Gary Gorton, and Bengt Holmstrom, "Ignorance, Debt and Financial Crises," Unpublished Working Paper, Columbia University 2015.

___ , ___ , and ___ , "The Information Sensitivity of a Security," Unpublished Working Paper, Columbia University 2015.

Demarzo, Peter M., "The Pooling and Tranching of Securities: A Model of Informed Intermediation," *Review of Financial Studies*, 2005, *18*, 1–35.

___ and Darrell Duffie, "A Liquidity-Based Model of Security Design," *Econometrica*, 1999, *67*, 65–100.

di Giovanni, Julian, Sebnem Kalemli-Ozcan, Mehmet Fatih Ulu, and Yusuf Soner Baskaya, "International Spillovers and Local Credit Cycles," Working Paper 23149, National Bureau of Economic Research February 2017.

Du, Wenxin and Jesse Schreger, "Sovereign Risk, Currency Risk, and Corporate Balance Sheets," *The Review of Financial Studies*, 2022.

___ , Carolin E. Pflueger, and Jesse Schreger, "Sovereign Bond Portfolios, Bond Risks and Credibility of Monetary Policy," *Journal of Finance*, 2020, *75* (6), 3097–3138.

Eren, Egemen and Semyon Malamud, "Dominant currency debt," *Journal of Financial Economics*, 2021.

Franck, Murray Z. and Vidhan K. Goyal, "Testing the pecking order theory of capital structure," *Journal of Financial Economics*, 2003, *67*, 217–248.

Fulghieri, Paolo and Dmitry Lukin, "Information Production, Dilution Costs, and Optimal Security Design," *Journal of Financial Economics*, 2001, *61*, 3–42.

Gopinath, Gita and Jeremy C Stein, "Banking, Trade, and the Making of a Dominant Currency*," *The Quarterly Journal of Economics*, 10 2020, *136* (2), 783–830.

Grenadier, Steven R. and Andrey Malenko, "Real options signalling games with applications to corporate finance," *Review of Financial Studies*, 2009, *24(12)*, 3993–4036.

Gutiérrez, Bryan, Victoria Ivashina, and Juliana Salomao, "Why is Dollar Debt Cheaper? Evidence from Peru," Working Paper 2021.

Hebert, Benjamin, "Moral Hazard and the Optimality of Debt," *Review of Economic Studies*, 2017, *85*, 2214–2252.

Helwege, Jean and Nellie Liang, "Is there a pecking order? Evidence from a panel of IPO firms," *Journal of Financial Economics*, 1996, *40*, 429–458.

Hennessy, Christopher A., "A Theory of ABS Design Based on Rational Noise-Traders," Working Paper, London Business School 2013.

—— **, Dmitry Livdan, and Bruno Miranda**, "Repeated signalling and firm dynamics," *Review of Financial Studies*, 2010, *23(5)*, 1981–2023.

Holmstrom, Bengt and Paul Milgrom, "Aggregation and Linearity in the Provision of Intertemporal Incentives," *Econometrica*, 1987, *55*, 303–328.

Inderst, Roman and Holger M. Mueller, "Informed Lending and Security Design," *Journal of Finance*, 2006, *61*, 2137–2162.

Ivashina, Victoria, Ruth Kostas, and Priscilla Zogbi, "Advent International: Kroton Investment," HBS case collection 2018.

Jeanne, Olivier, "Why Do Emerging Economies Borrow in Foreign Currency?," CEPR Discussion Papers 4030, C.E.P.R. Discussion Papers August 2003.

Jiang, Zhengyang, Arvind Krishnamurthy, and Hanno Lustig, "Foreign Safe Asset Demand and the Dollar Exchange Rate," *Journal of Finance*, 2021, *76* (3), 1049–1089.

Kim, Minsuk, "Financial Development, Exchange Rate Fluctuations, and Debt Dollarization: A Firm-Level Evidence," IMF Working Paper 19/168 2019.

___ **, Rui C. Mano, and Mico Mrkaic**, "Do FX Interventions Lead to Higher FX Debt? Evidence from Firm-Level Data," IMF Working Paper 20/197 2020.

Kim, Yun Jung, Linda L. Tesar, and Jing Zhang, "The impact of foreign liabilities on small firms: Firm-level evidence from the Korean crisis," *Journal of International Economics*, 2015, *97* (2), 209–230.

Kohn, David, Fernando Leibovici, and Michal Szkup, "Financial frictions and export dynamics in large devaluations," *Journal of International Economics*, 2020, *122* (C).

Koijen, Ralph and Motohiro Yogo, "Exchange Rates and Asset Prices in a Global Demand System," NBER Working Paper 27342 2020.

Leary, Mark T. and Michael R. Roberts, "The pecking order, debt capacity, and information asymmetry," *Journal of Financial Economics*, 2010, *95*, 332–355.

Maggiori, Matteo, Brent Neiman, and Jesse Schreger, "International Currencies and Capital Allocation," *Journal of Political Economy*, 2020, *128* (6), 2019–2066.

Melitz, Marc J., "The Impact of Trade on Intra-Industry Reallocations and Aggregate Industry Productivity," *Econometrica*, November 2003, *71* (6), 1695–1725.

Mendoza, Enrique G. and Vivian Z. Yue, "A General Equilibrium Model of Sovereign Default and Business Cycles*," *The Quarterly Journal of Economics*, 04 2012, *127* (2), 889–946.

Milgrom, Paul and Robert J. Weber, "A Theory of Auctions and Competitive Bidding," *Econometrica*, 1982, *50*, 1089–1122.

Morellec, Erwan and Norman Schuerhoff, "Corporate investment and financing under asymmetric information," *Journal of Financial Economics*, 2011, *99* (2), 262–288.

Myers, Stewart C. and Nicholas S. Majluf, "Corporate financing and investment decisions when firms have information that investors do not have," *Journal of Financial Economics*, 1984, *13*, 187–221.

Nachman, David C. and Thomas H. Noe, "Optimal Design of Securities under Asymmetric Information," *Review of Financial Studies*, 1994, *7*, 1–44.

Niepmann, Friederike and Tim Schmidt-Eisenlohr, "Foreign Currency Loans and Credit Risk: Evidence from U.S. Banks," *Journal of International Economics*, 2021, p. 103558.

Nikolov, Boris, Lukas Schmid, and Roberto Steri, "The Sources of Financing Constraints," *Journal of Financial Economics*, 2021, *139* (2), 478–501.

Ranciere, Romain, Aaron Tornell, and Athanasios Vamvakidis, "Currency mismatch, systemic risk and growth in emerging Europe," *Economic Policy*, 08 2014, *25* (64), 597–658.

Salomao, Juliana and Liliana Varela, "Exchange Rate Exposure and Firm Dynamics," *The Review of Economic Studies*, 06 2022, *89* (1), 481–514.

Townsend, Robert M., "Optimal Contracts and Competitive Markets with Costly State Verification," *Journal of Economic Theory*, 1979, *21*, 265–293.

Yang, Ming, "Optimality of Debt under Flexible Information Acquisition," *Review of Economic Studies*, 2020, *87(1)*, 487–536.

A Symmetry Between Expressions for LC and FC shares

Define $\tilde{B} = B\alpha,\ \tilde{\varepsilon} = 1/\varepsilon,\ \tilde{\alpha} = 1/\alpha$. Let also $\tilde{X} = X/\varepsilon$. Then, in these variables, we can re-define everything in dollars, and the joint density can be computed using the standard formula

$$\tilde{\eta}(\tilde{x}, \mu, \tilde{\varepsilon}) \;=\; \eta(\tilde{x}/\tilde{\varepsilon}, \mu, 1/\tilde{\varepsilon})\tilde{\varepsilon}^{-3}$$

where ε^{-3} is the determinant of the Jacobian of the map $(x/\varepsilon, \mu, 1/\varepsilon) \rightarrow (x, \mu, \varepsilon) = (\tilde{x}/\tilde{\varepsilon}, \mu, 1/\tilde{\varepsilon})$. The first observation is that $(\log \tilde{\eta})_{\mu x}$ has the same sign as $(\log \eta)_{\mu x}$. The second observation is that the conditions of positive association for $\tilde{\varepsilon}$ with $\tilde{x}$ and $\tilde{\mu}$ take the form

$$0 \;\le\; (\log \tilde{\eta})_{\mu\tilde{\varepsilon}} \;=\; (\log(\eta(\tilde{x}/\tilde{\varepsilon}, \mu, 1/\tilde{\varepsilon}) - 3\log\tilde{\varepsilon}))_{\mu\tilde{\varepsilon}} \;=\; -\tilde{\varepsilon}^{-2}(\log\eta)_{\mu\varepsilon} \;-\; \tilde{x}\tilde{\varepsilon}^{-2}(\log\eta)_{\mu x}$$

whereas

$$\begin{aligned} 0 \;\le\; (\log \tilde{\eta})_{x\varepsilon} \;&=\; (\log(\eta(\tilde{x}/\tilde{\varepsilon}, \mu, 1/\tilde{\varepsilon}) - 3\log\tilde{\varepsilon}))_{x\varepsilon} \\ &=\; -\tilde{\varepsilon}^{-2}(\log\eta)_{x\varepsilon} \;-\; \tilde{x}\tilde{\varepsilon}^{-2}(\log\eta)_{\mu x} - \tilde{x}/\tilde{\varepsilon}^2(\log\eta)_{xx} \;-\; \tilde{\varepsilon}^{-3}(\log\eta)_{x\varepsilon}\,. \end{aligned}$$

Now, total face value is $\bar{B} = B(1+\alpha\varepsilon) \;=\; \tilde{B}\tilde{\alpha}(1+1/(\tilde{\alpha}\tilde{\varepsilon})) \;=\; \tilde{B}\tilde{\varepsilon}^{-1}(1+\tilde{\alpha}\tilde{\varepsilon})$ equity value is

$$E[(X-\bar{B})^+] \;=\; E[(\tilde{X}/\tilde{\varepsilon} - \tilde{B}\tilde{\varepsilon}^{-1}(1+\tilde{\alpha}\tilde{\varepsilon}))^+] \;=\; E[\tilde{\varepsilon}^{-1}(\tilde{X} - \tilde{B}(1+\tilde{\alpha}\tilde{\varepsilon}))^+]\,.$$

Similarly,

$$\bar{P}(\alpha) \;=\; E[\tilde{\varepsilon}^{-1}(1+\tilde{\alpha}\tilde{\varepsilon})(1-\tilde{\Phi}(\tilde{B}(1+\tilde{\alpha}\tilde{\varepsilon})))]$$

We can define a new expectation with the measure $\tilde{\varepsilon}^{-1}/E[\tilde{\varepsilon}^{-1}]$, and all the formulas remain the same, with I replaced by $I/E[\varepsilon]$.

B Proofs

We will be extensively using the following technical lemma.

Lemma B.1

$$E[f(X)g(X)] \;\geq\; E[f(X)]\,E[g(X)]$$

for any two monotone increasing functions f, g.

The following lemma is a direct consequence of Lemma B.1.

Lemma B.2 *Suppose that we have two random variables* X_1, X_2 *with probability densities* η_1, η_2 *such that* $\eta_1(x)/\eta_2(x)$ *is monotone increasing in* x. *Then,* $E[f(X_1)] \geq E[f(X_2)]$ *for any monotone increasing function* f.

Proof of Proposition 3.3. At an interior optimum of

$$\max_{\alpha} E[\Psi(B(\alpha)(1+\varepsilon\alpha), \mu, \varepsilon)]\,,$$

we get that the first order condition defining the candidate optimum $\alpha = A(\mu)$ is given by

$$-E[(1-\Phi(B(\alpha)(1+\varepsilon\alpha), \mu, \varepsilon))(B'(\alpha)(1+\varepsilon\alpha)+B(\alpha)\varepsilon)] \;=\; 0\,,$$

where $B(\alpha) = I/\bar{P}(\alpha)$ and where

$$\bar{P}(\alpha) \;=\; E[(1+\varepsilon\alpha)(1-\Phi((1+\alpha\varepsilon)I/\bar{P}(\alpha), \mu(\alpha), \varepsilon))\,.$$

Thus, we have

$$B'(\alpha) = -I\bar{P}'(\alpha)\bar{P}(\alpha)^{-2}$$

and hence

$$
\begin{aligned}
0 &= -E[(1-\Phi(I\bar{P}(\alpha)^{-1}(1+\varepsilon\alpha),\mu,\varepsilon))(-I\bar{P}'(\alpha)\bar{P}(\alpha)^{-2}(1+\varepsilon\alpha)+I\bar{P}(\alpha)^{-1}\varepsilon)] \\
&= -I\bar{P}'(\alpha)\bar{P}(\alpha)^{-2}\underbrace{E[(1-\Phi(I\bar{P}(\alpha)^{-1}(1+\varepsilon\alpha),\mu,\varepsilon))(1+\varepsilon\alpha)]}_{=\bar{P}(\alpha)} \\
&+ I\bar{P}(\alpha)^{-1}E[(1-\Phi(I\bar{P}(\alpha)^{-1}(1+\varepsilon\alpha),\mu,\varepsilon))\varepsilon] \\
&= I\bar{P}(\alpha)^{-1}(-\bar{P}'(\alpha)+E[(1-\Phi(I\bar{P}(\alpha)^{-1}(1+\varepsilon\alpha),\mu,\varepsilon))\varepsilon])\,,
\end{aligned}
$$

and the claim follows. Q.E.D.

Proof of Proposition 3.4. We have

$$
\mu'(\alpha) \;=\; \frac{d}{d\alpha}F = \; F_x\bar{P}'(\alpha) \;+\; F_y\,.
$$

By the implicit function theorem,

$$
F_x \;=\; \frac{1 \;-\; I^{-1}E[((1+\varepsilon y)I/x)^2\eta((1+\varepsilon y)I/x,\;F,\;\varepsilon)]}{-E[(1+\varepsilon y)\Phi_\mu((1+\varepsilon y)I/x,\;F,\;\varepsilon)]}
$$

and

$$
F_y \;=\; \frac{E[\varepsilon((1-\Phi((1+\varepsilon y)I/x,\;F,\;\varepsilon))-((1+\varepsilon y)I/x)\varepsilon\eta((1+\varepsilon y)I/x,\;F,\;\varepsilon))]}{E[(1+\varepsilon y)\Phi_\mu((1+\varepsilon y)I/x,\;F,\;\varepsilon)]}
$$

By Proposition 3.3, we have

$$
\bar{P}'(\alpha) \;=\; E[\varepsilon(1-\Phi(B(\alpha)(1+\varepsilon\alpha),\mu(\alpha),\varepsilon))]\,.
$$

As a result, use the shorthand notation $z = B(\alpha)(1+\varepsilon(\alpha)) = (1+\varepsilon(\alpha))I/\bar{P}(\alpha)$, we have

$$\begin{aligned}
\mu'(\alpha) &= \frac{E[(1-I^{-1}z^2\eta(z))]}{-E[(1+\varepsilon y)\Phi_\mu((1+\varepsilon y)I/x,\ F,\ \varepsilon)]}E[\varepsilon(1-\Phi(z))] \\
&+ \frac{E[\varepsilon((1-\Phi(z)-z\eta(z))]}{E[(1+\varepsilon y)\Phi_\mu((1+\varepsilon y)I/x,\ F,\ \varepsilon)]} \\
&= \frac{-I^{-1}E[z^2\eta(z)]\,E[\varepsilon(1-\Phi(z))]\ +\ E[\varepsilon z\eta(z)]}{-E[(1+\varepsilon y)\Phi_\mu((1+\varepsilon y)I/x,\ F,\ \varepsilon)]}\,.
\end{aligned}$$

Since $\Phi_\mu < 0$, the sign of $\mu'(\alpha)$ coincides with that of

$$\begin{aligned}
\psi(\alpha) &\equiv -I^{-1}E[(I/\bar{P})^2(1+\varepsilon\alpha)^2\eta((I/\bar{P})(1+\varepsilon\alpha))]\,E[\varepsilon(1-\Phi((I/\bar{P})(1+\varepsilon\alpha)))] \\
&+\ E[\varepsilon(I/\bar{P})(1+\varepsilon\alpha)\eta((I/\bar{P})(1+\varepsilon\alpha))] \\
&= I/(\bar{P})^2\Big(-E[(1+\varepsilon\alpha)^2\eta((I/\bar{P})(1+\varepsilon\alpha))]\,E[\varepsilon(1-\Phi((I/\bar{P})(1+\varepsilon\alpha)))] \\
&+\ E[\varepsilon(1+\varepsilon\alpha)\eta((I/\bar{P})(1+\varepsilon\alpha))]\bar{P}\ \Big) \\
&= I/(\bar{P})^2\Big(-E[(1+\varepsilon\alpha)^2\eta(\kappa(1+\varepsilon\alpha))]\,E[\varepsilon(1-\Phi(\kappa(1+\varepsilon\alpha)))] \\
&+\ E[\varepsilon(1+\varepsilon\alpha)\eta(\kappa(1+\varepsilon\alpha))]E[(1+\varepsilon\alpha)(1-\Phi(\kappa(1+\varepsilon\alpha)))]\Big)
\end{aligned} \tag{6}$$

where we denote $\kappa = I/\bar{P}$. Let us change the measure to $(1+\varepsilon\alpha)(1-\Phi(\kappa(1+\varepsilon\alpha)))/E[(1+\varepsilon\alpha)(1-\Phi(\kappa(1+\varepsilon\alpha)))]$, and denote the covariances under this measure as Cov^*. Then, the sign of (6) coincides with that of

$$\mathrm{Cov}^*(\varepsilon/(1+\varepsilon\alpha),\,(1+\varepsilon\alpha)h(\kappa(1+\varepsilon\alpha)))$$

where we have defined

$$h(x,\mu,\varepsilon) \;=\; \frac{\eta(x|\mu,\varepsilon)}{1-\Phi(x|\mu,\varepsilon)}\,.$$

Thus, by Lemma B.1, the sign of $\mu'(\alpha)$ is positive (negative) if the function $(1+\varepsilon\alpha)h(\kappa(1+$

$\varepsilon\alpha$)) is monotone increasing (decreasing) in ε. Now,

$$\frac{d}{d\varepsilon}((1+\varepsilon\alpha)h(\kappa(1+\varepsilon\alpha))) \;=\; \alpha h \;+\; \kappa\alpha(1+\varepsilon\alpha)h_x \;+\; (1+\varepsilon\alpha)h_\varepsilon\,, \tag{7}$$

and h_ε is proportional to $\frac{\eta_\varepsilon}{\eta} - \frac{\int_x^\infty \eta_\varepsilon(y)dy}{\int_x^\infty \eta(y)dy}$, and hence h_ε is positive when $\frac{\eta_\varepsilon}{\eta}$ is decreasing in x. Since η is log-concave, standard properties of log-concave densities imply that $h(x)$ is monotone increasing. Suppose that $(\log\eta)_{\varepsilon x} < 0$ (the case of $(\log\tilde{\eta})_{\tilde{\varepsilon}x} < 0$ is analogous). This is equivalent to $\frac{\eta_\varepsilon}{\eta}$ being monotone decreasing in x. Thus, $h_\varepsilon > 0$ in this case, and hence all three terms in (7) are positive, and therefore (7) is positive.

To prove the last claim (monotonicity of the equity value with respect to μ), we notice that is easier to study monotonicity with respect to α. We have

$$\frac{d}{d\alpha}E[\Psi((1+\alpha\varepsilon)I/\bar{P}(\alpha),\mu(\alpha),\varepsilon)] \;=\; \mu'(\alpha)\,E[\Psi_\mu((1+\alpha\varepsilon)I/\bar{P}(\alpha),\mu(\alpha),\varepsilon)]\,.$$

Here,

$$\Psi_\mu \;=\; \int_x^\infty (y-x)\eta_\mu(y|\mu,\varepsilon)dy$$

By assumption, η_μ/η is monotone increasing in y and hence, by Lemma B.1, we have

$$\frac{\int_x^\infty (y-x)\eta_\mu(y|\mu,\varepsilon)dy}{1-\Phi(x)} \;\geq\; \frac{\int_x^\infty (y-x)\eta(y|\mu,\varepsilon)dy}{1-\Phi(x)}\frac{\int_x^\infty \eta_\mu(y|\mu,\varepsilon)dy}{1-\Phi(x)}$$

Since $\Phi_\mu \leq 0$, we have $\int_x^\infty \eta_\mu(y|\mu,\varepsilon)dy = -\Phi_\mu \geq 0$. If $\mu(\alpha)$ is increasing in α, then we get the required. If $\mu(\alpha)$ is decreasing in α, then the equity value $E(\alpha) = E[\Psi((1+\alpha\varepsilon)I/\bar{P}(\alpha),\mu(\alpha),\varepsilon)]$ is decreasing in α and hence $E(\mu) = E(A(\mu))$ is increasing in μ.

Q.E.D.

Lemma B.3 *The following is true:*

- *If $A(\mu)$ is monotone increasing in μ and*

$$\frac{\Phi_\mu(B(\alpha)(1+\varepsilon\alpha),\mu,\varepsilon)}{1-\Phi(B(\alpha)(1+\varepsilon\alpha),\mu,\varepsilon)}$$

is monotone increasing in ε for all $\alpha \in \mathbb{R}_+$, then $A(\mu)$ is indeed the optimum;

- *If $A(\mu)$ is monotone decreasing in μ and*

$$\frac{\Phi_\mu(B(\alpha)(1+\varepsilon\alpha),\mu,\varepsilon)}{1-\Phi(B(\alpha)(1+\varepsilon\alpha),\mu,\varepsilon)}$$

is monotone decreasing in ε for all $\alpha \in \mathbb{R}_+$, then $A(\mu)$ is indeed the optimum.

Proof of Lemma B.3. To prove that $\alpha = A(\mu)$ is indeed the maximizer of the equity value, it would suffice to show that the derivative of the equity value is negative for $\alpha < A(\mu)$ and positive otherwise. That is, it suffices to show that that

$$E[(1-\Phi(B(\alpha)(1+\varepsilon\alpha),\mu,\varepsilon))(B'(\alpha)(1+\varepsilon\alpha)+B(\alpha)\varepsilon)] \;<\; 0 \tag{8}$$

for $\alpha < A(\mu)$ and that the sign flips for $\alpha > A(\mu)$. Equivalently, we can rewrite the optimality condition (8) for $\alpha < A(\mu)$ as

$$\frac{B'(\alpha)}{B(\alpha)} \;<\; -\frac{E[\varepsilon(1-\Phi(B(\alpha)(1+\varepsilon\alpha),\mu,\varepsilon))]}{E[(1+\varepsilon\alpha)\,(1-\Phi(B(\alpha)(1+\varepsilon\alpha),\mu,\varepsilon))]},\;\; \alpha < A(\mu). \tag{9}$$

The proof for the case $\alpha > A(\mu)$ is analogous. Suppose first that $A(\mu)$ is monotone increasing in μ. Then, we need to show (9) for $\mu > \mu(\alpha)$. Since (9) holds with equality for $\mu = \mu(\alpha)$, it would be sufficient to show that the function $\frac{E[\varepsilon(1-\Phi(B(\alpha)(1+\varepsilon\alpha),\mu,\varepsilon))]}{E[(1+\varepsilon\alpha)\,(1-\Phi(B(\alpha)(1+\varepsilon\alpha),\mu,\varepsilon))]}$ is monotone decreasing in μ. Differentiating this function with respect to μ, we get that we need the inequality

$$
\begin{aligned}
&- E[\varepsilon\Phi_\mu(B(\alpha)(1+\varepsilon\alpha),\mu,\varepsilon)]E[(1+\varepsilon\alpha)(1-\Phi(B(\alpha)(1+\varepsilon\alpha),\mu,\varepsilon))] \\
&+ E[\varepsilon(1-\Phi(B(\alpha)(1+\varepsilon\alpha),\mu,\varepsilon))]E[(1+\varepsilon\alpha)\Phi_\mu(B(\alpha)(1+\varepsilon\alpha),\mu,\varepsilon)] \;\le\; 0\,,
\end{aligned}
$$

which is equivalent to

$$
\begin{aligned}
&- E[\varepsilon\Phi_\mu(B(\alpha)(1+\varepsilon\alpha),\mu,\varepsilon)]E[(1-\Phi(B(\alpha)(1+\varepsilon\alpha),\mu,\varepsilon))] \\
&+ E[\varepsilon(1-\Phi(B(\alpha)(1+\varepsilon\alpha),\mu,\varepsilon))]E[\Phi_\mu(B(\alpha)(1+\varepsilon\alpha),\mu,\varepsilon)] \;\le\; 0\,,
\end{aligned}
$$

Changing the density to $(1-\Phi(B(\alpha)(1+\varepsilon\alpha),\mu,\varepsilon))/E[(1-\Phi(B(\alpha)(1+\varepsilon\alpha),\mu,\varepsilon))]$, and denoting expectations under this density with E^*, we can rewrite the desired inequality as

$$
-\mathrm{Cov}^*[\varepsilon, \frac{\Phi_\mu(B(\alpha)(1+\varepsilon\alpha),\mu,\varepsilon)}{1-\Phi(B(\alpha)(1+\varepsilon\alpha),\mu,\varepsilon)}] \;\le\; 0\,,
$$

which follows from Lemma B.1 and the assumption that $\frac{\Phi_\mu(B(\alpha)(1+\varepsilon\alpha),\mu,\varepsilon)}{1-\Phi(B(\alpha)(1+\varepsilon\alpha),\mu,\varepsilon)}$ is monotone increasing in ε.

By contrast, if $A(\mu)$ is decreasing, then we need that $\frac{E[\varepsilon(1-\Phi(B(\alpha)(1+\varepsilon\alpha),\mu,\varepsilon))]}{E[(1+\varepsilon\alpha)\,(1-\Phi(B(\alpha)(1+\varepsilon\alpha),\mu,\varepsilon))]}$ be monotone increasing in μ. This is in turn equivalent to the inequality

$$
-\mathrm{Cov}^*[\varepsilon, \frac{\Phi_\mu(B(\alpha)(1+\varepsilon\alpha),\mu,\varepsilon)}{1-\Phi(B(\alpha)(1+\varepsilon\alpha),\mu,\varepsilon)}] \;\ge\; 0\,,
$$

which follows from Lemma B.1 under the assumption that $\frac{\Phi_\mu(B(\alpha)(1+\varepsilon\alpha),\mu,\varepsilon)}{1-\Phi(B(\alpha)(1+\varepsilon\alpha),\mu,\varepsilon)}$ is monotone decreasing in ε.

Q.E.D.

Lemma B.4 *We always have that*

$$
\frac{\Phi_\mu(x,\mu,\varepsilon)}{1-\Phi(x,\mu,\varepsilon)}
$$

is monotone decreasing in x*. If* $(\log\eta)_{x\varepsilon} \geq 0$ *and* $(\log\eta)_{\mu\varepsilon} \geq 0$*, then*

$$\frac{\Phi_\mu(x,\mu,\varepsilon)}{1-\Phi(x,\mu,\varepsilon)}$$

is monotone decreasing in ε *and*

$$\frac{\Phi_\mu(b+a\varepsilon,\mu,\varepsilon)}{1-\Phi(b+a\varepsilon,\mu,\varepsilon)}$$

is monotone decreasing in ε *for any* $a \geq 0$*.*

Proof of Lemma B.4. Since $\int_{\mathbb{R}} \eta(x|\mu,\varepsilon)dx = 1$, we have $\int_{\mathbb{R}} \eta_\mu(x|\mu,\varepsilon)dx = 0$, and hence

$$\frac{\Phi_\mu(x,\mu,\varepsilon)}{1-\Phi(x,\mu,\varepsilon)} \;=\; \frac{-\int_x^\infty \eta_\mu(y|\mu,\varepsilon)dy}{\int_x^\infty \eta(y|\mu,\varepsilon)dy}$$

Differentiating with respect to x, we get that the required monotonicity is equivalent to

$$\frac{\eta_\mu(x|\mu,\varepsilon)}{\eta(x|\mu,\varepsilon)} \;\leq\; \frac{\int_x^\infty \eta_\mu(y|\mu,\varepsilon)dy}{\int_x^\infty \eta(y|\mu,\varepsilon)dy}\,,$$

which follows directly from the assumed monotonicity of $\frac{\eta_\mu(x|\mu,\varepsilon)}{\eta(x|\mu,\varepsilon)}$.

Now, differentiating this quotient with respect to ε, we get that the sign of this derivative coincides with that of

$$-\int_x^\infty \eta_{\mu\varepsilon}(y|\mu,\varepsilon)dy \int_x^\infty \eta(y|\mu,\varepsilon)dy \;+\; \int_x^\infty \eta_\mu(y|\mu,\varepsilon)dy \int_x^\infty \eta_\varepsilon(y|\mu,\varepsilon)dy\,.$$

Introducing the conditional probability measure $\mathbf{1}_{y\geq x}\eta(y|\mu,\varepsilon)/\int_x^\infty \eta(y|\mu,\varepsilon)dy$, we can rewrite the quantity of interest as

$$-E[\eta_{\mu\varepsilon}(X|\mu,\varepsilon)/\eta] \;+\; E[\eta_\varepsilon/\eta]\,E[\eta_\mu/\eta]\,.$$

Suppose first $(\log \eta)_{\varepsilon x} \geq 0$ and $(\log \eta)_{\mu\varepsilon} \geq 0$. Then,

$$\eta_{\mu\varepsilon} \;\geq\; \frac{\eta_\varepsilon \eta_\mu}{\eta}$$

and hence, by Lemma B.1,

$$E[\eta_{\mu\varepsilon}(X|\mu,\varepsilon)/\eta] \;\geq\; E[(\eta_\varepsilon/\eta)(\eta_\mu/\eta)] \;\geq\; E[\eta_\varepsilon/\eta]\, E[\eta_\mu/\eta]\,.$$

Q.E.D.

Proof of Proposition 3.6. We only consider the case of negative association between x, μ, ε. The opposite case is analogous.

Suppose that $(\log \eta)_{\varepsilon x} < 0$. Let $\mu(\alpha)$ be a candidate equilibrium. By Proposition 3.4, it is monotone increasing in α, and hence $A(\mu)$ is also monotone increasing in α.

By assumption, $(\log \tilde{\eta})_{\tilde{x}\tilde{\varepsilon}} \geq 0$ and $(\log \tilde{\eta})_{\mu\tilde{\varepsilon}} \geq 0$. Therefore, Lemma B.4 implies that

$$\frac{\tilde{\Phi}_\mu(b + a\tilde{\varepsilon}, \mu, \tilde{\varepsilon})}{1 - \tilde{\Phi}(b + a\tilde{\varepsilon}, \mu, \tilde{\varepsilon})}$$

is monotone decreasing in $\tilde{\varepsilon}$ for any $a \geq 0$.

Let $\tilde{A}(\mu) = 1/A(\mu)$. Then, $\tilde{A}(\mu)$ is monotone decreasing in μ and the second item of Lemma B.3 implies that $\tilde{A}(\mu)$ is the interior optimum for firm value maximization over $\tilde{\alpha} = 1/\alpha$. The proof is complete.

Q.E.D.

Proof of Proposition 3.7. We have

$$\frac{\partial}{\partial \varepsilon}\Psi(B(\alpha)(1+\varepsilon\alpha), \mu, \varepsilon) \;=\; \frac{\partial}{\partial \varepsilon}\int_{B(\alpha)(1+\varepsilon\alpha)}^{\infty} (y - x)\eta(y|\mu,\varepsilon)dy$$
$$= \int_{B(\alpha)(1+\varepsilon\alpha)}^{\infty} (y - x)\frac{\partial}{\partial \varepsilon}\eta(y|\mu,\varepsilon)dy$$

where we have defined

$$x = B(\alpha)(1 + \varepsilon\alpha)$$

By the monotone likelihood property this beta will be positive if ε, y are positively related, and negative otherwise. Q.E.D.

C Additional tables from empirical analysis

Table C1: Full panel analysis: Robustness against inconsistent observations

	(1)	(2)	(3)	(4)	(5)
	baseline (no drop)	1%	5%	10%	25%
VARIABLES	$EBITDA_{f.t+1}$	$EBITDA_{f.t+1}$	$EBITDA_{f.t+1}$	$EBITDA_{f.t+1}$	$EBITDA_{f.t+1}$
foreign currency share$_{f,t}$	0.150***	0.151***	0.131***	0.142***	0.153***
	(0.041)	(0.049)	(0.044)	(0.040)	(0.040)
Observations	20,935	6,681	8,839	10,203	12,735
R-squared	0.854	0.862	0.859	0.856	0.853
Country*Industry*Year FE	✓	✓	✓	✓	✓
Firm-level controls	✓	✓	✓	✓	✓
No. clusters	56	54	54	55	56
No. FEs	2934	1442	1746	1917	2199

Note: For some firms, total debt reported in the debt capital structure module of Capital IQ (used to compute foreign-currency share) differ from total debt reported in the financial statements. This table examines the robustness of results from the full panel analysis presented in Table 3. The sample period is 2005 to 2019, focusing on firms with a negative stock return-depreciation beta over the same period. The independent variables are year-t financial variables and foreign-currency shares. The dependent variables are earnings (proxied by EBITDA) over year $t + 1$. Column (1) replicates column (2) of Table 3. Column (2) to (5) drops firm-year observations for which total debt reported in the debt capital structure module total deviates from total debt reported in the financial statements by 1%, 5%, 10%, or 25%, respectively. Standard errors are clustered at the industry level. *** p<0.01, ** p<0.05, * p<0.1.

Table C2: Full panel analysis: Alternative samples

Panel (a): Negative rolling-beta firms

VARIABLES	(1) all $EBITDA_{f.t+1}$	(2) with market access $EBITDA_{f.t+1}$	(3) non-tradable with access $EBITDA_{f.t+1}$	(4) hard currency with access $EBITDA_{f.t+1}$	(5) consistency with access $EBITDA_{f.t+1}$	(6) bank loan with access $EBITDA_{f.t+1}$	(7) normalized with access $EBITDA_{f.t+1}$ / $Asset_{f.t+1}$ (%)
foreign currency share$_{f,t}$	0.192***	0.144***	0.247**		0.134***		0.005*
	(0.039)	(0.044)	(0.101)		(0.046)		(0.003)
hard currency share$_{f,t}$				0.141***			
				(0.044)			
fc share (bank loan)$_{f,t}$						0.116**	
						(0.048)	
Observations	36,161	16,620	4,565	16,620	10,177	15,398	16,589
R-squared	0.850	0.863	0.865	0.863	0.864	0.858	0.434
Country*Industry*Year FE	✓	✓	✓	✓	✓	✓	✓
Firm-level controls	✓	✓	✓	✓	✓	✓	✓
No. clusters	60	57	38	57	57	57	57
No. FEs	3482	2662	1253	2662	1977	2514	2659

Panel (b): Non-zero foreign currency share only

VARIABLES	(1) $EBITDA_{f.t+1}$	(2) non-tradable $EBITDA_{f.t+1}$	(3) hard currency $EBITDA_{f.t+1}$	(4) consistency $EBITDA_{f.t+1}$	(5) bank loan $EBITDA_{f.t+1}$	(6) normalized $EBITDA_{f.t+1}$ / $Asset_{f.t+1}$ (%)
foreign currency share$_{f,t}$	0.135**	0.225		0.127*		0.003
	(0.057)	(0.156)		(0.076)		(0.004)
hard currency share$_{f,t}$			0.113**			
			(0.048)			
fc share (bank loan)$_{f,t}$					0.139**	
					(0.061)	
Observations	10,057	2,815	9,419	5,589	8,707	10,047
R-squared	0.871	0.876	0.877	0.872	0.866	0.468
Country*Industry*Year FE	✓	✓	✓	✓	✓	✓
Firm-level controls	✓	✓	✓	✓	✓	✓
No. clusters	54	33	54	54	52	54
No. FEs	2084	854	1992	1406	1845	2084

This table reports results of the full panel analysis (see Table 3) on alternative subsamples of data. Panel (a) use all firms whose rolling stock return-depreciation beta is negative up to year t. The configuration of columns (1) to (7) is the same as Table 3. Panel (b), columns (1), (2), (4) and (6) restrict the sample to firms with non-zero foreign-currency debt at year t. Column (3) focuses on firms with non-zero hard-currency borrowings. Column (5) looks at firms with non-zero foreign currency-denominated term loans or credit lines from banks. Standard errors are clustered at the industry level. *** p<0.01, ** p<0.05, * p<0.1.

Table C3: Full panel analysis: Alternative variables

Panel (a): Dependent variable: EBIT

VARIABLES	(1) all $EBIT_{f.t+1}$	(2) with market access $EBIT_{f.t+1}$	(3) non-tradable with access $EBIT_{f.t+1}$	(4) hard currency with access $EBIT_{f.t+1}$	(5) consistency with access $EBIT_{f.t+1}$	(6) bank loan with access $EBIT_{f.t+1}$	(7) normalized with access $EBIT_{f.t+1}$ / $Asset_{f.t+1}$ (%)
foreign currency share$_{f,t}$	0.133***	0.084**	0.081		0.078**		0.006**
	(0.034)	(0.036)	(0.078)		(0.031)		(0.003)
hard currency share$_{f,t}$				0.077*			
				(0.038)			
fc share (bank loan)$_{f,t}$						0.055	
						(0.043)	
Observations	45,319	20,948	5,742	20,948	12,741	19,552	20,913
R-squared	0.747	0.764	0.801	0.764	0.769	0.759	0.395
Country*Industry*Year FE	✓	✓	✓	✓	✓	✓	✓
Firm-level controls	✓	✓	✓	✓	✓	✓	✓
No. clusters	60	56	37	56	56	56	56
No. FEs	3756	2935	1437	2935	2200	2781	2932

Panel (b): Foreign-currency borrowing at extensive margin

VARIABLES	(1) all $EBITDA_{f.t+1}$	(2) with market access $EBITDA_{f.t+1}$	(3) non-tradable with access $EBITDA_{f.t+1}$	(4) consistency with access $EBITDA_{f.t+1}$	(5) normalized with access $EBITDA_{f.t+1}$ / $Asset_{f.t+1}$ (%)
FC Share > $0_{f,t}$	10.060***	4.954	10.487	5.048	0.394*
	(3.098)	(3.953)	(9.142)	(4.639)	(0.203)
Observations	36,161	16,620	4,565	10,177	16,589
R-squared	0.850	0.863	0.865	0.864	0.434
Country*Industry*Year FE	✓	✓	✓	✓	✓
Firm-level controls	✓	✓	✓	✓	✓
No. clusters	60	57	38	57	57
No. FEs	3482	2662	1253	1977	2659

This table reports results of the full panel analysis (see Table 3) using alternative independent or dependent variables. Panel (a) replaces the dependent variables from $EBITDA$ (or $EBITDA$ normalized by total assets) with $EBIT$ (or the normalized counterpart). The configuration of columns (1) to (7) is the same as Table 3. Panel (b) replaces the continuous foreign-currency share variable with a dummy variable that takes value one if foreign-currency share is positive, and zero otherwise. Standard errors are clustered at the industry level. *** p<0.01, ** p<0.05, * p<0.1.