Managed Float Regime and Transmission of Currency Risk: Indian Experience of Foreign Currency Borrowings

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Abstract

This study examines the linkage between firms' risk exposure and Foreign Currency Borrowing (FCB) within a managed float currency regime. A managed float regime offers an intriguing setting, as it can potentially induce a moral hazard problem. A moral hazard problem created by the managed float regime encourages firms to recklessly use FCB which could impact their risk exposure. We analyse the data of Indian firms for the period from 2012 to 2019. We measure the firms' risk exposure by modelling it as both default and equity risks. Our findings show that firms with FCB-heavy balance sheets are relatively more exposed to both default and equity risks as compared to firms with FCB-low balance sheets. The findings of this study showcase that a managed float regime has induced a moral hazard problem in India making FCB a transmission vehicle through which currency risk is transmitted to the economy. Based on our investigation, we recommend an exchange rate policy where the currency exchange rate is more market-driven. Such a policy can simultaneously help in developing of a well-functioning currency derivatives market in India and mitigate the financial stability concerns in the economy.

Keywords: Foreign Currency Borrowing, Currency Risk, Firm Risk, Managed Float Regime, Risk Exposure

JEL Classification**:** G15, G28, F31

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1. Introduction

The global financial crisis has seen a massive increase in credit liquidity due to quantitative easing by the US government. In emerging market economies, non-financial firms have exploited this opportunity by issuing a large volume of debt denominated in foreign currencies. At the close of 2020, dollar credit to Emerging Market Economies (EMEs) amounted to $4 trillion. This figure is over double the outstanding balance during the global financial crisis (BIS, 2020). The increase in dollar-based lending in emerging economies grew steeply by 5% on a year-on-year basis by the close of 2020 which is almost close to the average recorded for the last decade. (Chakrabarti and Sen, 2023).

The broad objectives with which non-financial firms indulge in borrowing denominated in foreign currency are 1.) diversification of sources of funds 2) reduction in financial frictions as showcased by Acharya et al. (2015), and 3) borrowing cheaply from abroad (Shin and Zhao, 2013). The flipside of FCB is the risk arising from currency mismatch, i.e., when the domestic currency depreciates and poses a risk for the domestic firms (Bruno and Shin, 2020). This adversely affects the firm's balance sheet by increasing the firm's debt burden (also known as the balance sheet channel). This risk transmitted risk through the balance sheet could be detrimental for firms that have stacked up their balance sheets with FCB.

The severity of this issue could escalate further in a scenario where the country adopts a managed float regime. In managed float, the Central bank allows for a currency band within which the currency fluctuates. Such a regime actively aims at managing the risks of currency mismatch and implicitly guarantees to safeguard against external economic shocks. The regime serves as an implicit guarantee as it assures the borrowers that the currency will oscillate in the currency band itself thereby managing the currency mismatch risk. The regime may go foul when this implicit guarantee acts counter-intuitive and makes the domestic firms too reckless in availing the foreign borrowings. If this is so, firms might get too confident that the central bank has effectively protected them from the risk associated with Foreign Currency Borrowings (FCBs), following which firms may be less inclined to hedge the currency risk further through the currency derivatives market. In this way managed or dirty float system introduces a moral hazard issue by encouraging firms to recklessly accumulate Foreign Currency Borrowings (FCB) on their balance sheets leaving the currency derivatives market incomplete (Patnaik et al., 2015).

The current body of literature primarily focuses on identifying the factors that influence Foreign Currency Borrowing (FCB) within the context of Emerging Market Economies (EMEs). Existing research in this area has observed that one of the major determining factors of FCB in EMEs is the presence of interest rate differential during favourable global funding conditions (Acharya and Vij, 2021; Shin and Zhao, 2013). Banti and Bose (2021) discover that foreign currency borrowings become more widespread during periods of ample global credit conditions. Additionally, Alter and Elekdag (2020) find that in emerging markets, the dovish stance of the monetary policy put in place by the US influenced the borrowing denominated in foreign currency during the post-global financial

crisis times. Goldstein (2005) and Villegas-Sanchez (2016) investigate the causes and outcomes of currency crises coupled with banking crises. Recent research conducted by Bruno and Shin (2020) revealed that firms, that secured foreign currency loans during favourable financing conditions, face increased market value stress when the local currency depreciates. However, there is a scarcity of studies that specifically delve into the impact of FCB on heightening the risks of firms in Emerging Market Economies (EMEs). Chakrabarti and Sen (2023) explored the impact of fluctuations in global credit market liquidity on a firm's risk exposure when the balance sheet of the firm is dominated by FCB. However, one of the limitations of the study by Chakrabarti and Sen (2023) is that it does not examine how FCBs during currency depreciation affect a firm's risk exposure when such firms have FCB-heavy balance sheets. This paper addresses this gap by examining the risks associated with foreign currency fluctuations arising from FCB, particularly when the local currency depreciates. As India follows a managed float regime, it enables us to detangle the implications of global credit market liquidity fluctuations and foreign currency fluctuations.

The macro-finance literature highlights that heavy reliance on foreign currency borrowings (FCBs) increases sovereign default risk (Du and Schreger, 2022). This research stream delves into the role of currency mismatch in financial crises (Krugman, 1999; Aghion et al., 2001; Cespedes et al., 2003). Despite evidence linking FCBs to currency mismatch and associated firm risk, little is known about how this mismatch translates into currency risk. In emerging markets like India, where a managed float regime operates, firms may over-rely on implicit guarantees, leading to excessive FCB accumulation and heightened risk exposure. This paper investigates how such regimes drive FCB accumulation, amplifying firms' vulnerability and creating potential channels for economic instability.

We contextualize our study to India. In 2019, India ranked 2nd among EMEs whose borrowings are primarily denominated in US dollars (Avdjiev et al., 2020). Following the taper tantrum (after 2013), India witnessed notable variations in foreign exchange rates. This makes the setting more conducive to understanding the impact of foreign currency borrowings on the risk exposure of the firms through the balance sheet channel. Furthermore, the currency derivatives market in India is characterized by illiquidity, incompleteness, and high costs, rendering it unattractive for explicit hedging strategies (Patnaik et al., 2015). In this paper, we argue that in India, due to the managed float-induced moral hazard and lack of a well-functioning market for currency derivatives, the firms with FCBs become more exposed to financial market risks (default and equity risks) when local currency depreciates. We conjecture when firms stack-up their balance sheet with high FCBs over the years will likely face more risk than firms with lower FCBs.

Our results indicate that FCB has a significant impact on the firm risk in times of local currency depreciation. Further, we find that large FCB holdings will increase a firm's risk exposure. We find that when domestic currency depreciates, default and equity risks increase when a firm’s balance sheet is FCB heavy due to stacked up FCB. The results suggest a word of caution when domestic

firms borrow from abroad and local currency depreciates. This problem is exacerbated in emerging markets, where the strength of currency is relatively weaker as compared to the currency of the developed markets. Our findings reveal that FCB seems to be the transmitter of currency risks to domestic firms. Firms with higher levels of FCB face substantially greater risks, both in terms of equity volatility and default probabilities as compared to firms with lower FCB exposure. By highlighting this balance sheet channel, we contribute to the macro-finance literature by offering a deeper understanding of how currency mismatch and foreign currency borrowing transmit currency risks in an emerging market. Such transmission can lead to the percolation of external risk to domestic firms through foreign currency borrowing and can lead to financial instability in the domestic economy.

To confirm our findings, we conduct a series of robustness tests. We use different variable definitions and employ alternative estimation methods to enhance the robustness of the results.

The rest of this study is organized as follows: Section 2 explores the relevant literature, Section 3 delves into sample and variable construction, and Section 4 outlines the empirical model along with the results. Section 5 discusses the robustness tests to validate the results, and Section 6 provides the paper's conclusion.

2. Related Literature & Hypothesis Development

We identify two prominent strands of literature on foreign currency borrowings (FCBs): 1.) Capital flow literature and 2.) Macro-finance literature.

The capital flow literature, extensively discusses how FCBs heighten a firm's risk exposure. Chui, Fender, and Sushko (2014), suggest that in emerging markets, leverage and currency mismatch significantly contribute to making the balance sheet position of firms riskier. When firms with FCB engage in carry-trade i.e., borrowing in foreign currencies to invest in higher-yielding domestic assets, they become more vulnerable in times of local currency depreciation (Bruno and Shin 2020). Gourinchas and Obstfeld (2012) and Rey (2018), observed that in emerging economies, capital flow volatility can result in asset price crashes coupled with challenging deleveraging. According to a study by the IMF (2015), an increase in foreign currency exposure is linked to periods of high leverage. Episodes of high capital inflow contribute to the creation of boom-bust cycles in credit and periods of elevated leverage (Schneider and Tornell, 2004; Lorenzoni, 2008; Mendoza and Terrones, 2008). Based on the discussion we note that the extant literature focuses on how the foreign borrowings impact firm risk. In the context of capital flow literature, we illustrate how in times of currency depreciation the flow of capital through FCB influences firms' risk exposure. Based on this, we hypothesise the following :

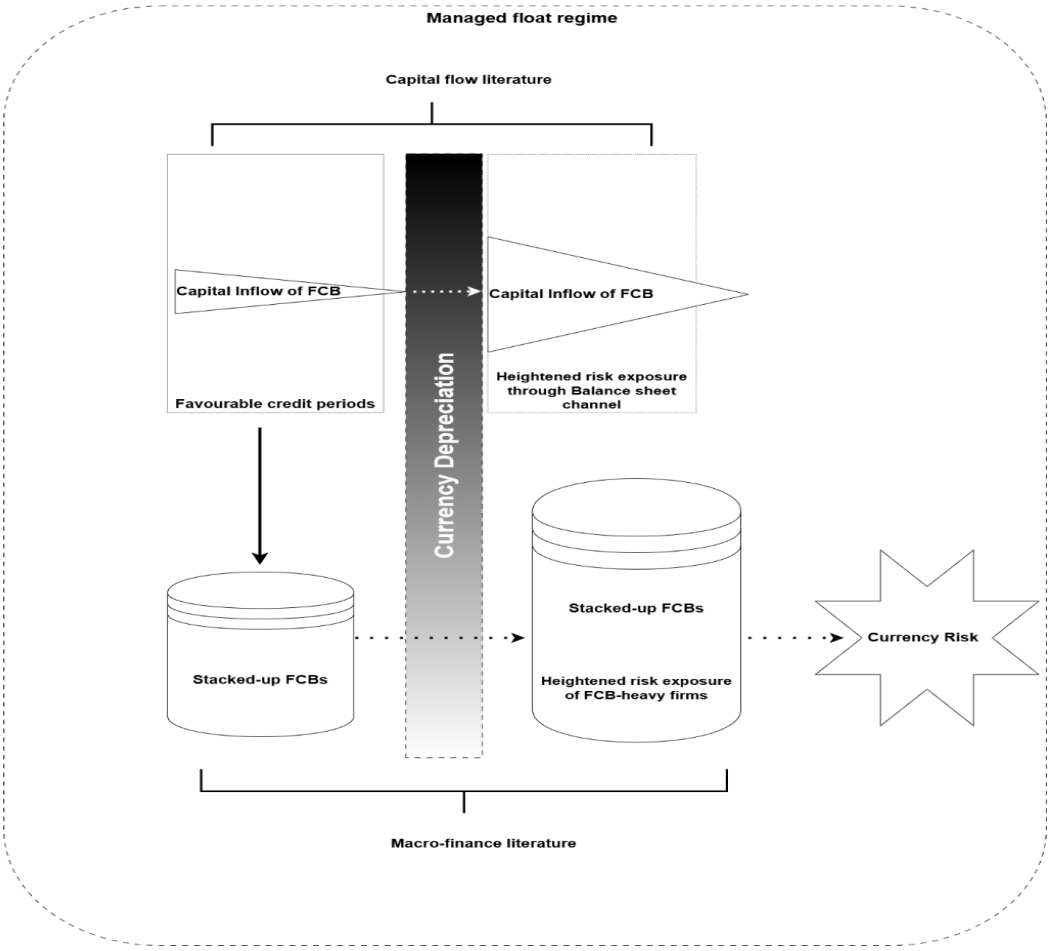
H1: Foreign currency borrowing (FCB) and local currency depreciation impact firm’s risk exposure.

The second strand of literature is the macro-finance literature on currency mismatch. The macro-finance literature on currency mismatch shows that high reliance on FCB can lead to higher sovereign default risk (Du and Schreger 2022). The origin of this strand of literature is the Tequila crisis of 1994 in Mexico and the East Asian crisis of 1997. Seminal contributions by Krugman (1999), Aghion, Bacchetta, and Banerjee (2001), and Cespedes, Chang, and Velasco (2003) and Jeanne, (2002) ; all focus on the causes and consequences of currency mismatch followed by a banking or financial crisis. The aftermath of the 2008 Global Financial Crisis and the euro crisis revealed that numerous East European and emerging economy firms suffered adverse effects due to currency mismatch. Research by Calvo et al. (1996) and Calvo (1998) illustrates how external shocks can elevate the risk of sovereign default. A cross-country study by Du and Schreger (2022) demonstrates that a greater dependence on FCB correlates with an increased risk of sovereign default. While the extant literature has suggested that there is a relationship between the FCBs, currency mismatch and currency risk, there is dearth of evidence on how currency mismatch in context of FCB transmits into currency risk. Such evidence is particularly relevant in an emerging market context, where firms not only rely heavily on foreign currency borrowings (FCBs) but also face weaker currency exchange rates. Besides these characteristics of an EME, India has a managed float regime. In the Indian context where managed float operates, we recognise the emergence of a moral hazard problem where firms may over-rely on the implicit guarantee of this regime and feel safeguarded against extreme currency mismatch risks. Though when firms would continue to over-rely on this risk hedging mechanism, they would be recklessly accumulating their balance sheets with FCBs. We conjecture that owing to this firms with high FCB in their balance sheets might face higher risk exposure which can potentially culminate into a transmission channel for currency risk and economic instability. We contribute to this literature by demonstrating that how a managed float regime induces firms to stack-up FCBs in their balance sheets which increases their risk exposure. Based on this, we hypothesize the following:

H2: Firms with higher levels of foreign currency borrowings experience greater risk exposure as compared to firms with lower levels of foreign currency borrowings when local currency depreciates.

Drawing on Chakrabarti and Sen (2023), we analyse firms' risk exposures within the context of an emerging market economy operating under a managed float regime. Specifically, in H1 we provide evidence on how foreign currency borrowing and local currency depreciation impact firms' risk exposure encompassing both default risk and equity risk, while controlling for global and domestic risk factors and firm-level heterogeneity. In H2 we provide evidence to showcase that in times of currency depreciation the stacking-up or accumulation of FCBs on firms' balance sheets over time amplifies their risk exposure.

Based on this discussion, Figure:1 presents transmission channels and theoretical mechanisms showing FCB as a transmission channel of firm risk and currency risk, and the relevant body of literature in the context of currency depreciation and managed float regime.



Figures 1. Transmission channels and theoretical mechanisms

This figure shows FCB as a transmission channel of Firm risk and Currency risk, and the relevant body of literature in the context of currency depreciation and managed float regime.

3. Sample & Variable Construction

Data:

We mainly obtained data from the Centre for Monitoring Indian Economy (CMIE), Prowess database. This source provides us with the necessary balance sheet, income statement, and trading-related information for listed firms2. Additionally, the daily adjusted closing prices of the firms are sourced from the Thomson Reuters database. The India VIX closing values are extracted from the National Stock Exchange (NSE) website, while the CBOE VIX values are acquired from the Chicago Board Options Exchange (CBOE). For interest-rate data, we refer to the database maintained by the Reserve Bank of India (RBI) in this study.

[2] We only consider listed firms of National Stock Exchange (NSE) of India and Bombay Stock Exchange (BSE) in our study since the measures the risk exposure employed by us are based on market.

The data pertains to financial year-end for March 2012 to March 20193. Data is used at a yearly frequency and converted to a yearly frequency wherever needed. Firms are selected based on the variable of interest, FCB, resulting in 450 non-financial firms that have borrowed in foreign currency at least once during the sample period. After excluding firms with unavailable data in the Prowess database, our final sample consists of 378 non-financial listed firms (refer to Table 2 for variable descriptions and sources). To mitigate the impact of outliers, all continuous variables are winsorized at the 1% and 99% levels.

Dependent variables

Estimation of Default Risk

The Black-Scholes-Merton Option Pricing Model provides the measure of default distance and Expected default frequency (EDF). This model formulates the relationship among a firm's liabilities, total value, and equity value. The model assumes that the firm's total market value follows a Geometric Brownian Motion.

$$dV = \mu V dt + \sigma_v V dW$$

In this context, V represents the firm's value, μ is the expected return of the firm's value, σ_v signifies the fluctuation in the firm's value, and dW denotes the Weiner process.

Subsequently, by treating the firm's asset values as a call option on the underlying firm value, where the strike price is equivalent to the value of debt, the formulation is as follows:

$$E = VN(d_1) - De^{-rt}N(d_2)$$

Here, E signifies the firm's equity value, V represents the total value of the firm, D denotes the total liabilities of the firm, and N(.) stands for the cumulative distribution function of the normal distribution, and

$$d_1 = \frac{ln\frac{V}{D} + \left(r + \frac{1}{2}\sigma_v\right)^2 T}{\sigma_v\sqrt{T}},\ d_2 = d_1 - \sigma_v\sqrt{T}$$

Within the given equation, both V and σ_v are unobservable. The determination of unobservable variables involves introducing an additional equation for volatility of the firm's value σ_v, and the volatility of the firm's equity value σ_e.

$$\sigma_e = \frac{V}{E}N(d_1)\sigma_v$$

[3] Sample is narrowed down based on the availability of short data needed for the estimation of default risk and excluding the data for post March 2019 on account of pandemic period.

The two equations; the firms' equity value E, and the volatility of the firm's equity value σ_e creates a system of equation for two unknowns, i.e., V and σ_v , respectively. The rest of the variables: firm's equity value (E); firm's debt value (D); risk-free interest rate (r), and maturity time (T) are observable. We use the Prowess database to obtain the data of all these observable variables for each firm in our data set. The risk-free interest rate (r) is measured by the 3-month Treasury bill of the Indian government.

A final step in calculating a firm's default distance requires measuring the default point. KMV defines the default point as:

$$DefaultPoint(DP) = STD + 0.5LTD$$

STD is the short-term debt of a firm, and LTD is the long-term debt of a firm. The default distance (DD) is measured as shown below:

$$DD = \frac{V - DP}{V\sigma_v}$$

The EDF is subsequently measured as:

$$EDF = N(-d_2)$$

Estimation of Equity Risk

The volatility of stock returns is assessed by calculating the standard deviation of daily stock returns for each stock in each of the financial years. Meanwhile, the proxy for equity risk, is Firm-Specific Stock Return Volatility, which is determined by calculating the standard deviation of daily excess returns using the classical four-factor model for each stock at the year-end of year t in every financial year. To compute the standard deviation of daily excess returns in the classical four-factor model, we run the following return regression for each stock for each of the financial years:

$$r_t^j = \alpha_0 + \beta_{ERM}^j ERM_{t,T}^M + \beta_{SMB}^j SMB_{t,T} + \beta_{HML}^j HML_{t,T} + \beta_{WML}^j WML_{t,T} + \varepsilon_t^j$$

In this regression, the dependent variable is represented by the daily stock returns of stock j, denoted as r_t^j. The independent variables encompass classical risk factors, such as excess market returns (EM), firm size (SMB), book-to-market value (HML) as proposed by Fama and French (1993), and the momentum factor (WML) introduced by Jegadeesh and Titman (1993). Subsequently, the standard deviation of the residual ε_t^j is computed, serving as a metric for firm-specific equity risk and indicating the volatility of the specific returns of the stock.

Independent and Control variables

The variable of interest in this study is foreign currency borrowing (FCB) [4], which is considered as the proportion of the total debt held by the firms. Similar definition of FCB is adopted

[4] We consider the definition of FCB as given by CMIE database: "*Any loan taken by the company in a currency other than in Indian rupees is a foreign currency loan. Examples of such loans are loans taken from foreign banks, foreign currency loans taken from foreign branches of Indian banks, foreign currency loans taken from Indian banks, loans taken from EXIM banks, loans taken from multinational lending institutions such as World Bank,*

by Allayanis et al. (2003) and Aguiar (2005), to explore the relationship between debt and firms' vulnerability.

Both global and domestic risk factors are important drivers of the firm's risk exposure. We control for these by CBOE VIX (Rey, 2018; Bruno and Shin, 2017; Banti and Bose, 2021) and India VIX (measure of domestic risk aversion for the Indian economy), respectively. We take the logarithm of the VIX measure to reduce the impact of outliers (Bekaert et al., 2013).

The risk exposure of a firm is also influenced by its characteristics. To account for firm heterogeneity, we consider measures such as leverage, firm size, market-to-book value, liquidity, and tangibility (Bruno and Shin, 2020; Viral and Vij, 2021; Banti and Bose, 2021). Leverage is defined as the ratio of total debt to total assets, firm size is the logarithm of total assets, and market-to-book value is the ratio of market value to the stock's book value. Liquidity is assessed using the quick ratio, representing the ratio of quick assets to quick liability. Tangibility is determined by the ratio of net fixed assets to total assets. All continuous variables are winsorized at the 1% and 99% levels to mitigate the impact of outliers. Table 3 presents the descriptive statistics of these variables.

4. Empirical Model & Results

Impact of FCB and Local Currency Depreciation on Firm Risks

We investigate how the changes in forex return (the return of the exchange rate for the Indian rupee against the US dollar) is channelized through foreign currency borrowing to increase the risk exposure of the firms. Depreciation of currency will lead to higher risk exposure for firms who have borrowed in foreign currency in the previous period. Firms borrowing from abroad are more exposed to the vagaries of currency movement because depreciation of the currency will result in an increasing debt burden in terms of domestic currency, increasing the liability and leverage of the firms. Alternatively, this is also known as the balance sheet channel.

We investigate the balance sheet channel through an OLS estimation with a Depreciation[5] term and a term containing the interaction between foreign currency borrowing and Depreciation as follows:

$$Risk_{i,t} = \beta_1 FCB_{i,t-1} + \beta_2 Depreciation_{\mathrm{t}} + \beta_3\left(FCB_{i,t-1} * Depreciation_{\mathrm{t}}\right) + \sum RFC_{t-1} + \sum FC_{i,t-1} + u_i + \gamma_t + \zeta_j + \varepsilon_{i,t} \quad (1)$$

$Risk_{i,t}$ represents the default risk and equity risk of a firm i in year t. We account for global risk aversion, domestic risk aversion, and firm heterogeneity. RFC_{t-1} represents the control for global

IBRD, and Asian Development Bank, external commercial borrowings, suppliers/buyers' credit, global depository receipts and American depositary receipts."

[5] Depreciation refers to the annual percentage change in the exchange rate of Indian rupees relative to the US dollar.

and domestic risk aversion at year $t-1$, with CBOE VIX serving as a proxy for global risk aversion and India VIX as a proxy for domestic risk aversion. $FC_{i,t-1}$ denotes firm heterogeneity for firm i at year $t-1$, controlled through firm characteristics including leverage, firm size, price-to-book ratio, liquidity, and tangibility. We incorporate firm fixed effect (u_i) year fixed effect (γ_t) and industry fixed effect (ζ_j) to account for unobserved heterogeneity in the cross-section of firms, time-varying shocks, and industry-specific influences on a firm's risk exposure. To address endogeneity concerns, we measure FCB and the control variables with a lag of one period.

As in the previous sections, we have used two proxies to measure default risk and two proxies to measure equity risk. We split the analysis of our results into two cases: default risk and equity risk, respectively. The two scenarios are additionally categorized into two subcategories based on the respective indicators for default risk and equity risk. In each scenario, the significance of the interaction term coefficient, which identifies the balance sheet channel, is observed at a 5 percent level of significance (Table 4, column 1, 2, 3, 4).

In the first case, for default distance, the coefficient of the balance sheet channel represented by the interaction terms is negative (Table 4, column 1), implying that default distance decreases as the change in the domestic value of the foreign currency debt increases. For the expected default frequency, the coefficient is positive (Table 4, column 2), implying that the expected default frequency increases as the change in the domestic value of the foreign currency debt increases. Both the subcases with respect to default risk show that default risk increases as the domestic value of foreign currency debt increases.

In the second case, for volatility in stock return, the coefficient of the balance sheet channel represented by the interaction terms is positive (Table 4, column 3), implying that volatility in stock return increases as the change in the domestic value of the foreign currency debt increases. Similarly, for the firm-specific volatility in stock return, the coefficient is positive (Table 4, column 4), implying that firm-specific volatility in stock return increases as the change in the domestic value of the foreign currency debt increases. Both the subcases with respect to equity risk we show that equity risk increases as the domestic value of foreign currency debt increases.

Our findings broadly indicate that foreign currency borrowing contributes to an increase in firms' risk exposure. The depreciation of the currency raises the burden of debt in terms of domestic currency, consequently elevating both default and equity risk for the firm. While existing literature on foreign currency borrowing primarily explores its determinants, our results contribute by examining the implications of increased foreign currency borrowings. We find that foreign currency borrowing is one of the factors in exacerbating the firm’s risk exposure. These outcomes support the assertions made by Avdjiev and Takats (2014), Chui et al. (2014), and Bruno and Shin (2017) regarding the heightened vulnerabilities associated with issuing debt in foreign currency.

Role Of High FCB In Transmitting Currency Risk

We then examine the role of FCB in transmitting currency risk through firms with high levels of FCBs during times of currency depreciation. We use the specification as shown below:

$$\begin{aligned} Risk_{i,t} = {} & \beta_1 FCB_{i,t-1} + \beta_2 \text{Depreciation}_t + \beta_3 \text{FCB\_High\_Dummy} + \beta_4 \text{FCB\_Low\_Dummy} \\ & + \beta_5 \left(FCB_{i,t-1} * \text{Depreciation}_t * \text{FCB\_High\_Dummy} \right) \\ & + \beta_6 \left(FCB_{i,t-1} * \text{Depreciation}_t * \text{FCB\_Low\_Dummy} \right) \\ & + \sum RFC_{t-1} + \sum FC_{i,t-1} + u_i + \gamma_t + \zeta_j + \varepsilon_{i,t} \end{aligned} \quad (2)$$

$Risk_{i,t}$ denotes default risk and equity risk for a firm i at year t. RFC_{t-1} denotes control for global and domestic risk aversion at year $t-1$. $FC_{i,t-1}$ denotes time varying firm controls at year $t-1$. We include firm fixed effect (u_i) , industry fixed effect (ζ_j) and year fixed effect (γ_t) to capture unobserved heterogeneity. To minimize the endogeneity concerns in our model, we measure FCB and the control variables at a lag of one period. In equation (2), the interaction term 'FCB, Depreciation, and the dummy for the level of FCB' identifies the transmission channel for firms with high level of FCB and low level of FCB, respectively. We control for the double and triple interaction terms if the fixed effect does not absorb them but we have omitted the same from the equation for brevity. In Table 5, the interaction term 'FCB, Depreciation, and the dummy for the level of FCB' is significant at 5% level in all the columns for all specifications when the FCB level is high in the firm's balance sheet. For firms with a low level of FCB, the interaction term shows no statistical significance. This indicates that firms with high FCB as compared to those with low FCB, are more disposed to face risk (both default and equity risk).

The results broadly support the evidence theorized by the macro-finance literature. The macro-finance literature focuses on the currency mismatch and how it leads to a financial crisis. The studies in this literature (Jeanne, 2002; and, Du and Schreger, 2022) are concentrated at the country level study. There are very few studies conducted at the firm level. The study by Bruno and Shin (2020) is one of the most noted firm-level studies to date. In their study, they provide evidence that currency depreciation has a role to play in exacerbating corporate distress for emerging market firms. Our result adds to this study by explicitly modelling the risk exposure of firms in the form of default risk and equity risk. We find that firms with a higher level of foreign currency borrowing are more prone to currency mismatch vis-à-vis firms with a lower level of FCB. Patnaik et al. (2015) and Acharya (2021) suggest that Indian firms have a moral hazard problem with respect to foreign currency borrowing. Our findings reveal that firms with elevated levels of foreign currency borrowings encounter heightened risk exposure owing to currency mismatch, verify the fact stated by Patnaik et al. (2015) and Acharya (2021). Additionally, firms with high FCB in their balance sheets not only face higher risk exposure but when adequate policy mechanisms on capital flow and exchange rate are not in place the same can potentially culminate into a transmission channel for currency risk and economic instability.

5. Robustness Checks

An alternative measure of exchange rate

Although Indian firms mainly borrow in US dollars, to validate our result for the balance sheet channel, we use the real effective exchange rate (REER), and the nominal effective exchange rate[6] (NEER) as alternate measures of the exchange rate. Our results for the same in Table 6, are consistent with the main analysis in establishing that FCB plays a crucial role as a transmission channel that transfers the currency risk associated with FCB to the domestic firms' risk exposure.

An alternative measure of risk exposure

The risk exposure measures employed in the primary analysis are forward-looking risk measures. In order to validate our results, we also use an accounting-based measure: interest coverage ratio (ICR), in estimating a firm's risk exposure. We measure ICR by the ratio of Earning Before Interest and Tax (EBIT) to Interest Expenses. A decline in the ICR indicates an elevated level of risk exposure for the firm and vice-versa (Dothan, 2006). The results as presented in Table 7 confirm our findings that FCB plays an important role in transferring foreign currency risk to domestic firms when we measure the risk as ICR (an accounting-based measure)

Dynamic Panel Estimation

To provide further robustness to our results and solve for any potential endogeneity, we also undertake a two-step system GMM estimation. The findings support and validate the primary findings of our paper. Results in Table 8 confirm that foreign currency borrowing plays a crucial role in exacerbating firms' risk exposure, and that it also plays a major role in transmitting foreign currency risk to domestic firms' risk exposure.

6. Conclusion

Our research is set against the backdrop of evolving global credit market dynamics and the quest for higher returns by global investors. This trend has led to a noteworthy surge in the borrowings denominated in foreign currency by firms in developing economies. The widespread accessibility of credit in the aftermath of the global financial crisis has contributed significantly to a substantial increase in Foreign Currency Borrowing (FCB) within emerging markets. The considerable increase in foreign currency borrowing may expose the firms to risks associated with volatilities in the foreign exchange rate. In the absence of an adequate policy on capital flow control the situation can become rather detrimental when the FCBs are further bolstered by the exchange rate regime followed in a country. A managed float regime incentivises unhedged FCBs, making it very important to understand the impact of FCB in such a setting.

[6] Effective exchange rate is a weighted measure of the bilateral exchange rates. The data has been sourced from the effective exchange rate statistics of BIS.

Among emerging market economies, Indian firms are one of the largest borrower groups of FCB. In India, the period spanning from March 2012 to March 2019 witnessed contrasting periods of currency exchange rate fluctuations. The Indian context where a managed float regime operates and incomplete currency derivative market exists gives us the perfect backdrop to investigate FCB's impact on firms' risk exposure during times of currency depreciation and its potential threat to economic stability.

Our analysis of the full sample shows that foreign currency borrowing has a significant effect on the risk exposure of the firms during times of currency depreciation. FCBs transmit risk to firms through the balance sheet channel. Firms with stacked-up FCBs in their balance sheets experience a significantly higher risk exposure when the domestic currency depreciates relative to firms with low levels of foreign borrowing. These findings suggest that FCBs through the balance sheet channel can transmit currency risk into the economy when the local currency depreciates. The increased risk exposure also alludes to the fact that the RBI policy of managed float creates a moral hazard problem in the Indian market Patnaik et al. (2015), where the domestic firms recklessly rely on FCBs without sufficient hedging the risk. Results are robust when employing alternative measures of interest coverage ratio (ICR) to assess the firm's risk exposure, examining the alternative measure of exchange rate: Real Effective Exchange Rate (REER) and the nominal effective exchange rate (NEER), and an alternative estimation approach through a two-step system GMM.

Our findings suggest that FCB has the potential to act as the vehicle of currency risk within an economy, warranting serious concern and attention. The stacking-up of FCB can trigger the percolation of currency risk into the financial system of the domestic firms which can shake the country's financial stability. The findings of this study showcase that a managed float has induced a moral hazard problem in India. The policy implication of this study is, that a currency exchange-rate policy that is more market-driven might help in curbing the impediments of the currency risk associated with high FCB. This will help in simultaneously developing a well-functioning derivatives market and aid in mitigating financial stability concerns.

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Table 1. Summary of extant literature

Body of literature:	Research paper:	Key findings/observations:	Contribution of this study:
Factors that influence FCBs & related consequences	Goldstein (2005)	Cause and effects of currency crises	We investigate how capital flow through FCBs heightens the equity & default risks of firms in Emerging Market Economies (EMEs) during currency depreciation.
	Shin and Zhao (2013)	Increase in FCB during favourable global funding condition	
	Villegas-Sanchez (2016)	Quantified effects of lending and balance sheet channels on corporate investments during currency devaluation	
	Alter and Elekdag (2020)	Increase in FCB due to US Monetary policies on extending credit	
	Bruno and Shin (2020)	Firms with foreign currency loans face market value stress when local currency depreciates	
	Acharya and Vij (2021)	Increase in FCB due to interest rate differential	
	Banti and Bose (2021)	Increase in FCB during ample global credit conditions	
Capital Flow	Schneider and Tornell (2004)	Currency mismatches in borrowing result in widespread bankruptcies, economic recessions, and credit shortages	
	Lorenzoni (2008)	High capital inflow contributes to the creation of boom-bust cycles	
	Mendoza and Terrones (2008)	Emerging market crises are usually associated with credit booms, which are often driven by large capital inflows.	
	Gourinchas and Obstfeld (2012)	Capital flow volatility can result in asset price crashes	
	Chui, Fender, and Sushko (2014)	Leverage and currency mismatch make the balance sheet position of firms riskier	
	Rey (2018)	Asset price bubbles and excessive credit growth are indicators of financial crises	
	Bruno and Shin (2020)	Firms face more risk when they use FCBs for carry-on trade	
	Chakrabarti and Sen (2023)	Impact of fluctuations in global credit market liquidity on a firm's risk exposure	
Macro-finance Literature on currency mismatch	Calvo, Leiderman, and Reinhart (1996)	Better policy making can shield developing economies from the unpredictability of international capital flows	We investigate how a managed float regime induces firms to stack-up FCBs in their balance sheets and increases their risk exposure. We provide evidence on how FCB might act as a transmission channel for currency risk in the economy.
	Calvo (1998)	External shocks can elevate the risk of sovereign default	
	Krugman (1999)	Causes and effects of currency mismatches leading to banking or financial crises	
	Aghion, Bacchetta, and Banerjee (2001)	Exchange rate regimes can cause balance sheet problems and give rise to currency crises	
	Cespedes, Chang, and Velasco (2003)	Significant balance sheet effects during currency depreciation can make currency mismatch harmful for the economy	
	Goldstein (2005)	Vicious circle between banking crises and currency crises and destabilising of the economy	
	Du and Schreger (2022)	High reliance on FCB can lead to higher sovereign default risk	

This table presents a summary of the findings from the extant literature subdivided into three major strands and respective contribution of this study indicated therewith.

Table 2. Description of the variables

Variable Name	Definition	Source
Foreign Currency Borrowing (FCB)	Total FCB debt divided by the firm's total debt in a financial year	Centre for Monitoring Indian Economy (CMIE), Prowess database
VIX	CBOE VIX (log)	Chicago Board Options Exchange (CBOE)[7]
India VIX	India VIX (log)	National Stock Exchange (NSE)
Leverage	Total debt divided by the total assets	CMIE
Firm size	Total assets (log)	
Market to book value	Market value divided by the stock's book value	
Liquidity	Quick assets divided by the quick liability of a firm	
Tangibility	Net fixed assets divided by the total assets of a firm	
Interest rate		RBI database
Daily adjusted closing prices		Thomson Reuters database

Table 3. Descriptive Statistics of the variables

	Mean	Sd	Median	P01	P25	P75	P99
Default Distance	2.3229	0.7393	2.2191	0.6061	1.8134	2.7282	4.3968
FCB	0.2444	0.2242	0.1767	0.0012	0.0685	0.3551	0.9335
Firm-Specific Stock Return Volatility	0.0267	0.0138	0.0241	0.0121	0.0195	0.0302	0.1021
Expected Default Frequency	0.0269	0.0424	0.0132	0.0000	0.0032	0.0349	0.2722
Stock Return Volatility	0.0305	0.0138	0.0284	0.0143	0.0231	0.0347	0.1039
VIX	16.8334	3.7940	14.5962	12.4696	14.1151	17.6233	24.1015
Tangibility	0.3978	0.1714	0.3880	0.0568	0.2790	0.5054	0.8554
Liquidity	0.7262	0.5265	0.6325	0.0977	0.4199	0.8613	2.6751
INR-USD Rate	58.7112	7.4091	61.1474	45.5737	54.4511	65.4610	67.0895
Leverage	0.3751	0.1724	0.3682	0.0404	0.2492	0.4819	0.7926
Firm size	6.3214	1.6892	6.1317	3.0233	5.1304	7.3051	10.5601
India VIX	18.1917	3.0801	17.7080	13.0330	16.4287	18.8222	23.7708
Market to book value	2.4608	4.5929	1.4188	0.1256	0.7221	2.9682	13.6255
% Change of dollar credit flow (BIS)	2.9259	7.1179	1.2900	-7.3540	-4.7010	5.5270	15.4430

[7] See www.cboe.com for more details

Table 4. Impact of Foreign Currency Borrowing on Firm Risks

	Default Risk		**Equity Risk**	
	Default Distance (1)	**Expected Default Frequency** (2)	**Stock Return Volatility** (3)	**Firm-Specific Stock Return Volatility** (4)
FCB*Depreciation	-2.2898**	0.2190***	0.0715***	0.0717***
	(1.0452)	(0.0831)	(0.0265)	(0.0269)
Controls	Yes	Yes	Yes	Yes
Firm Fixed Effect	Yes	Yes	Yes	Yes
Industry Fixed Effect	Yes	Yes	Yes	Yes
Year Fixed Effect	Yes	Yes	Yes	Yes
Observations	1272	1272	1272	1272
R^2	0.124	0.054	0.059	0.050

Note: Results from OLS regression linking firm risks to depreciation and FCB. FCB is scaled by total debt at year-end t-1. Depreciation is the annual exchange rate percentage change of the Indian rupee against the U.S. dollar. The interaction between FCB and Depreciation is the key independent variable. Standard errors are clustered at the firm level. Significance levels: *(p<0.10), **(p<0.05), *** (p<0.01).

Table 5. Impact of FCB Level on Firm Risks

	Default Risk		**Equity Risk**	
	Default Distance (1)	**Expected Default Frequency** (2)	**Stock Return Volatility** (3)	**Firm-Specific Stock Return Volatility** (4)
FCB*Depreciation* FCB_High	-2.3480**	0.2140**	0.0686**	0.0694**
	(1.0851)	(0.0862)	(0.0274)	(0.0278)
FCB*Depreciation* FCB_Low	-3.0027	0.1557	0.0365	0.0441
	(3.7077)	(0.2946)	(0.0938)	(0.0953)
Controls	Yes	Yes	Yes	Yes
Firm Fixed Effects	Yes	Yes	Yes	Yes
Industry Fixed Effects	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes
Observations	1271	1271	1271	1271
R^2	0.124	0.054	0.060	0.050

Note: Results from OLS regression linking firm risks to FCB levels and local currency depreciation. High_FCB (Low_FCB) dummy equals 1 if FCB exceeds (is below) the median of average FCB during the sample period. Standard errors clustered at the firm level. Significance levels: *(p<0.10), **(p<0.05), *** (p<0.01).

Table 6. Robustness test for an alternative measure of exchange rate: Real Effective Exchange Rate (REER)

	Default Risk				**Equity Risk**			
	REER		**NEER**		**REER**		**NEER**	
	Default Distance	Expected Default Frequency	Default Distance	Expected Default Frequency	Stock Return Volatility	Firm-Specific Stock Return Volatility	Stock Return Volatility	Firm-Specific Stock Return Volatility
FCB*Depreciation*FCB_High	-1.6351**	0.1484**	-1.3631***	0.1563**	0.0559*	0.0638*	0.0560*	0.0639*
	(0.779)	(0.0697)	(0.5237)	(0.0653)	(0.0307)	(0.0355)	(0.0335)	(0.0341)
FCB*Depreciation*FCB_Low	4.6624	-0.1504	2.9303	0.1056	-0.0443	-0.032	0.0253	0.0406
	(5.2765)	(0.4198)	(4.2619)	(0.339)	(0.1337)	(0.136)	(0.108)	(0.1098)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1271	1271	1271	1271	1271	1271	1271	1271
R^2	0.125	0.053	0.123	0.052	0.06	0.047	0.058	0.046

Note: Results from OLS regression using alternative measures of exchange rate: REER and NEER. FCB is scaled by total debt at year-end t-1. Depreciation measured as yearly exchange rate percentage change against REER and NEER indices. High_FCB (Low_FCB) dummy equals 1 if FCB exceeds (is below) the median of average FCB during the sample period. Standard errors clustered at the firm level. Significance levels: *(p<0.10), **(p<0.05), *** (p<0.01).

Table 7. Robustness test for an alternative measure of risk exposure the Balance Sheet Channel

	Interest Coverage Ratio
FCB*Depreciation*FCB_High	-1.3341***
	(0.4931)
FCB*Depreciation*FCB_Low	1.7242
	(3.2059)
Controls	Yes
Firm Fixed Effect	Yes
Industry Fixed Effects	Yes
Year Fixed Effects	Yes
Observations	1271
R^2	0.026

Note: Results from OLS regression linking the interest coverage ratio to the interaction of FCB, depreciation, and FCB level. High_FCB (Low_FCB) dummy equals 1 if FCB exceeds (is below) the median of average FCB during the sample period. Standard errors clustered at the firm level. Significance levels: *(p<0.10), **(p<0.05), *** (p<0.01).

Table 8. Robustness test with alternative estimation technique: Dynamic Panel estimation for the relationship between FCB and default and equity risk through the balance sheet channel

	Default Risk		**Equity Risk**	
	Default Distance	**Expected Default Frequency**	**Stock Return Volatility**	**Firm-Specific Stock Return Volatility**
Lagged dependent variable	0.2249***	0.0304	0.007	0.0129
	(0.0644)	(0.0354)	(0.0309)	(0.0284)
FCB*Depreciation*FCB_High	-3.5518**	0.5825**	0.0878**	0.0652**
	(1.5988)	(0.2919)	(0.0356)	(0.0318)
FCB*Depreciation*FCB_Low	-5.99	0.2370**	0.1411*	0.1339
	(5.1617)	(0.1022)	(0.0812)	(0.0823)
Controls	Yes	Yes	Yes	Yes
Observations	1286	1286	1286	1286
Number of Clusters	324	324	324	324
Year Dummies	Yes	Yes	Yes	Yes
Number of Instruments	53	53	51	53
AB AR(1) (p-value)	0	0	0	0
AB AR(2) (p-value)	0.311	0.465	0.628	0.664
Hansen J test (p-value)	0.121	0.085	0.355	0.126

Note: Results from a two-step system GMM estimation linking default and equity risks to FCB via the balance sheet channel. Dependent variables include Default Distance, Expected Default Frequency, Stock Return Volatility, and Firm-Specific Stock Return Volatility. High_FCB (Low_FCB) dummy equals 1 if FCB exceeds (is below) the median of average FCB during the sample period. Hansen J statistic tests instrument validity. Significance levels: *($p<0.10$), **($p<0.05$), *** ($p<0.01$).