Regulating Carry Trades: Evidence from Foreign Currency Borrowing of Corporations in India*

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Abstract

We establish that macroprudential controls limiting capital flows can curb risks arising from foreign currency borrowing by corporates in emerging markets. Firm-level data show that Indian firms tend to issue more foreign currency debt when the interest rate differential between India and the United States is higher. This "carry trade" relationship, however, breaks down once regulators institute more stringent interest rate caps on borrowing; in response, riskier borrowers cut issuance most. Prior to adoption of this macroprudential measure, stock price exposure of issuers to currency risk rises after issuance, as witnessed during the "taper tantrum" episode of 2013; this source of vulnerability is nullified by the measure, as confirmed during the October 2018 oil price shock and the COVID-19 outbreak. We find no evidence of the policy's efficacy being undermined by leakage or regulatory arbitrage.

Keywords: emerging markets; foreign currency debt; foreign exchange risk; taper tantrum; capital controls

JEL Codes: F31; F34; G15; G30

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Foreign currency borrowing is an increasingly popular source of funding for non-financial firms in emerging market economies (EMEs). According to Bank for International Settlements (BIS) statistics, the stock of foreign currency debt securities of EME non-financial corporations grew more than tenfold between 2001 and 2019.[1] The traditional view has been that borrowing abroad allows firms with revenues in foreign currency to access deeper international funding markets while the sales provide a natural hedge for the debt. However, following the Global Financial Crisis (GFC), favorable funding conditions have prompted non-financial corporates, even those without foreign currency revenues, to engage in a form of "carry trade", where they borrow cheaply abroad and park those funds as short-term wholesale deposits in domestic banks (Bruno and Shin, 2017). This carry trade is profitable if firms are able to unwind, i.e., pay off the debt, before the currency depreciates.

However, the magnitude of this carry trade debt leaves the borrowing firms exposed to adverse exchange rate movements – such as during a "sudden stop" – especially since these liabilities are in foreign currency. As these borrowers tend to be large local firms, increased foreign currency borrowing is seen to have potentially adverse implications for domestic growth and stability of the local financial sector when external sector risks materialize.[2]

With a view to control these incipient risks, many EMEs significantly strengthened their capital flow management and other macroprudential tools (IMF, 2020). The International Monetary Fund recently revised its Institutional View to recognize the importance of these pre-emptive tools in ameliorating risks (IMF, 2022). Theoretical work including Brunnermeier and Sannikov (2015), Korinek (2018), and Acharya and Krishnamurthy (2019) analyze such tools and suggest that – in the spirit of Pigouvian taxation – firms contributing more to the fire-sale externality in the case of a sudden stop should be taxed more (e.g., be subjected to stronger capital controls).[3] However, the effectiveness of such tools may be limited if risky

[1] See Table C3 at https://stats.bis.org/statx/toc/SEC.html.

[2] See Acharya et al. (2015); Shin and Zhao (2013); Chui, Fender and Sushko (2014); Du and Schreger (2022) for a discussion of the potential risks posed by increased corporate foreign currency borrowing.

[3] The externality arises because individuals firms do not internalize that, on realization of a negative shock, repaying their past debt leads to exchange rate depreciations further exacerbating the shock.

borrowers are able to evade them (Ahnert et al., 2021).

Ultimately, the efficacy of macroprudential policy in regulating carry trade borrowing is an empirical question. While existing work has focused on the causes (Gutiérrez, Ivashina and Salomao (2020), di Giovanni et al. (2021)) and consequences (Bruno and Shin (2017), Bruno and Shin (2020)) of corporate carry trade borrowing, in this paper we seek to evaluate the regulatory response by analyzing the impact of a specific macroprudential policy tool targeted at limiting foreign currency borrowing. By regulation, Indian firms can only borrow in foreign currency if the all-in-cost interest rate of the borrowing is below a certain spread over the 6-month LIBOR rate. India's central bank, the Reserve Bank of India (RBI) sets the maximum allowable spread for the interest rate on the debt. Policy is tightened (loosened) by decreasing (increasing) the maximum interest rate spread. We focus on this specific policy lever since, as theory recommends, it explicitly targets riskier borrowers, and variation in the maximum rate during our sample period allows us to identify the effects on firm borrowing, operations, and risk.

To carry out our analysis, we employ detailed borrowing, accounting, and market data on Indian firms from 2004 to 2020. We construct a comprehensive sample of firms that borrow in foreign currency, both through the bond market and bank loans. This sample is unique in the literature since over 90% of the borrowing is through banks; in contrast, existing studies of foreign currency borrowing rely exclusively on bond issues (Bruno and Shin (2017), Bruno and Shin (2020)).

We start by confirming that the carry trade behavior of corporations plays an important role in explaining foreign currency borrowing. The *same* firm is more likely to issue debt in foreign currency when the difference in short-term interest rates between India and the United States is higher. In particular, the CT index, our proxy for the profitability of the carry trade, defined as the difference between Indian and U.S. 3-month interest rates scaled by the implied volatility of 3-month FX options (i.e., $\frac{3Mrate(IND)-3Mrate(US)}{IVof3MFXoptions}$), has a strong positive relationship with a firm's propensity to issue foreign currency debt even after

controlling for firm fixed effects. This phenomenon is driven by the period immediately following the GFC.[4] Firms that borrow when the carry trade is more profitable, whom we refer to as *carry trade* borrowers, see their exposure to foreign exchange risk increase. During periods of market stress such as the "taper tantrum" episode of 2013,[5] it is these carry trade borrowers that perform the most poorly. Can this source of vulnerability be nullified or mitigated by regulation of carry trades?

To answer this, we turn to our primary contribution – an analysis of how macroprudential policy affects carry trade borrowing. We show that the relationship between foreign currency debt issuance and the CT index is positive only when macroprudential policy is loose. When policy is tightened, i.e., the maximum interest rate spread allowed in foreign currency borrowing is reduced below its sample median, the relationship is no longer positive. This correlation suggests that the CT index stops being relevant at the same time that controls are strengthened. The magnitude of the effect is large – a one standard deviation increase in the CT index is associated with a 39% lower probability of foreign currency debt issuance when policy is tight compared to when it is loose. While suggestive, these results are merely correlational; the change in the maximum interest rate spread may not be exogenous and can simply be a reaction to corporate borrowing in the foreign currency debt market. At the same time, firm demand for foreign currency debt might have declined overall, further complicating inference.

In order to pin down the causal role of the macroprudential policy itself in curtailing borrowing, we test how firms with differing interest expenses react to changes in the interest rate caps. Since policy tightening reduces the maximum allowable interest rate on borrowing, the effects of the macroprudential policy should only be seen among firms that issue foreign

[4]Prior research has documented that, globally, the carry trade explains foreign currency borrowing in the period of unconventional U.S. monetary policy following the GFC (Bruno and Shin, 2017). Hence, we focus on this period in the bulk of our analysis.

[5]The "taper tantrum" refers to a period of turmoil in financial markets in 2013 precipitated by U.S. Federal Reserve statements that were seen to increase the probability of the tapering of the quantitative easing program. Emerging markets, in particular, saw a surge of capital outflows and asset price declines (Sahay et al., 2014).

currency debt at high interest rates, i.e., riskier borrowers. This is exactly what we find. The aggregate data shows that the distribution of interest expenses for issuers is narrower when policy is tight and this is driven by constriction on the higher end of the distribution. Firm-level regressions confirm that high interest expense firms reduce issuance, on both extensive and intensive margins, following a reduction in the maximum allowable interest rate.

Further support for a causal interpretation of the relationship between macroprudential policy and foreign currency borrowing comes from a difference-in-differences analysis. In November 2015, the RBI undertook a major tightening of regulation around corporate foreign currency borrowing with the first reduction in the interest rate cap since the GFC. To identify the risky borrowers exposed to this policy treatment, we use their interest expenses. Coding firms with high (low) interest expenses as treated (control) firms, we find that issuance in the months following November 2015 is lower for treated firms compared to control firms. Importantly, an analysis of dynamic effects suggests that treated and control firms had parallel trends prior to treatment, a necessary condition for the validity of the difference-in-differences research design.

The preceding results indicate that the macroprudential policy is successful in altering the composition of foreign currency borrowers. However, a lingering concern with macroprudential regulation is that the risk is not eliminated but merely shifted elsewhere (Ahnert et al., 2021). We rule out three important ways in which firm actions might render the policy change less effective. First, the reduction in interest rate caps might push firms that are still able to borrow to shorten the maturity of their borrowing thereby increasing their rollover risk. We directly test if this is the case by looking at the effect of the interest rate caps on maturity of issuance. This intensive margin analysis shows that issuance maturity does not decline when policy is tightened.

Second, firms newly excluded from foreign currency bond and loan markets might turn to trade credit denominated in foreign currency instead. This is potentially harmful as trade credit is generally of a much shorter maturity than bank and bond debt leaving firms still

exposed to sudden stops. We find that there are no statistically significant changes in overall trade credit outstanding for riskier borrowers following macroprudential tightening.[6] This result ameliorates the worry that the macroprudential policy pushes riskier borrowers to employ an even riskier source of financing – foreign currency trade credit.

Finally, we look at changes in domestic currency debt. Since this debt is often held by foreign portfolio investors, firms might be substituting away the foreign exchange risk with the risk of fickle capital flows. Our results indicate that debt in domestic currency does not increase following the policy change. This is consistent with the carry trade hypothesis as firms undertake foreign currency borrowing to take advantage of favorable financing costs (Du and Schreger, 2016) and not because of limited availability of domestic currency debt. Once macroprudential policy puts a brake on carry trade borrowing, these firms do not turn to domestic markets as an alternate source of financing.

In addition, we rule out the concern that macroprudential regulation only alters the source of risk rather than alleviating it by testing how macroprudential policy affects overall firm-level risk. We construct a stock market-based measure of a corporation's foreign exchange rate exposure, i.e., an FX β. A positive value indicates a positive correlation between the firm's stock market return and the Indian Rupee's performance relative to the U.S. Dollar, or conversely, negative average reaction to a Rupee depreciation. When macroprudential policy is loose, the FX β of riskier firms – carry trade borrowers and high interest expense firms – rises immediately after they issue foreign currency debt, indicating that the firms do not totally hedge the new risk exposure. However, when policy is tightened, we find there is no longer a statistically significant increase in firm FX β following the issuance of foreign currency debt. This indicates that the issuance-driven increase in risk is alleviated, even nullified, when policy is tightened to allow access only to safer firms.

We also confirm this risk reduction via macroprudential policy using the event study

[6]Though we do not have the currency composition of trade credit, when we restrict our analysis to firms with high imports, that is, firms more likely to have trade credit denominated in foreign currency, we again find no changes in trade credit utilization.

methodology. The taper tantrum episode of Summer 2013 was an unexpected negative shock to the exchange rate and equity markets (Chari, Stedman and Lundblad, 2021) during a time when capital controls were looser. The results of our event study show that carry trade borrowers are more adversely affected during the taper tantrum stress period. These results support the idea that carry trade incentives have been at least partly responsible for the rise in foreign exchange borrowings in EMEs, the currency risk is not completely hedged, and it is exactly those firms that obtain funding when it is cheap that are the most vulnerable during times of stress.

We complement the taper tantrum event study with an analysis of two periods of market stress that arose when capital controls were tight. The first period of market stress was in October 2018 when there was a sudden depreciation in the Indian Rupee and a spurt of outflows due primarily to an increase in oil prices in anticipation of sanctions on Iran.[7] The second period of market stress was in March 2020 when Indian markets were roiled by the uncertainty caused by the COVID-19 pandemic. Our analysis of market reactions to both these events suggests that carry trade borrowers are no longer more vulnerable than other issuers during times of stress.

The preceding results are robust to several alternate explanations and specifications. The pre-GFC period serves as a placebo time period for our analysis. Since the carry trade did not explain foreign currency borrowing in this period, we would not expect the interest rate caps to affect borrowing which is exactly what we find. Defining the CT index as the raw difference of short-term interest rates does not alter the significance of any results ruling out volatility in the foreign exchange market being spuriously responsible for our results. We include controls for size, leverage, exports, and cash holdings to control for time-varying firm-level demand for foreign currency debt. Industry-year fixed effects absorb any industry-level demand shocks for foreign currency debt ensuring we are comparing issuance behavior for high and low interest expense firms in the same industry in the same year.

[7] See https://www.business-standard.com/article/markets/rupee-crashes-to-all-time-low-of-73-81-on-capital-outflows-oil-prices-118100400991_1.html

Finally, we turn to the real effects of the foreign currency borrowing and ensuing policy action. A use-of-funds analysis indicates that carry trade borrowers use the raised funds not only for investment, the most popular stated rationale, but more importantly to also increase cash holdings. Once macroprudential policy restricts their access to the foreign currency debt market, their investment and cash holdings decline. While return on assets are unaffected, the previously documented reduction in risk (FX β) points to an improvement in risk-adjusted outcomes. Though we do not attempt a complete welfare analysis, these results are overall supportive of the conclusion that policy changes to regulate financial carry trades by corporations in foreign currency borrowing worked as intended and mitigated attendant risks.

Our results are related to recent work by Das, Gopinath and Kalemli-Özcan (2021) who show that preemptive capital flow management measures reduced the vulnerability of emerging markets during the taper tantrum and COVID-19 market shocks. While the papers have similar objectives, the approaches are complementary. Das, Gopinath and Kalemli-Özcan (2021) use a cross-country panel approach and study the impact of capital flow management policies on external financing costs and exchange rates at the country level. We, on the other hand, undertake a micro-level analysis of firm issuance behavior to document the causal mechanism through which macroprudential policy works. Our results indicate, as suggested by theory, that the targeting of riskier corporate carry trade borrowers leads to a reduction in their debt issuance, making them less vulnerable to negative external shocks.

The rest of the paper proceeds as follows: Section 1 links our analysis to existing literature; Section 2 provides context on foreign currency borrowing by Indian corporations; Section 3 describes the data and summary statistics; Section 4 focuses on the carry trade motive for foreign currency borrowing; Section 5 studies the efficacy of macroprudential policy changes; Section 6 measures the change in market risks due to foreign currency borrowing; Section 7 analyzes the use of funds raised by corporations; and Section 8 concludes.

1 Related Literature

Our results fit into a burgeoning literature on the risks to local growth and financial stability from the worsening external debt position of the corporate sector in EMEs. Du and Schreger (2022) show, in a cross-country setting, that higher corporate foreign currency borrowing is associated with higher sovereign default risk. A set of related papers do a firm-level analysis to distinguish between the different hypotheses regarding foreign currency borrowing by EME firms. Bruno and Shin (2017) find that emerging market firms with high cash holdings tend to issue dollar-denominated bonds and add to their cash pile. This behavior is more pronounced when the (financial) carry trade is more profitable.[8] The profitability of the carry trade is a failure of the uncovered interest rate parity (UIP) condition. Potential explanations in terms of corporate dollar borrowing include household dollar deposit demand (Gutiérrez, Ivashina and Salomao, 2020) and borrowing costs for banks (di Giovanni et al., 2021). Caballero, Panizza and Powell (2015) show that the corporate carry trade motive is concentrated in countries with higher capital controls on inflows, i.e., regulatory arbitrage is driving this behavior since non-financial firms are better able to circumvent capital controls. We contribute by analyzing the consequences of macroprudential policy targeted at these non-financial carry trade borrowers.

Most of the above papers focus on dollar bond issuance since they use the SDC database. We collect issuance data from India's central bank which allows us to study both bank and bond financing. The vast majority of foreign currency debt issuance by Indian firms in our sample is through bank loans. Since firms with access to bond markets tend to be larger, our study covers a more representative sample of firms. Importantly, our bank-driven results provide a complement to the hypothesis that the Second Phase of Global Liquidity (Shin, 2014) is driven primarily by global asset managers "reaching for yield" in international debt

[8] There is a vast literature on the classic carry trade wherein financial market participants borrow in a low interest rate currency and invest in a high interest rate currency (e.g., Brunnermeier, Nagel and Pedersen (2008), Lustig, Stathopoulos and Verdelhan (2019)).

markets. Our results show that global liquidity transmission is still at work in large EMEs through the bank lending channel. The richness of our data allows us to incorporate firm fixed effects in all our tests. Controlling for unobserved time-invariant firm-specific heterogeneity, our results indicate how the *same* firm behaves under different macroeconomic and financial conditions.

We also study how the risks arising from foreign currency borrowing manifest during times of market stress. Kaminsky and Reinhart (1999), Goldstein (2005), and Kalemli-Özcan, Kamil and Villegas-Sanchez (2016) study the causes and consequences of currency crises accompanied by banking crises. Bruno and Shin (2020) find that when the local currency depreciates, firms that borrowed in foreign currency when financing conditions were favorable are the ones that experience higher stress in terms of market values. We find similar results when we examine stock market returns for Indian firms around the taper tantrum episode. Eichengreen and Gupta (2015), Chari, Stedman and Lundblad (2021), and Sahay et al. (2014) study the taper tantrum episode and its impact on asset prices, particularly in emerging markets. Sahay et al. (2014) find that the U.S. Federal Reserve's monetary policy announcement is strongly correlated with asset prices and capital flows in emerging markets, and this phenomenon strengthened during the post-crisis phase of unconventional monetary policy. Our analysis goes a step further by comparing market reactions during periods of stress when domestic macroprudential policy was looser (taper tantrum) to when it was tighter (October 2018 oil price shock and COVID-19 crisis), and we show that market stress is reduced during the latter period.

Our analysis also contributes to a wider literature on the centrality of dollar funding and U.S. monetary policy in driving cross-border flows (Rey, 2013; McCauley, McGuire and Sushko, 2015; Kalemli-Özcan, 2019; Miranda-Agrippino and Rey, 2020; Bräuning and Ivashina, 2020).[9] Within this broader framework, macroprudential regulations can mitigate

[9]Rey (2013) argues that surges and retrenchments in capital flows are driven by a common global factor that can be linked to U.S. monetary policy. This global financial cycle, intermediated by global banks, affects risky asset prices and leverage in recipient countries. Kalemli-Özcan (2019) argues that U.S. monetary policy spills over into other countries through global investors' risk perceptions and its effect can be undone by

the domestic effects of the global financial cycle of capital flows. Brunnermeier and Sannikov (2015), Korinek (2018), and Acharya and Krishnamurthy (2019) provide a theoretical analysis of the potential benefits of these tools. In their models, foreign currency borrowing on the part of individual firms creates a negative pecuniary externality since, when the risk of a sudden stop arises, firms scramble to make large dollar repayments, further amplifying the shock. Prudent macroprudential policy can dampen these risks by discouraging the use of excessive dollar debt. Our detailed firm-level analysis for India provides strong evidence of such dampening in the context of a particular interest rate policy regulating corporate foreign currency debt.

Other papers analyzing macroprudential regulations, in a cross-country panel setting, include Bergant and Forbes (2021), Ahnert et al. (2021), Ostry et al. (2012), and Bruno, Shim and Shin (2017). Erten, Korinek and Ocampo (2021) provides a comprehensive survey on capital controls. These policies often have leakages or unintended consequences (Reinhardt and Sowerbutts, 2015), such as increased foreign currency debt of non-financial firms (Keller, 2019), reduced firm exports (Jung, 2021), and increased inter-firm lending (Huang, Panizza and Portes, 2018). We investigate these mechanisms for possible leakage or arbitrage of macroprudential controls and find that the consequence of reducing carry trade-driven foreign currency borrowing seems to be as intended in the Indian case.

2 India's External Debt: Institutional Background

India's total external debt at the end of March 2019 was $543 billion[10] of which 38% was made up of borrowing for corporate purposes. These borrowings are the largest component of the external debt followed by deposits of non-resident Indians (24%), short-term trade credit (18.9%), and loans from multilateral or bilateral agencies (15.4%).

The share of external corporate debt in the country's overall external borrowing has increased sharply since 2005. In 1995, this ratio was 13.1%. It had risen to only 19.7% by 2005

allowing exchange rate flexibility.

[10]See https://dea.gov.in/sites/default/files/STATUSREPORT2018-19.pdf

before escalating to 38% at the end of 2015. It has been around that level since then. Multiple factors have been suggested for the increasing dominance of foreign currency commercial borrowing in India's external debt. These include strong investment demand at home, increase in investor risk appetite for emerging market credit, rising domestic interest rates relative to foreign rates, improved sovereign credit ratings, and continued underdevelopment of India's local corporate bond market.

The external commercial debt currently has three major components: (1) Corporate loans and bonds denominated in foreign currency; (2) foreign investment in domestic corporate bonds; and (3) Rupee-denominated bonds issued overseas. We focus on the first component since the latter two refer to domestic currency debt. Figure 1 shows the evolution of the stock of foreign currency debt outstanding as well as the evolution of the INR/USD exchange rate. As a share of GDP, the stock of debt outstanding started declining after the taper tantrum. The Indian Rupee has significantly depreciated against the U.S. Dollar since the GFC.

One of the features of the Indian market for foreign currency commercial debt is the relative scarcity of bond issuance compared to bank debt. Over 90% of issuance by volume is through the bank route. Given the scarcity of bond issuance, we do not distinguish between the two types of debt in our analysis, and include both types in all our tests.[11] Foreign currency debt is issued to facilitate the import of capital goods, modernization, rupee expenditures on local capital goods, overseas acquisitions, new projects and refinancing of existing debt.

Macroprudential Regulation

Foreign currency corporate debt issuance is regulated by India's central bank, the RBI. The goal of the regulations is to guard against the debilitating effects of a sudden stop (Acharya and Krishnamurthy, 2019). Along with reserve accumulation, capital controls are the primary tools of macroprudential regulation.

In addition to aggregate limits on the volume of foreign currency borrowing by corpora-

[11] The main results are qualitatively unchanged if we restrict the analysis purely to bank loans.

tions, individual debt issues are also regulated. Limits exist on issue size, maturity, use of funds, and interest rate.[12] All issue sizes above $750 million need central bank approval. The minimum maturity allowed is three years. On-lending or investment of proceeds in capital markets in India is generally not permitted.

The RBI sets the maximum allowed interest rate on borrowing, as a spread over the 6-month LIBOR rate, with a view to controlling access to foreign currency debt markets. These all-in-cost (AIC) interest rate limits vary by maturity and over time. In Figure 2, we plot how the AIC limits have changed over time for issues with more than five years. In October 2008, the maximum AIC limit for longer maturity issues was increased from 350 bps over 6-month LIBOR to 500 bps over 6-month LIBOR. In November 2015, the maximum AIC limit was reduced to 450 bps over 6-month LIBOR.[13] We use the variation of this limit in the post-crisis period as our measure of the stance of macroprudential policy. A higher (lower) AIC interest rate limit reflects looser (tighter) macroprudential policy.

We focus on the AIC interest rate limits in this paper since these introduce cross-sectional variation in firms to which they apply. Changes in the interest rate caps will bind for firms with higher interest costs as opposed to those with lower interest costs. However, changes in interest rate limits are often accompanied by other changes such as issue size and the overall economy-wide issuance volume. The November 2015 policy change was significant since, in addition to lowering interest rate caps for the first time since the GFC, it also created a multi-track system of regulation. Borrowers borrowing from foreign subsidiaries of Indian banks, thought to be riskier borrowers, were subjected to tighter regulation in the form of lower issue size and longer required maturity. While we do not have borrower identities in our sample and so cannot pinpoint the effects of these particular changes, we point them out to emphasize that the raw change in AIC interest rate caps should not be

[12]The updated regulations are available at https://www.rbi.org.in/Scripts/BS_ViewMasDirections.aspx?id=11510.

[13]The AIC interest rate limit on issues with maturities of less than five years was also increased in November 2011. In the empirical tests, we use the AIC limit corresponding to the maturity of the issue. The vast majority of issues in our sample are of maturity five years or greater.

taken as a measure of the degree of tightening since other changes happened concurrently. Due to the overall significance of the November 2015 changes, we use that policy change in a difference-in-differences analysis to identify the causal effects of macroprudential policy action.

3 Data and Summary Statistics

The RBI maintains a public database on the foreign currency borrowing of Indian firms.[14] The data, available from January 2004 onwards, has the following information on all instances of issuance: the identity of the borrower, issue size in U.S. dollars, maturity, and calendar month and year of issue. Our sample covers debt issued between January 2004 and October 2019. Over this period, there were 12,452 instances of foreign currency borrowing by 5,355 distinct firms.

Accounting and stock price data are from the Prowess database which has annual balance sheet and income statement data as well as daily data on stock prices. Since the financial year ends on March 31 for the vast majority of Indian firms, our Prowess sample covers the period from March 2004 to March 2019. We also collect data on exchange rates and interest rates from Datastream.

There is no common identifier linking firms in Prowess to the companies in the RBI data on foreign currency borrowing. In order to link the two data sources, we match names using a string-matching algorithm and supplement this approach with a manual match for verification and completeness. This process results in a match of 1,786 firms between the two databases. Although these 1,786 firms are only 33.4% of the firms in the RBI database, they account for 46.7% of the issuances and 82.6% of the total amount issued. The firms that are not matched are mainly financial firms, which we exclude from our analysis, and smaller private firms for which financial data are unavailable in Prowess. The matched Prowess-RBI sample is the basis of all the analysis from here forward.

[14] Available at https://rbi.org.in/Scripts/ECBView.aspx

Figure 3 shows some of the characteristics of the foreign currency debt issued by firms in the matched sample. Panel (a) shows that the average (inflation-adjusted) issue amount rose from less than $30 million to over $50 million in a four-year span (2004-2007) just before the financial crisis. Issue sizes decreased during the crisis and right after but started rising around 2012. There was another sharp decrease in 2015-2016 but they started climbing again and reached their highest level at the end of the sample period in October 2019.

Compared to issue size, maturity is much less volatile, averaging near six years throughout the sample. Panel (b) of Figure 3 is a histogram of issue maturities. Issues of a maturity less than three years are very rare. This is unsurprising since regulatory approval is required to issue foreign currency debt with those maturities. Even though many of the assets being funded through these borrowings are long-lived and take time to generate cash flows, long maturity issues remain relatively rare. This is partly due to most of the debt being bank loans and partly due to a hesitation on the part of creditors to extend long maturity credit given the somewhat uncertain strength of creditor rights in the Indian legal context. Term loans of five years are, by far, the most popular kind of claim issued.

Panel A of Table 1 provides summary statistics for the issuance characteristics of the firms in the matched Prowess-RBI sample. From 2004 to 2019, these 1,786 firms issued 5,821 foreign currency debt claims. The median firm borrowed twice in the period, while the firm at the 95th percentile borrowed ten times. There is a significant positive skew in issue size as the median size is $13 million but the average size is $59.4 million.

In Panel B of Table 1, we examine key balance sheet measures and ratios for the sample firms. Current and fixed assets are held in similar proportions (0.370 vs. 0.341). On the liabilities side, the median firm-year has a debt-to-asset ratio of 0.353. Most of the debt is long-term, i.e., not due within the next year. The median long-term to total debt ratio is 0.727. Prowess also has some data on the outstanding foreign currency debt of firms. Their definition of foreign currency debt also includes trade credit which is not a part of the RBI data. Including debt taken from suppliers, the ratio of foreign currency to total debt is 0.290

for the median firm-year. There is a wide variance in this ratio, with the standard deviation being 0.291, almost the same as the median. Interestingly, foreign currency borrowing is not dominated by export-dominated firms. In fact, the median firm-year in our sample of foreign currency debt issuers has an exports-to-sales ratio of less than 3%. A majority of the firms that borrow abroad do not have a natural hedge through the channel of foreign currency revenues.

4 Carry Trade and Foreign Currency Debt Issuance

In this section, we test the determinants of the issuance decision. Motivated by the results in Bruno and Shin (2017) and Caballero, Panizza and Powell (2015), we test whether foreign currency borrowing (both bank and bond debt), within our sample of Indian corporates, is affected by a carry trade motive. Our first hypothesis is that Indian firms issue more foreign currency debt when the carry trade is more profitable.

To test this hypothesis we estimate the following logit model at the firm-month level to predict issuance:

$$Issue_{it} = \alpha_i + \beta_{CT} CT_{t-1} + \beta_M r_{M,t-1} + \beta_{FX} r_{FX,t-1} + \gamma X_{i,y-1} + \varepsilon_{it} \tag{1}$$

The left-hand side variable takes the value 1 if firm i issues foreign currency debt in month t, and 0 otherwise. The main variable of interest is CT which is a measure of the profitability of the carry trade that, following Bruno and Shin (2017), we define as $CT = \frac{\text{3M rate(IND)} - \text{3M rate(US)}}{\text{IV of 3M FX options}}$, i.e., the difference in short-term interest rates between India and the U.S. standardized by the implied volatility of 3 month INRUSD options. It can be thought of as the Sharpe ratio of the carry trade. We control for the aggregate stock market return using the NIFTY index return and for the foreign exchange return using the INRUSD return defined as $\frac{P_t - P_{t-1}}{P_{t-1}}$ where P_t is the number of U.S. dollars required to buy 1 Indian rupee at the end of period t. A negative INRUSD return indicates depreciation of the Indian rupee relative to the U.S. dollar. To control for firm-level determinants, we

include a set of accounting measures recorded at the previous fiscal year-end. These are total assets, leverage, cash-to-assets ratio, and exports-to-sales ratio. Importantly, to control for unobserved time invariant firm-level characteristics, we also employ firm fixed effects which means the results we get reflect within-firm estimates of carry trade profitability on the issuance decision. Standard errors are clustered at the firm level.

Results

Figure 4 shows how aggregate issuance and our carry trade index (CT) move over time. The figure is quite stark - before the financial crisis of 2008 (demarcated by the solid red line), there seems to be a negative relation between the number of issues in a quarter against the CT measure in the quarter. However, post-crisis this pattern almost completely reverses. Aggregate foreign currency debt issuance and the profitability of the carry trade seem to be strongly positively correlated. That is, until the taper tantrum episode of Summer 2013 (indicated by the dashed green lines). During May-September 2013, the U.S. Federal Reserve made a series of statements about the probability of the tapering of their quantitative easing (QE) program. Sahay et al. (2014) show that the taper tantrum led to a surge of capital outflows from emerging markets, creating turmoil and a sharp decline in asset prices including in equities. Dollar liquidity declined precipitously, and tighter funding conditions were anticipated.

Following the taper tantrum, the correlation between foreign currency debt issuance and the CT index is considerably weakened. The table below Figure 4 reports the monthly pairwise correlations between issuance activity (both counts and volume) and the CT index. Over the whole sample, the correlation is near zero. However, this masks widely differing correlations across three distinct periods. From January 2004 to August 2008 ('pre-crisis'), the correlation is moderately negative. Between September 2008 and September 2013 ('post-crisis'), the correlation is strongly positive but weakens starting October 2013 ('post-taper') and after the macroprudential tightening of November 2015, it turns strongly negative.

We systematically confirm these patters at the firm-month level by estimating Equation

1. The results are in Table 2. In the first two columns, we use an indicator for whether the firm issued in a given month as our dependent variable. In columns (3) and (4), we look at volumes by using the log of the amount of foreign currency debt issued in a month by a firm as our dependent variable and running OLS regressions.

The results in columns (1) and (3) show that a higher value of the CT index predicts higher foreign currency borrowing in the next month. The effect is statistically significant at the 1% level. Since the specifications include firm fixed effects, it means that the same firm is more likely to issue foreign currency debt in months immediately following those in which the carry trade is more profitable. Quantitatively, the effect is large. Using the estimated coefficient of 0.448 in column (1) of Table 2, a one standard deviation increase in the CT index (The CT index has a standard deviation of 0.263 during the sample period) would increase a firm's probability of issuing by 11.8%. On the size margin, the results are also significant indicating larger amounts borrowed when the carry trade is more profitable. A one standard deviation increase in the CT index would increase the amount borrowed by 3.9%. Interestingly, the magnitudes are larger on the indicator compared to the volume. This indicates that the issuance decision itself is more sensitive to the carry trade than the amount of issuance. Overall, these results strongly support our first hypothesis that firms in India borrow in foreign currency when the carry trade is more profitable.

Does the propensity to issue when the carry trade is more profitable change over time? The aggregate evidence in Figure 4 seems to suggest so, but is this true at the firm level? To test this, we re-estimate equation 1 but with a couple of additional variables included. The first is the interaction of the CT index with a dummy variable that takes the value 1 for the period between September 2008 and September 2013 ('post-crisis'). The coefficient on this interaction term is the differential probability of issuing in the post-crisis period. The second is the interaction of the CT index with a dummy variable that takes the value 1 for the period after September 2013 ('post-taper'). The coefficient on this interaction term is the differential probability of issuing in the post-taper tantrum period. The differential

effect for both interaction terms is relative to the effect of the CT index in the baseline or pre-crisis period.

The results are in columns (2) and (4) of Table 2. The results are again consistent across specifications. In column (2), the coefficient on CT is insignificant though negative in magnitude. In the pre-crisis period, issue propensity is not significantly related to the carry trade profitability. However, in the post-crisis period, the coefficient is positive and significant. The magnitude is large – the coefficient of 1.286 implies that a one standard deviation increase in the CT index would increase a firm's probability of issuing by 33.8%. For the post-taper tantrum period, the coefficient on the interaction is small and insignificant suggesting the effect of the CT index on issuance is similar to that before the crisis. We find similar results when the amount issued is the dependent variable. The result in column (4) suggests that the amount of foreign currency borrowing is significantly related to the carry trade only during the post-crisis period. Once again, the sensitivity of the amount issued is smaller than the issuance decision itself.

5 The Effect of Macroprudential Policy Action

The analysis in the previous section shows that there were three clear phases of foreign currency borrowing in India. The first was prior to the global financial crisis. During this phase, the carry trade was not a determinant of corporate foreign currency debt issuance. In the second phase, during and immediately following the crisis, the carry trade became a strong predictor of issuance. Finally, in the period following the taper tantrum, the carry trade again became less important. The transition from the first to the second phase seems to be a result of the crisis and ensuing monetary policy expansion in the U.S. (Rey, 2013; Bruno and Shin, 2017). Our interest is in the transition from the second to third phase and the role played by local macroprudential policy, if any.

In response to risks arising from enhanced foreign currency borrowing, many EMEs tightened macroprudential regulation (IMF, 2020). India was among them, tightening limits on

aggregate borrowing, investments by investor type, debt maturity, and cost of borrowing (Acharya and Krishnamurthy, 2019). Of these measures, we test the effects of reducing the ceiling on the all-in-cost (AIC) interest rate of foreign currency borrowings. We hypothesize that this tightening, soon after the taper tantrum episode, prevented riskier firms from using foreign currency borrowing as carry trades. Figure 2 shows how the maximum AIC limits vary over time. There are different limits for issuances of less than 5 years and those more than 5 years. The maximum AIC limits are specified as spreads are over the 6-month LIBOR rate.

To test our hypothesis, we estimate a variant of our baseline Equation 1. We include a dummy for whether the AIC spread is over its sample median in the post-crisis period from September 2008 onwards.[15] A *High AIC* spread signals looser macroprudential regulation. We also include a term which is the interaction of CT and *High AIC* spread. This coefficient on this interaction term is our coefficient of interest. We hypothesize that this coefficient should be positive. If the AIC spread is high, the carry trade plays a greater role in explaining issuance. Conversely, when the AIC spread is low, i.e., regulation is tight, the carry trade motive is less important.

Cross-Sectional Results

Before we present the results, we provide evidence that the macroprudential policy action of reducing the maximum AIC limit did have an effect on the distribution of foreign currency borrowers. Since the policy action targets the maximum allowable interest rate, we would expect that, following tightening of policy, the distribution of borrower interest costs would be narrower and the effect would be driven by the right hand side of the distribution. This is exactly what we find, a result we show both graphically and through regression analysis.

In Figure 5, we show kernel density estimates of the distribution of (standardized) borrower interest costs.[16] The solid (dashed) line show the distribution when the maximum

[15] We restrict ourselves to the period from September 2008 onwards as our interest is in the transition from the second to third phase.

[16] Since we do not have the interest rate per issuance, we use the interest expense in a year scaled by debt

AIC limit is above (below) its sample median. The right tail of the distribution is fatter for the High AIC distribution compared to the Low AIC distribution.

In Panel A of Table 3, we regress a proxy for the spread of the interest costs in the right tail of the interest cost distribution on the stance of macroprudential policy. The proxy we use is the difference in interest costs between the borrower at the 90th percentile and the median borrower in a month scaled by the standard deviation of interest costs in that month. The results for the post-taper period are particularly instructive - in the period before the macroprudential tightening in 2015, the spread is significantly higher than after the tightening, indicating that the distribution of borrowers does change following the macroprudential action.

As a placebo test, in Panel B of Table 3 we regress a proxy for the spread of the interest costs in the left tail of the interest cost distribution on the stance of macroprudential policy. Here, the proxy is the difference in interest costs between the borrower at the 10th percentile and the median borrower in a month scaled by the standard deviation of interest costs in that month. In contrast to the right tail, in none of the periods does macroprudential policy affect the left tail which is what we would expect since the policy placed interest rate caps for high interest cost borrowers. The results in Panel B also help rule out that what we capture is some other shock contemporaneous with the macroprudential policy.

Together, the results in Figure 5 and Table 3 provide us with evidence that the macroprudential tightening was a relevant shock to higher risk foreign currency borrowers in India.

Next, we test our hypothesis that macroprudential policy reduced carry trade borrowing. The results are presented in Table 4. The coefficient on the interaction term of CT and *High AIC Spread* is positive and highly significant in all specifications - with and without firm fixed effects and on the issuance decision and amount. The results imply that, from 2008 onwards, the carry trade motive explains issuance only when macroprudential regulation was loose. In periods when limits on borrowing costs were tight, the carry trade's relationship

to get the borrower interest cost

with issuance was actually negative. Given that tighter limits were introduced only after the taper tantrum episode (Figure 2), these results potentially explain the dichotomy we find in the post-crisis and post-taper periods in our earlier results. The carry trade motive became less important due to macroprudential regulation.

To confirm that the macroprudential regulation is responsible for curbing carry trade borrowing, we conduct another test. Since the regulation we study is a cap on the cost of borrowing, we would expect it to reduce borrowing among firms with high costs of borrowing. Although we do not see actual borrowing costs in the RBI issuance data, we can use Prowess financial data to get an implied annual interest cost for each firm.[17] Our assumption is that riskier firms will have higher interest costs in both domestic and foreign borrowing markets. Our hypothesis is that firms with high interest costs are more likely to borrow when regulations are loose (*High AIC Spread*) and *CT* is high. To implement this, we extend the previous methodology to include a triple difference term which is the interaction of *CT*, *High AIC Spread* and the firm's implied interest cost.

The results are in Table 5. The triple interaction of interest is in column (2) for the issuance decision and column (4) for the issuance amount. In column (2), the coefficient is positive and significant implying that when the carry trade is profitable and regulations are looser, firms with high interest costs, i.e., riskier firms are more likely to issue foreign currency debt than firms with lower interest costs. Conversely, the negative coefficient on the interaction of *CT* with *Interest Cost* indicates that when carry trade is profitable but regulations are tighter, firms with higher interest costs, i.e., riskier firms are less likely to issue foreign currency debt than firms with lower interest costs. Overall, these results confirm that the regulations do bind and do prevent riskier firms from taking advantage of the carry trade.

[17] This is simply the annual interest expense divided by the average debt outstanding over the year.

Difference-in-Differences Analysis

To further pin down the macroprudential tightening of November 2015 as being responsible for the decline in foreign currency borrowing among riskier borrowers, we conduct a dynamic difference-in-differences analysis around that period. To do so we estimate the following model:

$$Issue_{it} = \alpha_i + \sum_{\tau \neq -1} \beta_\tau (D_t^\tau \times \text{Treat}_i) + \gamma X_{it} + \varepsilon_{it} \tag{2}$$

Here, D_t^τ is a dummy variable that takes a value 1 if quarter t is τ quarters after the macroprudential tightening of 2015, which happened in the fourth quarter. *Treat* is an indicator that takes the value 1 for firms in the top tercile of the interest cost distribution in the fiscal year ending March 2015, and 0 for firms in the bottom tercile.[18] The coefficient of interest is β_τ, which measures the difference in issuance between treated and control firms τ periods after the policy action. The difference-in-differences analysis assumes that the treated and control firms were on parallel paths before the treatment. The inclusion of indicator variables for periods prior to the treatment allows for a visual examination of this parallel trends assumption.

The point estimates and 95% confidence intervals are plotted in Figure 6. The graph indicates that in the quarters prior to the treatment, treated and control firms had parallel trends since none of the coefficients are significant. After treatment however, there is a decline in issuance for the treated firms. The coefficient is negative and significant (at the 5% level) immediately after the treatment.

Placebo Test: Pre-crisis period

We also implement a falsification analysis to provide additional support for our main hypotheses. We do this by analyzing how macroprudential tightening affected issuance in

[18] We exclude firms in the middle tercile from the regression so that we have a clear demarcation between the high interest cost ('treated') and low interest cost ('control') firms.

the pre-crisis period. Since tightening is economy-wide, it is possible that some unobserved time-varying shock is driving our results. Although our cross-sectional tests and difference-in-differences analysis using interest costs point against this explanation, we also conduct a placebo test to rule it out further. Since we have already shown that *CT* did not predict issuance in the pre-crisis period, we would not expect macroprudential tightening in this period to affect carry trade borrowing. The RBI did lower AIC limits on borrowing in 2007. In Appendix C, we report the results from the pre-crisis complements to Tables 4 and 5 ,and find no evidence of the interaction of *CT* and *High AIC Spread* playing any role in issuance behavior. In Appendix Table C.2, we find that the total effect of tightening on *High Interest Cost* firms is near zero. This suggests that the AIC limits in the pre-crisis periods were not binding. This is likely due to the difference in the type of firms borrowing in the pre-crisis period. The median interest cost of *High Interest Cost* firms in the pre-crisis period is 3 percentage points lower than of those firms in the post-crisis period, further suggesting that favorable funding conditions following the crisis attracted riskier firms to the foreign currency debt market.

Testing for Leakages and Unintended Consequences

The preceding results indicate that macroprudential tightening accomplished its direct objective of reducing carry trade borrowing by risky firms. However, prior literature has emphasized that the direct effects of macroprudential policy changes are often undone by risky activity shifting to other avenues, a form of regulatory arbitrage (Ahnert et al., 2021). In this section, we analyze whether the macroprudential policy targeting foreign currency borrowing had unintended consequences by testing effects on (i) the maturity of foreign currency borrowing, (ii) trade credit received, and (iii) domestic currrency debt.

First, we look at effects on the intensive margin of foreign currency borrowing, namely at the maturity of the issuance. While the results in Table 5 focus on the extensive margin and show that riskier borrowers reduce foreign currency borrowing when AIC spreads are lowered, it is possible that the remaining borrowers reduce the maturity of the borrowing in

order to be able to borrow under the tighter interest rate caps. This is potentially dangerous as lower maturities exposes firms to higher rollover risk in the case of a sudden stop. To test the effects on maturity, we use the same specifications as in Tables 4 and 5 but with maturity of issuance as the dependent variable. The results are in the first two columns of Table 6. In the first column, we find that the maturity of issuance is actually lower during periods when the CT index is high and policy is loose. The triple difference coefficient in the second column is insignificant indicating that there is no statistically significant difference in maturity of issuance undertaken by riskier borrowers when policy is tight relative to when it is loose. Together, these results mean we find no evidence that on the intensive margin borrowing becomes riskier through maturity shortening.

Second, we turn our attention to the receipt of trade credit. As the RBI's regulations target financial borrowing, carry trade borrowers might substitute foreign currency bank and bond debt with operational credit. In that case, an increase in foreign currency trade credit might be an unintended consequence of the macroprudential tightening. This would be particularly harmful as trade credit is normally of a much shorter maturity than bank or bond debt. To test the impact on trade credit, we use the same specifications as above but with the change in trade credit received (accounts payable scaled by assets) as the dependent variable. We get on trade credit from the financial statements. Unfortunately, this data does not distinguish the trade credit received by currency. Since our focus is on trade credit in foreign currency, we restrict our analysis to firms with an above-median share of imports in their raw materials. These are the firms most likely to have trade credit in foreign currency. The results are in the third and fourth columns of Table 6. In the third column, we see that there is an increase in trade credit when the CT index is higher and macroprudential policy is loose, suggesting that firms take advantage of the trade credit route as well to indulge in carry trade borrowing. However, this suggests that when policy is tightened, there is no unintended spillover into trade credit. This finds further support in the triple difference result in the fourth column – there is no significant difference in trade credit borrowing for

riskier borrowers when policy is tight compared to when it is loose.

Finally, we study borrowing in domestic currency. If firms were using foreign currency debt for business needs, rather than for carry trades, we would expect borrowing in domestic currency to increase following the imposition of tighter norms on foreign currency debt. If this was the case, it would be an unintended consequence as firms were being forced to shift to a more expensive source of financing.[19] We test the effect on domestic INR debt by using the change in INR debt, from the financial statements, as the dependent variable. The results are in the last two columns of Table 6. The key coefficients in both columns are insignificant. The result in the fifth column indicates that even when foreign currency borrowing is higher, i.e., when CT index is high and policy is loose, there is no change in domestic currency outstanding indicating that the additional dollar borrowing is over and above local borrowing, and is not a substitute. The insignificant result in the sixth column means that borrowers with higher interest costs do not change their domestic borrowing based on the stance of macroprudential policy.[20]

6 Firm Exposure to FX Risk

We now examine if foreign currency borrowing affects foreign exchange risk, and whether macroprudential policy can ameliorate this risk. A primary concern that regulators express about the rise in foreign currency debt issuance is that borrowers leave the resulting foreign currency exposure unhedged (Ministry of Finance, 2015). Two primary reasons are identified as to why companies might not hedge this exposure: first, the local derivatives market is illiquid and firms lack access to offshore markets; and second, firms imagine an implicit guarantee from the RBI that it will not let the currency depreciate outside a narrow band.[21]

[19] From a policy perspective, this might still be preferable as firms would no longer be exposed to the risk of a sudden stop.

[20] While the above results take into account all domestic borrowing, in Appendix we analyze aggregate changes in domestic currency bonds issued in foreign markets, and show that the data do not support a substitution from foreign currency issuance to domestic currency bonds issued abroad.

[21] The danger with the perpetuation of the low volatility exchange rate regime is that when the eventual adjustment does take place it will be sharp

To measure the extent of exposure that is left unhedged, we look at market-based measures obtained from stock returns.

To obtain a market-based measure of foreign exchange risk, we estimate the following market model separately for each firm:

$$r_{it} = \alpha + \beta_M r_{Mt} + \beta_{FX} r_{FX,t} + \varepsilon_{it} \tag{3}$$

where r_{it} is the return for firm i in month t, r_{Mt} represents the return on the broader Indian stock market and is proxied by the NIFTY index return, and $r_{FX,t}$ is the INRUSD monthly return. The model is estimated using OLS with an estimation window of 60 months,[22] which allows us to obtain rolling estimates of β_{FX} for each firm. Low FX β firms, presumably exporters, are the ones that do well when the Indian rupee depreciates against the U.S. dollar while high FX β firms are the ones that do badly. Summary statistics in Panel C of Table 1 suggest that the median firm in our sample has an FX β of 0.11, indicating that the median firm would lose value on a currency depreciation.

Motivated by concerns expressed by policymakers, we hypothesize that firms that borrow abroad do not fully hedge their foreign exchange exposure. This leads to the hypothesis that firm FX $\beta's$ increase following foreign currency debt issuance.

To test this hypothesis, we estimate the following equation:

$$beta_{it} = \alpha + \beta_1 Issue_{i,t-1} + \nu_t + \eta_i + \varepsilon_{it} \tag{4}$$

The dependent variable is the β estimated for firm i from the market model in a 60-month trading window starting at the beginning of month t. The independent variable is a dummy that takes a value of 1 if firm i issued foreign currency debt in month $t-1$. We include firm and month fixed effects since the analysis is at the firm-month level.

The results from this estimation are presented in Table 7. In column (1), we see that

[22] Results are similar with 36 and 48-month estimation windows.

the FX β does not change right after foreign currency debt issuance in the full sample. We next introduce interaction terms to test whether the lack of a change in foreign exchange risk exposure after issuance holds during different periods. Motivated by our prior analysis, we introduce two interaction terms so we can test across three time periods. $Issue \times PostCrisis$ is 1 if the issuance takes place between September 2008 and September 2013 while $Issue \times PostTaper$ is 1 if the issuance takes place after September 2013. On estimating this regression, we find that the the coefficient on $Issue$ is negative and significant (column (2)), suggesting that in the base pre-crisis period, foreign currency debt issuance is associated with a *decline* in FX β, perhaps reflecting a selection effect, i.e., firms start borrowing abroad exactly when their risk exposure to currency depreciation reduces, perhaps through an expansion in their export business. However, in the post-crisis period, this phenomenon is reversed with FX β rising post issuance. The positive, significant coefficient of 0.118 on the interaction term is large given a median FX β of 0.109. This result suggests that currency risk for foreign currency borrowers increases only in the post-crisis period. In the post-taper period, risk changes are not significantly different from the pre-crisis period.

The reversion to the pre-crisis pattern in the post-taper period is consistent with our prior analysis that macroprudential policy tightening soon after the taper tantrum changed aggregate borrowing behavior by restricting riskier firms from accessing foreign currency debt. In column (3) of Table 7, we directly test for this phenomenon by introducing an interaction term $Issue \times HiAIC$ which is 1 when the max AIC allowed is above its sample median, i.e., when policy is loose. We find the coefficient on this interaction term to be positive and significant. This means that when policy is less stringent, the firms that borrow see their foreign exchange exposure go up. In other words, when policy is stricter, riskier firms are unable to access the foreign currency debt market, hence firm-level foreign exchange risk does not increase during these periods.

Next, we conduct the same tests but use the NIFTY (or market) β as the dependent variable. In columns (4)-(6) of Table 7, we find that there is no significant change of the

market β in either the full sample or any of the three distinct periods. These results serve as a placebo test and emphasize that the effects we detect are indeed due to the foreign currency debt issuance, not to some fundamental change in the firm's business risk.

Next, we test how the FX β post-issuance changes for different sets of firms. To identify carry trade borrowers, we define a *Firm CT* index which is a weighted average of the *CT* index in the months when the firm borrows abroad. The weights are the volume of foreign currency debt issued. We restrict ourselves in this analysis to those firms that borrow abroad at least four times in our sample. In Panel A, we split firms by their *Firm CT* measure while in Panel B, we use the *Interest Cost*. Do firms which borrow when funding conditions are favorable (*High Firm CT*) or firms which pay higher interest rates (*High Interest Cost*) see more of an increase in FX β following issuance?

The results in Table 8 suggest that this is true. All the increase in post-issuance FX β that we see in Table 8 comes from *High Firm CT* and *High Interest Cost* issuers. The macroprudential policy is effective because it constrains exactly these firms and hence is able to keep FX risks down.

These results are consistent with models that emphasize that firms do not internalize the pecuniary externality created by their individual borrowing (Brunnermeier and Sannikov, 2015; Korinek, 2018). It is exactly when the risk of a sudden stop rises that these firms need to scramble for foreign currency to pay off their debts putting additional downward pressure on the local currency, further stressing their balance sheets. A direct implication is that the local currency should depreciate more when more corporate foreign currency debt is due to be repaid analogous to carry trade unwinding by financial market participants leading to currency crashes (Brunnermeier, Nagel and Pedersen, 2008). We test this time series implication and present the results in Appendix Table A.1. Our issuance data tells us the month in which the bond or loan matures. We calculate the total amount of corporate foreign currency debt maturing in each month. This number is determined years in advance of the maturity date itself. But we find that the change in the log amount of foreign currency

debt maturing negatively predicts the change in the logged exchange rate, i.e., it predicts a rupee depreciation. The effects are stronger for issuances that take place following the crisis and before the tightening of macroprudential policy.

Event Studies around Negative Shocks

A tightening of international funding conditions and dollar appreciation pose rollover risks to corporations that borrow abroad (Acharya et al., 2015). Capital controls and reserve accumulation on the part of the monetary authority are strategies that may help countries cope with the risks posed by a sudden stop (Acharya and Krishnamurthy, 2019). In the previous section, we saw that the tightening of borrowing cost ceilings in India was effective in ameliorating the carry trade motive when it came to foreign currency borrowing. However, was it successful in reducing the risks associated with foreign currency borrowing? To test this, we conduct tests in the spirit of Bruno and Shin (2020) who find that local currency depreciation is associated with higher market stress for firms that use foreign currency borrowing as carry trades, i.e., borrow cheaply abroad and invest in liquid assets locally. We conduct our analysis using the event study methodology focusing on discrete, unexpected events characterized by capital outflows and sharp depreciation in the Indian rupee.

The first set of events involve the 'taper tantrum'. We use U.S. Federal Reserve statements on the probability of tapering of the quantitative easing program as proxies for shocks to foreign exchange volatility, and as a preview of tighter future funding conditions. Sahay et al. (2014) show that the 'taper tantrum' led to a surge of foreign capital outflows from emerging markets, creating turmoil and a sharp decline in asset prices including in equities. The Indian market was not spared during this period – from the start of May to the end of September of, the Indian rupee declined almost 14% against the U.S. dollar while the NIFTY market index fell about 2.35%. In fact, the RBI responded in August 2013 by imposing capital controls on outflows by residents.[23]

We use an event study to analyze which foreign currency borrowers experienced the

[23] See https://rbi.org.in/scripts/BS_PressReleaseDisplay.aspx?prid=29309

largest abnormal stock returns, and how this was related to their propensity to borrow when the carry trade is favorable. To identify the effects of the taper tantrum episode, we focus on three events that market participants identify as having significantly altered the probability of tapering:

- *May 22, 2013*: In a testimony to the Joint Economic Committee of the U.S. Congress, Federal Reserve Chairman Ben Bernanke suggested that tapering could begin after the next couple of meetings of the Federal Open Market Committee (FOMC).[24]

- *June 19, 2013*: In a press conference following the FOMC meeting, Chairman Bernanke again suggested that asset purchases would be reduced later in 2013.[25]

- *September 18, 2013*: After the FOMC meeting, Chairman Bernanke unexpectedly announced that the Fed was going to delay tapering till economic conditions improved.[26]

We consider the first two dates as having increased the probability of tapering while the third decreased it. Consistent with this interpretation, we find that the Indian rupee depreciated on the day after the first two events (by 0.14% and 1.69% respectively) and appreciated by 2.15% the day after the third event.[27] In the results that follow, for the sake of brevity, we only report results from the events of June 19, 2013. Market reactions were strongest on that date and we believe that date provides the cleanest shock related to tapering.

The'taper tantrum episode divides the post financial crisis period into two parts in our prior analysis. At the time of the taper tantrum, capital controls were looser. Following the episode, they were tightened. We complement our taper tantrum event study analysis with

[24] http://www.marketwatch.com/story/bernanke-premature-tightening-could-end-growth-2013-05-22

[25] https://research.stlouisfed.org/publications/es/article/10036

[26] http://www.bloomberg.com/news/articles/2013-09-18/fed-refrains-from-qe-taper-keeps-bond-buying-at-85-bln

[27] The NIFTY stock index actually rose by 0.28% after the first event date. On the other two dates, the impact was much starker – the index fell 2.86% following the second event date and rose 3.66% after the third

two events that took place in the post taper tantrum period, specifically in the period after the tightening of capital controls. These are:

- *October 3, 2018*: In October 2018, there was a sudden depreciation in the Indian rupee and a spurt of outflows owing primarily to an increase in oil prices.[28]
- *March 11, 2020*: In light of the intensifying COVID-19 pandemic, U.S. President Donald Trump announced a series of restrictions including bans on travel from most of the European Union. This led to a sharp decline in global markets including India.[29]

With respect to each of the event dates, we estimate the market model (Equation 3) over a 180 calendar day window ending at $t = -6$ where $t = 0$ captures the event date. The estimated market and FX βs are used to predict returns around the event date. The abnormal return on a particular date is the difference between the actual and predicted return. We focus on the cumulative abnormal return (CAR) on the first three trading days following the event (CAR[0,3]).

Next, we sort the sample of firms into terciles based on different metrics. The CAR is then regressed on indicator variables for each tercile. The first metric we use measures the propensity of firms to issue when the CT value is high. For each firm that has at least four issuances in the sample, we calculate a firm-specific CT measure which is the amount-weighted average of the CT index values in the immediate month preceding issuance. Firms in the top tercile of the CT measure are those with a higher propensity to issue when the carry trade is more profitable. Our second sorting metric is the implied *Interest Cost* in the period before the event.

Event Study Results

Table 9 presents the event study results. Panel A presents the results based on the firm-specific CT measure; in Panel B, the results are based on the implied *Interest Cost*.

[28] See https://www.business-standard.com/article/markets/rupee-crashes-to-all-time-low-of-73-81-on-capital-outflows-oil-prices-118100400991_1.html

[29] https://www.livemint.com/market/live-blog/sensex-nifty-live-today-12-03-2020-nifty-nse-bse-news-updates-11583982298421.html

The results in column (1) of Panel A indicate that it is exactly those firms that issue more when the carry trade is more profitable (high CT issuers) that see the sharpest negative abnormal reaction to the taper tantrum (6/19/13). Their CAR is smaller than -2%, about 2% worse than low CT issuers. Figure 7 shows the difference in CAR for high and low CT issuers as it develops over the five days before and after the event date. The difference in CAR between high and low CT issuers is large in magnitude and statistically significant (at the 10% level), although we have a small sample of firms since we need firms that have issued at least four times over the sample period. Another interesting finding is that the entire sample of repeat foreign currency borrowers experiences large negative declines following increase in taper risk (post June 19, 2013). Since we are controlling for the overall market reaction in the market model, this implies that foreign currency borrowers perform worse as compared to non-borrowers, who can be thought of as the omitted group.

The results in Panel B of Table 9 suggest that the abnormal reaction post event is sharpest for the firms with high interest costs. Over the three-day period following June 19, 2013, the CAR for low FX β firms was 0.5% points more negative than that for low interest cost firms; however, this difference is statistically insignificant.

When we turn to our two post-taper events, the results in columns (2) and (3) suggest that high CT issuers now no longer react significantly worse to negative events. The magnitude of the difference across firms is significantly lower, suggesting that in an environment of tighter capital controls, the difference in risk exposure between high and low CT issuers is significantly lower. The same lack of difference exists between high interest cost and low interest cost firms.

7 Effects on Firm Outcomes

We now turn to the real outcomes of the carry trade borrowing and policy changes we analyze. The stated purpose of most foreign currency borrowing is capital expenditure. In our data, over 80% of the issuances state this as the rationale for the issue. The next most

popular purpose is refinancing of loans. But do firms abide by their stated rationale? If the carry trade really is responsible for the rise in foreign currency borrowing, we would expect firms to hold the proceeds as cash or bank deposits rather than invest it in risky capital projects. Perhaps, firms are substituting equity with debt and paying out higher dividends.

To figure out how exactly the proceeds from carry trade borrowing are being used in practice, we test how firm outcomes evolve for firms that borrow when the carry trade is more profitable. We compare outcomes in the post-taper period to the post-crisis period, as well as when policy is loose compared to when it is tight. To identify carry trade borrowers we define a *Firm CT* index which is a weighted average of the *CT* index in the months when the firm borrows abroad. The weights are the volume of foreign currency debt issued. To construct *Firm CT*, we only use firms with at least four issuances in the sample. We estimate the following regression by OLS at the firm-fiscal year level:

$$Y_{ijt} = \alpha_i + \beta \text{Post-Taper}_t \times \text{Firm CT}_{ij} + \gamma X_{ijt} + \delta_{jt} + \varepsilon_{ijt} \tag{5}$$

The dependent variable, Y_{ijt}, is an outcome for firm i in industry j for year t. It can be (i) gross investment (change in gross fixed assets from year $t-1$ to t) in year t, (ii) cash holdings at end of year t, (iii) debt at end of year t, and (iv) profits in year t. All dependent variables are scaled by end of year t assets.

The independent variable of interest is the interaction of a *Post-Taper* dummy with the value of the *Firm CT* index. The coefficient β tells us how the outcome changes in the post-taper period for a company which generally issues when the *CT* index is high compared to one which issues when the *CT* index is low. Industry-year fixed effects are included to control for industry-wide macroeconomic shocks and ensure all comparisons are between firms in the same industry while firm fixed effects control for unobserved time invariant firm characteristics. We cluster standard errors at the firm level.

The results are in Table 10. In Panel A, we find that firms with a high *Firm CT* index see a reduction in investment and, more strongly, cash holdings in the post-taper period. There is no effect on leverage or ROA. We've seen earlier that the sensitivity of issuance to carry trade profitability reduces following the taper tantrum, and now we confirm that the firms which are likely to have taken advantage of the carry trade cut down on investment but more strongly on cash holdings, a result consistent with carry trade behavior (Bruno and Shin, 2017).

In Panel B of Table 10, we examine whether the difference between the post-crisis and post-taper period is due to macroprudential policy. When the AIC spread is high, i.e., policy is loose, issuers with a high *Firm CT* index have higher investment and cash holdings. Equivalently, when policy is tightened, their investment and cash holdings are lower. This confirms that tighter macroprudential policy constrains issuers who take advantage of carry trade borrowing, and affects their investment and liquidity position.

8 Conclusion

In this paper, we examine the foreign currency borrowing of Indian firms from 2004 to 2020. We find that firms are more likely to borrow in foreign currency when the dollar carry trade is more profitable. Carry trade borrowers are riskier and significantly more likely to suffer poor stock market returns during periods of market stress. However, macroprudential regulation can play a role in alleviating the risk arising due to foreign currency borrowing. We show that the imposition of tighter capital controls, in the form of interest rate caps on foreign currency debt issues, was successful in restricting access to higher quality borrowers. Subsequently, during periods of market stress, carry trade borrowers were no longer harder hit than other borrowers.

Our results have implications for the literature on emerging market corporate debt as well as for policymakers tasked with preventing the spread of any stress that emerges due to firms' foreign currency borrowings. We provide direct evidence supporting theoretical models

on pecuniary externalities arising out of foreign currency borrowing, and the appropriate regulatory response of targeting the riskiest borrowers (Brunnermeier and Sannikov (2015), Korinek (2018), Acharya and Krishnamurthy (2019)). Given that we find favorable funding conditions to be a strong determinant of issuance, it is reasonable to conclude that these risks will re-emerge as we enter another U.S. monetary policy tightening cycle following the easing in response to the COVID-19 pandemic.

While we do not study how external firm financing patterns influence trade, there is reason to believe that macroprudential policy and trade policy need to work in conjunction (see, in particular, Gopinath (2019)). Carry trade borrowing is particularly risky for importers as their revenues are in local currency and they have additional non-interest expenses in foreign currency. If these firms use the funds from foreign currency borrowing to boost imports, we would expect trade imbalances to widen. Preliminary analysis, shown in Figure 8, supports this conjecture – India's trade balance had a *negative* correlation with the CT index in the period between the onset of the GFC and the macroprudential tightening in 2015. However, domestic macroprudential policy severs the negative link between global financing conditions and trade balances, with the correlation between India's trade balance and CT index turning positive after the macroprudential tightening. We leave a deeper analysis of this relationship to future work.

References

Acharya, Viral V., and Arvind Krishnamurthy. 2019. "Capital Flow Management with Multiple Instruments." In *Monetary Policy and Financial Stability: Transmission Mechanisms and Policy Implications*. Vol. 26 of *Central Banking, Analysis, and Economic Policies Book Series*, , ed. Álvaro Aguirre, Markus Brunnermeier and Diego Saravia, Chapter 6, 169–203. Central Bank of Chile.

Acharya, Viral V., Stephen Cecchetti, Jose De Gregorio, Sebnem Kalemli Ozcan, Philip R. Lane, and Ugo Panizza. 2015. "Corporate Debt in Emerging Economies:

A Threat to Financial Stability?" In *Report for Committee on International Economics Policy and Reform (CIEPR)*. 1–53. Brookings Institute and Centre for International Governance Innovation.

Ahnert, Toni, Kristin Forbes, Christian Friedrich, and Dennis Reinhardt. 2021. "Macroprudential FX regulations: Shifting the snowbanks of FX vulnerability?" *Journal of Financial Economics*, 140: 145–174.

Bergant, Katharina, and Kristin Forbes. 2021. "Macroprudential Policy during COVID-19: The Role of Policy Space." National Bureau of Economic Research Working Paper 29346.

Brunnermeier, Markus K., and Yuliy Sannikov. 2015. "International Credit Flows and Pecuniary Externalities." *American Economic Journal: Macroeconomics*, 7(1): 297–338.

Brunnermeier, Markus K., Stefan Nagel, and Lasse H. Pedersen. 2008. "Carry Trades and Currency Crashes." *NBER Macroeconomics Annual 2008*, 23: 313–347.

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

Bruno, Valentina, and Hyun Song Shin. 2020. "Currency Depreciation and Emerging Market Corporate Distress." *Management Science*, 66(5): 1935–1961.

Bruno, Valentina, Ilhyock Shim, and Hyun Song Shin. 2017. "Comparative assessment of macroprudential policies." *Journal of Financial Stability*, 28: 183–202.

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

Caballero, Julian, Ugo Panizza, and Andrew Powell. 2015. "The second wave of global liquidity: Why are firms acting like financial intermediaries?" C.E.P.R. CEPR Discussion Papers 10926.

Chari, Anusha, Karlye Dilts Stedman, and Christian Lundblad. 2021. "Taper Tantrums: Quantitative Easing, Its Aftermath, and Emerging Market Capital Flows." *The Review of Financial Studies*, 34: 1445–1508.

Chui, Michael, Ingo Fender, and Vladyslav Sushko. 2014. "Risks related to EME corporate balance sheets: the role of leverage and currency mismatch." *BIS Quarterly Review*, 35–47.

Das, Mitali, Gita Gopinath, and Şebnem Kalemli-Özcan. 2021. "Preemptive Policies and Risk-Off Shocks in Emerging Markets." National Bureau of Economic Research 29615.

di Giovanni, Julian, Şebnem Kalemli-Özcan, Mehmet Fatih Ulu, and Yusuf Soner Baskaya. 2021. "International Spillovers and Local Credit Cycles." *The Review of Economic Studies*, 89(2): 733–773.

Du, Wenxin, and Jesse Schreger. 2016. "Local Currency Sovereign Risk." *The Journal of Finance*, 71(3): 1027–1070.

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

Eichengreen, Barry, and Poonam Gupta. 2015. "Tapering talk: The impact of expectations of reduced Federal Reserve security purchases on emerging markets." *Emerging Markets Review*, 25: 1–15.

Erten, Bilge, Anton Korinek, and José Antonio Ocampo. 2021. "Capital Controls: Theory and Evidence." *Journal of Economic Literature*, 59(1): 45–89.

Goldstein, Itay. 2005. "Strategic Complementarities and the Twin Crises." *The Economic Journal*, 115(503): 368–390.

Gopinath, Gita. 2019. "Rethinking International Macroeconomic Policy." In *Evolution or Revolution? Rethinking Macroeconomic Policy after the Great Recession.* , ed. Olivier Blanchard and Lawrence H. Summers, Chapter 19, 271–299. MIT Press.

Gutiérrez, Bryan, Victoria Ivashina, and Juliana Salomao. 2020. "Why is Dollar Debt Cheaper? Evidence from Peru." *SSRN Working Paper.*

Huang, Yi, Ugo Panizza, and Richard Portes. 2018. "Corporate Foreign Bond Issuance and Interfirm Loans in China." National Bureau of Economic Research.

IMF. 2020. "Dampening Global Financial Shocks in Emerging Markets: Can Macroprudential Regulation Help?" In *World Economic Outlook.* 53–75. International Monetary Fund.

IMF. 2022. "Review of the Institutional View on the Liberalization and Management of Capital Flows." In *IMF Policy Paper.* International Monetary Fund.

Jung, Hyeyoon. 2021. "The Real Consequences of Macroprudential FX Regulations." *Federal Reserve Bank of New York Staff Reports.*

Kalemli-Özcan, Şebnem. 2019. "US Monetary Policy and International Risk Spillovers." *Jackson Hole Symposium.*

Kalemli-Özcan, Şebnem, Herman Kamil, and Carolina Villegas-Sanchez. 2016. "What Hinders Investment in the Aftermath of Financial Crises: Insolvent Firms or Illiquid Banks?" *Review of Economics and Statistics*, 98(4): 756–769.

Kaminsky, Graciela L, and Carmen M Reinhart. 1999. "The Twin Crises: The Causes of Banking and Balance-of-Payments Problems." *American Economic Review*, 89(3): 473–500.

Keller, Lorena. 2019. "Capital Controls and Risk Misallocation: Evidence From a Natural Experiment." *Jacobs Levy Equity Management Center for Quantitative Financial Research Paper*.

Korinek, Anton. 2018. "Regulating capital flows to emerging markets: An externality view." *Journal of International Economics*, 111: 61–80.

Lustig, Hanno, Andreas Stathopoulos, and Adrien Verdelhan. 2019. "The Term Structure of Currency Carry Trade Risk Premia." *American Economic Review*, 109(12): 4142–4177.

McCauley, R. N., P. McGuire, and V. Sushko. 2015. "Global dollar credit: links to US monetary policy and leverage." *Economic Policy*, 30(82): 187–229.

Ministry of Finance. 2015. "Report of the Committee to Review the Framework of Access to Domestic and Overseas Capital Markets." Ministry of Finance, Government of India.

Miranda-Agrippino, Silvia, and Hélène Rey. 2020. "US Monetary Policy and the Global Financial Cycle." *The Review of Economic Studies*.

Ostry, Jonathan D., Atish R. Ghosh, Marcos Chamon, and Mahvash S. Qureshi. 2012. "Tools for managing financial-stability risks from capital inflows." *Journal of International Economics*, 88(2): 407–421.

Reinhardt, Dennis, and Rhiannon Sowerbutts. 2015. "Regulatory Arbitrage in Action: Evidence from Banking Flows and Macroprudential Policy." *Bank of England Working Paper*.

Rey, Hélène. 2013. "Dilemma Not Trilemma: The Global Financial Cycle and Monetary Policy Independence." *Global Dimensions of Unconventional Monetary Policy, Jackson Hole Symposium on Economic Policy 2013*, 284–333.

Sahay, Ratna, Vivek B. Arora, Athanasios V Arvanitis, Hamid Faruqee, Papa M N'Diaye, and Tommaso Mancini Griffoli. 2014. "Emerging Market Volatility; Lessons from The Taper Tantrum." International Monetary Fund IMF Staff Discussion Notes 14/9.

Shin, Hyun Song. 2014. "The Second Phase of Global Liquidity and Its Impact on Emerging Economies." In *Volatile Capital Flows in Korea*. 247–257. Palgrave Macmillan US.

Shin, Hyun Song, and Laura Yi Zhao. 2013. "Firms as Surrogate Intermediaries: Evidence from Emerging Economies." *ADB Working Paper*.

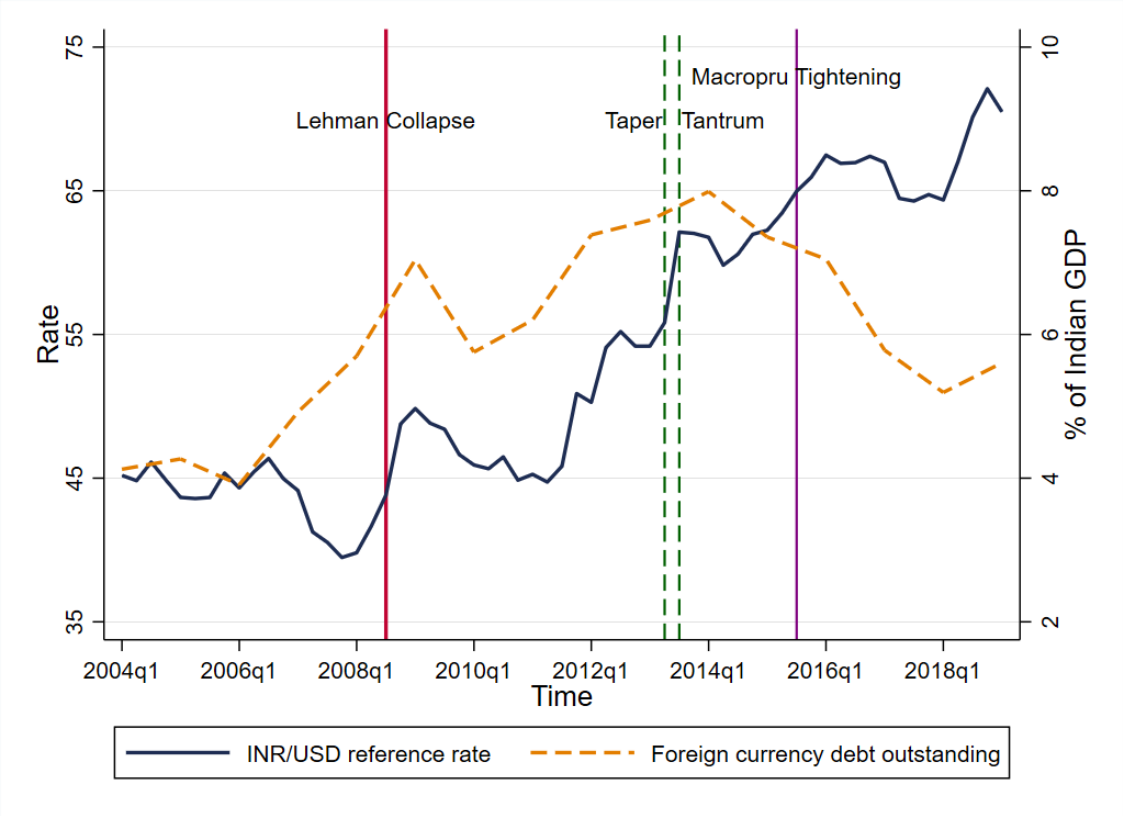


Figure 1: **INR/USD Exchange Rate and Foreign Currency Debt Outstanding** The figure shows the evolution of the INR/USD exchange rate and the ratio of the stock of foreign currency debt outstanding to Indian GDP. The time period is from March 2004 to March 2019.

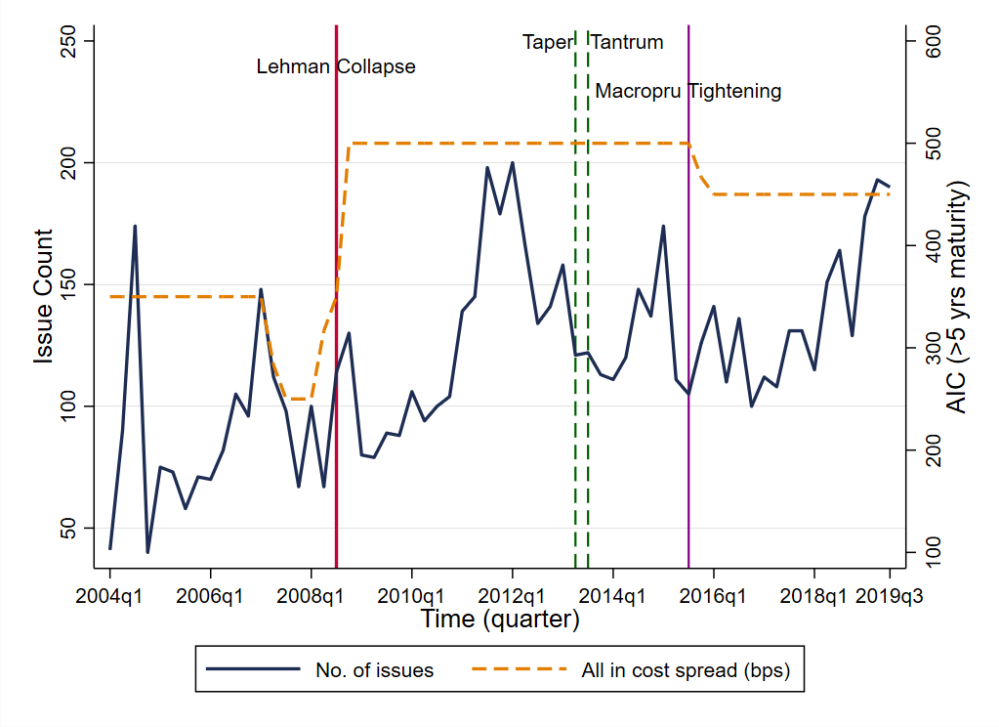
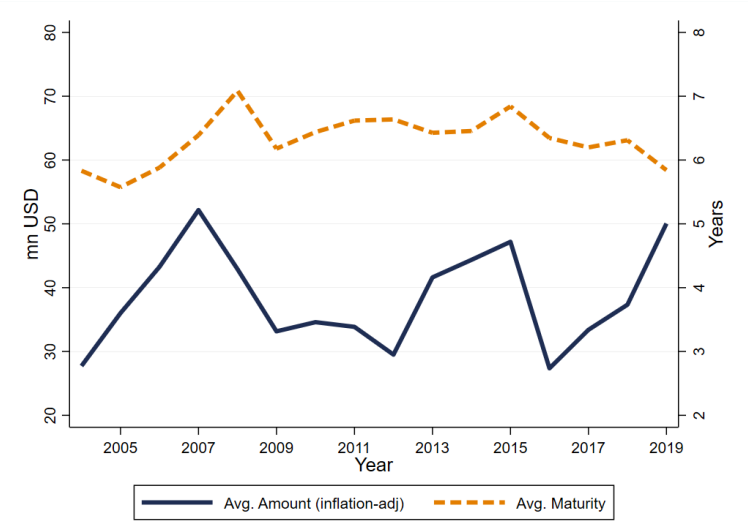


Figure 2: **Macroprudential Policies and Debt Issuance**

The figure depicts the evolution of foreign currency debt issuance activity and the maximum permissible all-in-cost (AIC) spread over the 6-month LIBOR rate for issuances with maturity more than five years. A higher AIC spread is our proxy for looser macroprudential regulation. The sample period is from January 2004 to September 2019.

(a) Average amount and maturity of debt issuance



(b) Distribution of maturity of debt issuance

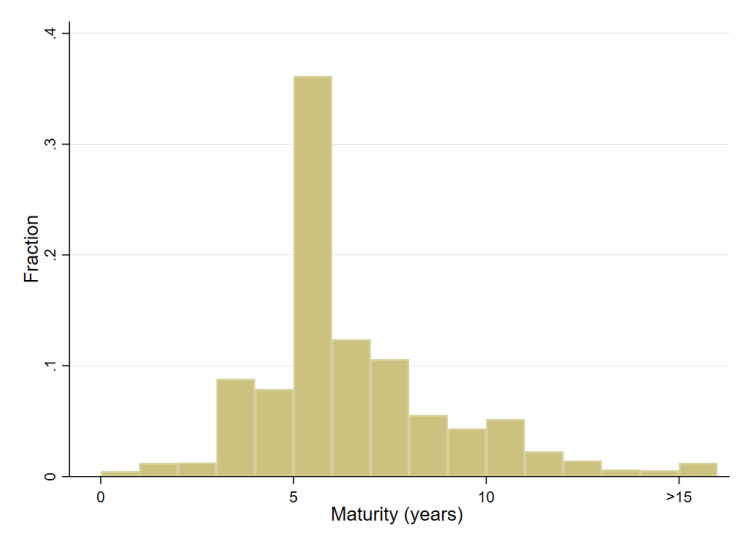


Figure 3: **Characteristics of foreign currency debt issuance**
The figure depicts the salient characteristics of foreign currency borrowing of firms that can be matched to the Prowess database. The sample period is from January 2004 to September 2019. Figure (a) shows how the inflation-adjusted average issuance amount and maturity vary over time. Figure (b) is a histogram showing the distribution of maturities of the borrowings.

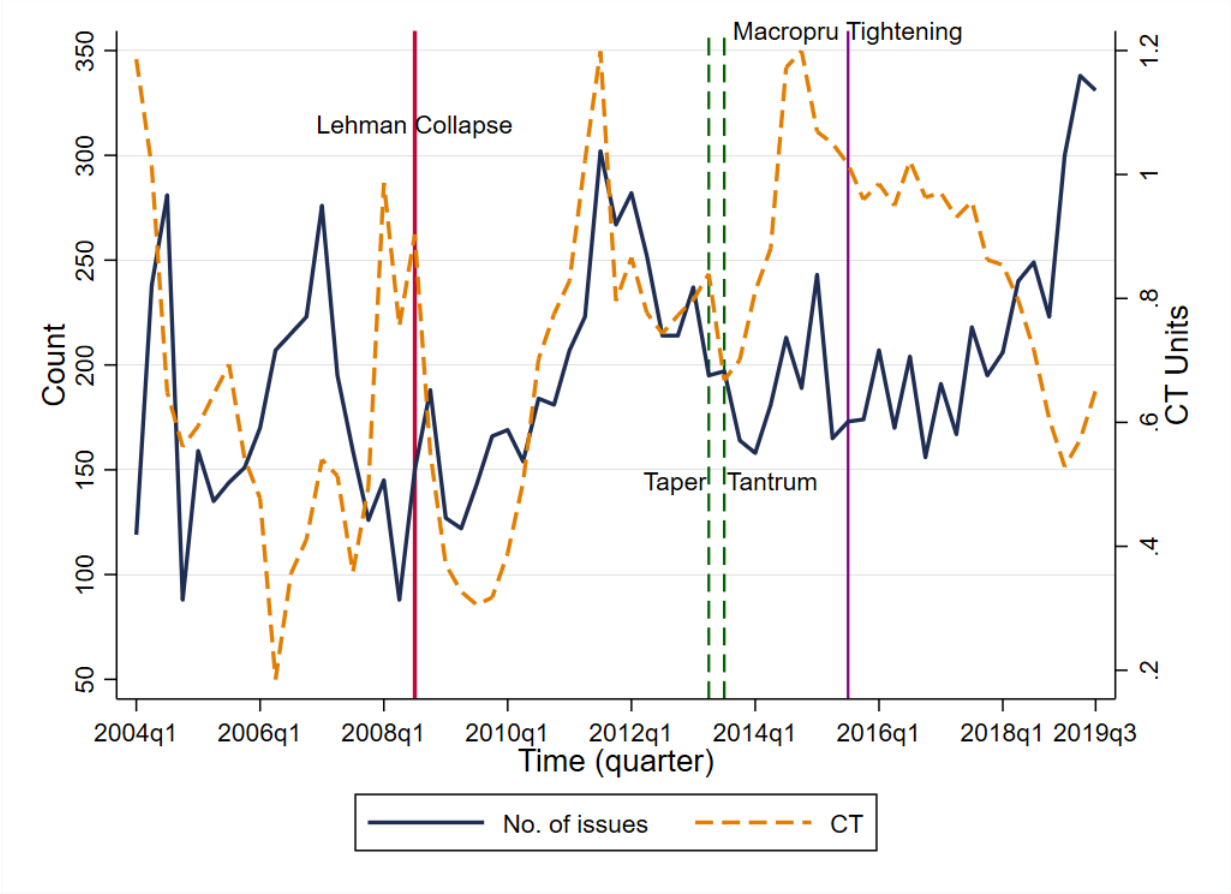


Figure 4: **Carry Trade and Aggregate Issuance**

The figure plots the total number of foreign currency debt issues each quarter against CT, a proxy for the difference in short-term rates between India and the US. CT is the difference in 3-month interest rates between India and the U.S. scaled by the implied volatility of 3-month FX options. The sample period is from January 2004 to September 2019.

The table below lists the correlation between the monthly CT index and the monthly issuance count and total amount issued. Significance levels: *(p<0.10), **(p<0.05), *** (p<0.01).

ρ (monthly)	Jan 04-Sep 19	Jan 04-Aug 08	Sep 08-Sep 13	Oct 13-Oct 15	Nov 15-Sep 19
ρ(Issues, CT)	0.080	-0.173	0.559***	0.461**	-0.684***
ρ(Amount, CT)	0.003	-0.298**	0.454***	-0.197	-0.540***

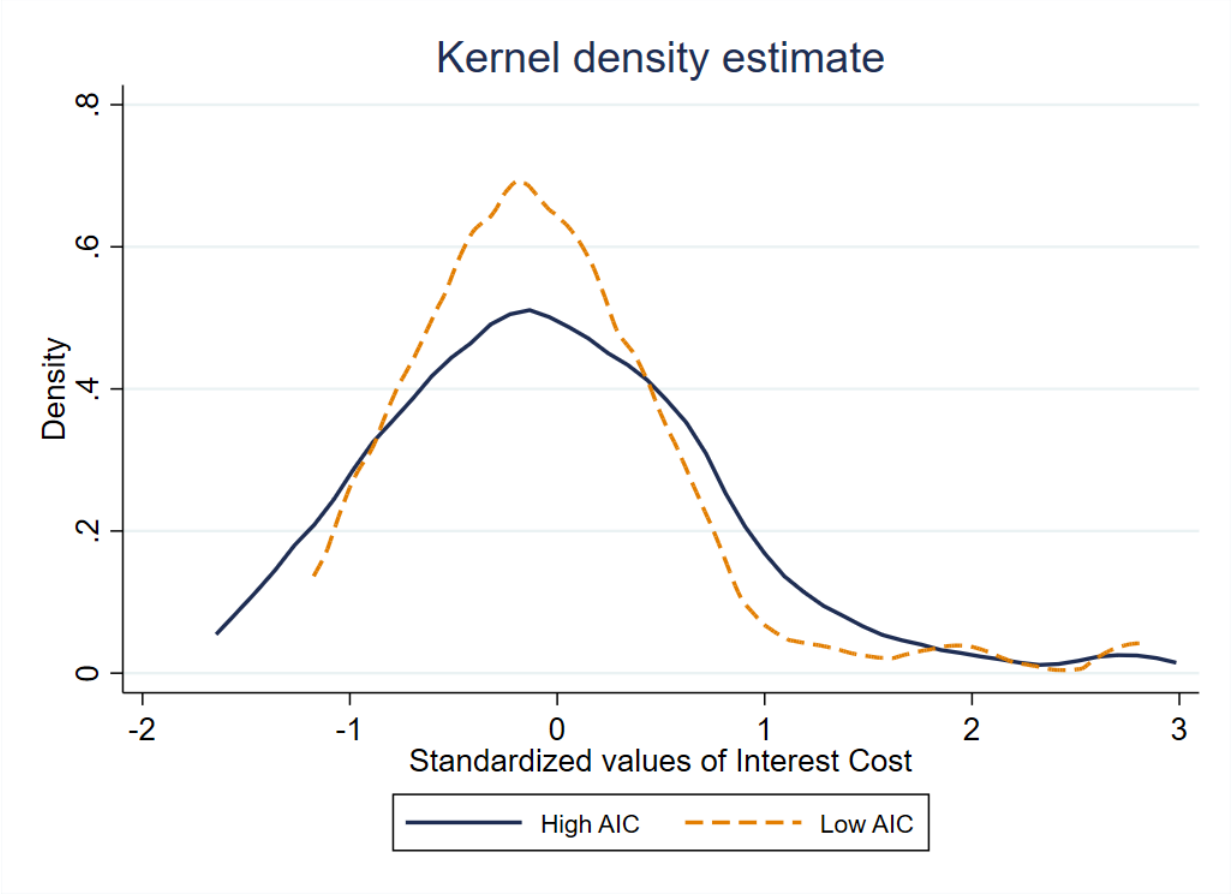


Figure 5: **Macroprudential Policies and Borrower Interest Cost Distribution** The figure plots the kernel density estimates of the borrower interest cost distribution in the post-crisis period. The solid (dashed) graph shows the distribution of interest costs when the maximum AIC limit is above (below) its sample median. The interest costs are standardized by subtracting the mean and scaling by their standard deviation. The time period is from September 2008 to October 2019.

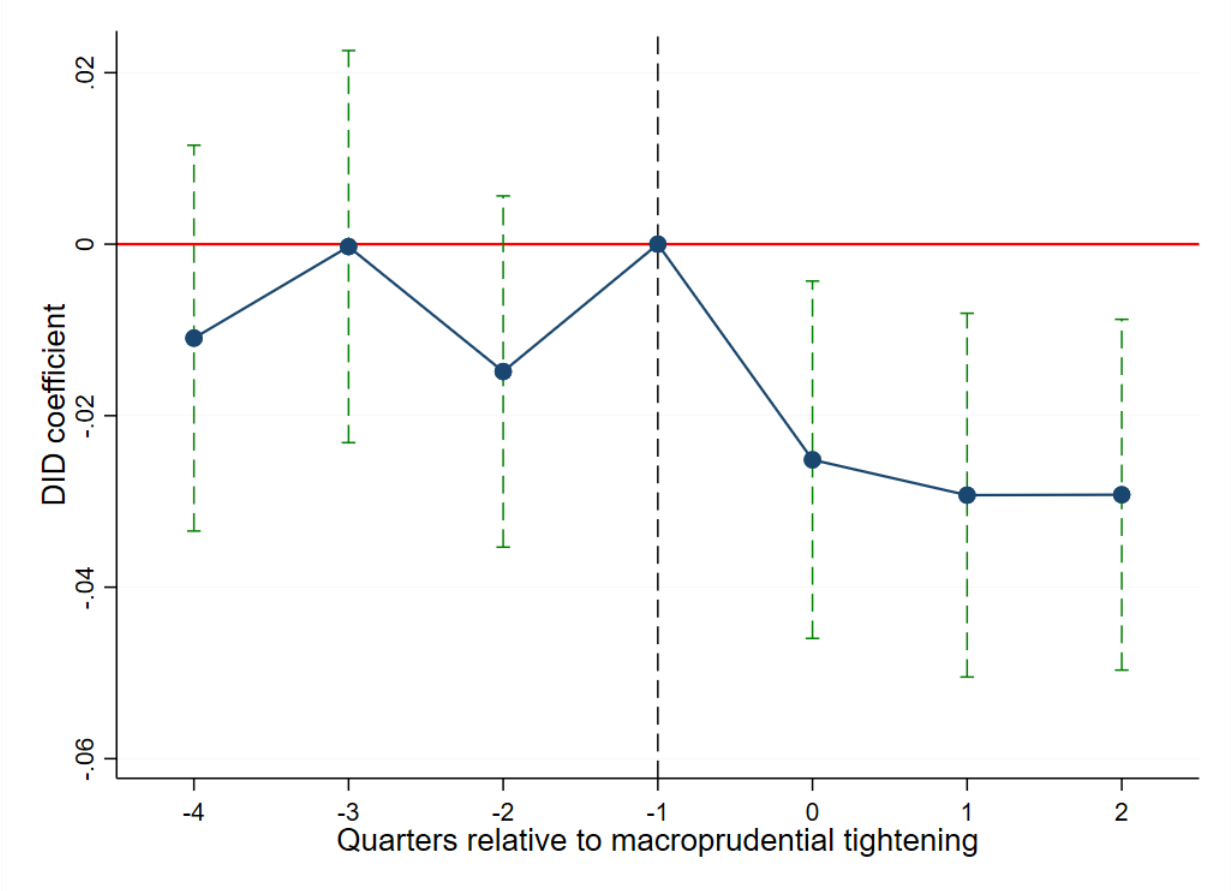


Figure 6: **Issuance volume around macroprudential tightening for High vs. Low Interest Cost Borrowers**

The figure depicts the coefficients from a dynamic difference-in-difference regression.All observations are at the firm-quarter level. The dependent variable takes the value 1 if a firm makes at least one issuance in the quarter, and 0 otherwise. Firms in the top tercile of the interest cost distribution are the treated firms while those in the bottom tercile are the control firms. The treatment is the macroprudential tightening of November 2015. The quarter before the treatment is the omitted base level.

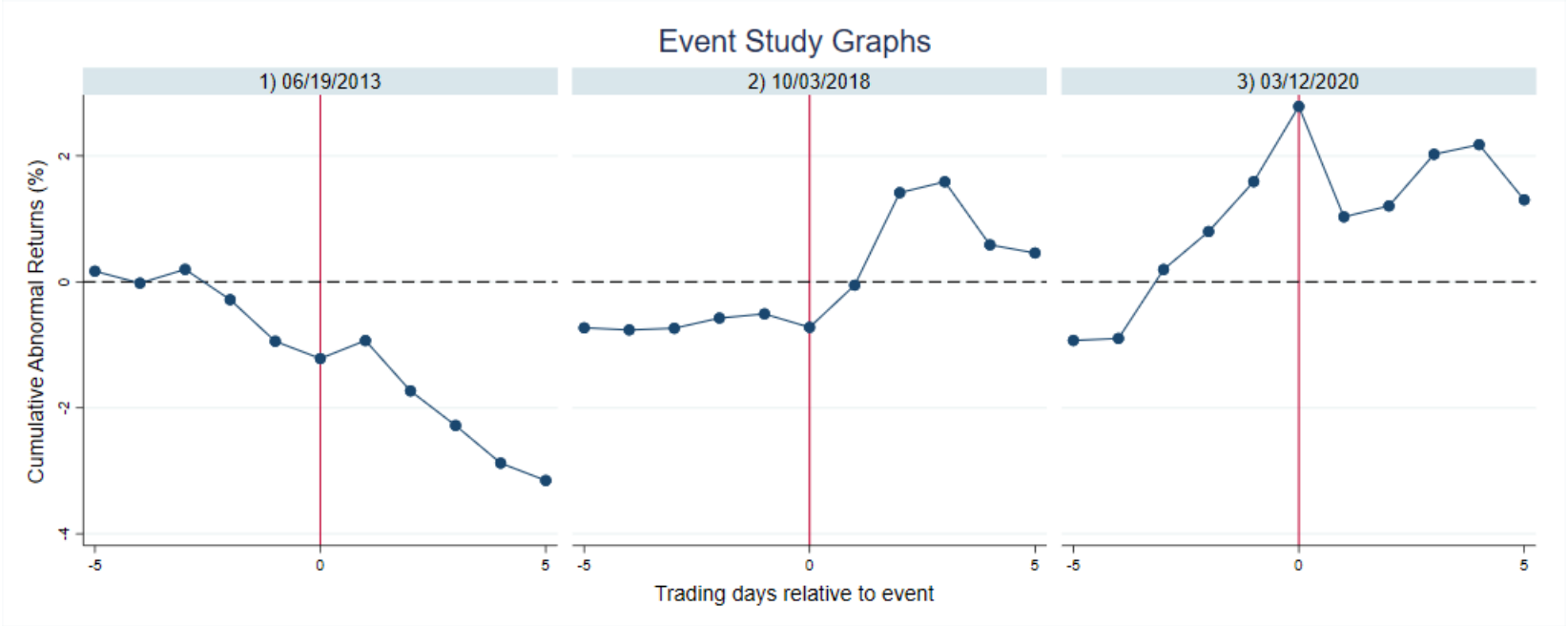


Figure 7: **Event Study: CAR of high CT issuer (top tercile) relative to low CT issuer (bottom tercile)** The figure shows the cumulative abnormal return (CAR) for high CT issuer stocks relative to low CT issuer stocks, for three event dates, from five days prior to the event date to five days after. June 19, 2013 is a date on which the likelihood of tapering went up; October 3, 2018 is a date when the rupee fell sharply owing to a spike in oil prices and March 12, 2020 was the date after the U.S. imposed travel restrictions from Europe owing to the COVID-19 pandemic. A multivariate market model is used for estimation with the NIFTY return proxying for the market return while INRUSD return proxies for FX return. The estimation window is 180 calendar days and ends five trading days before the event date.

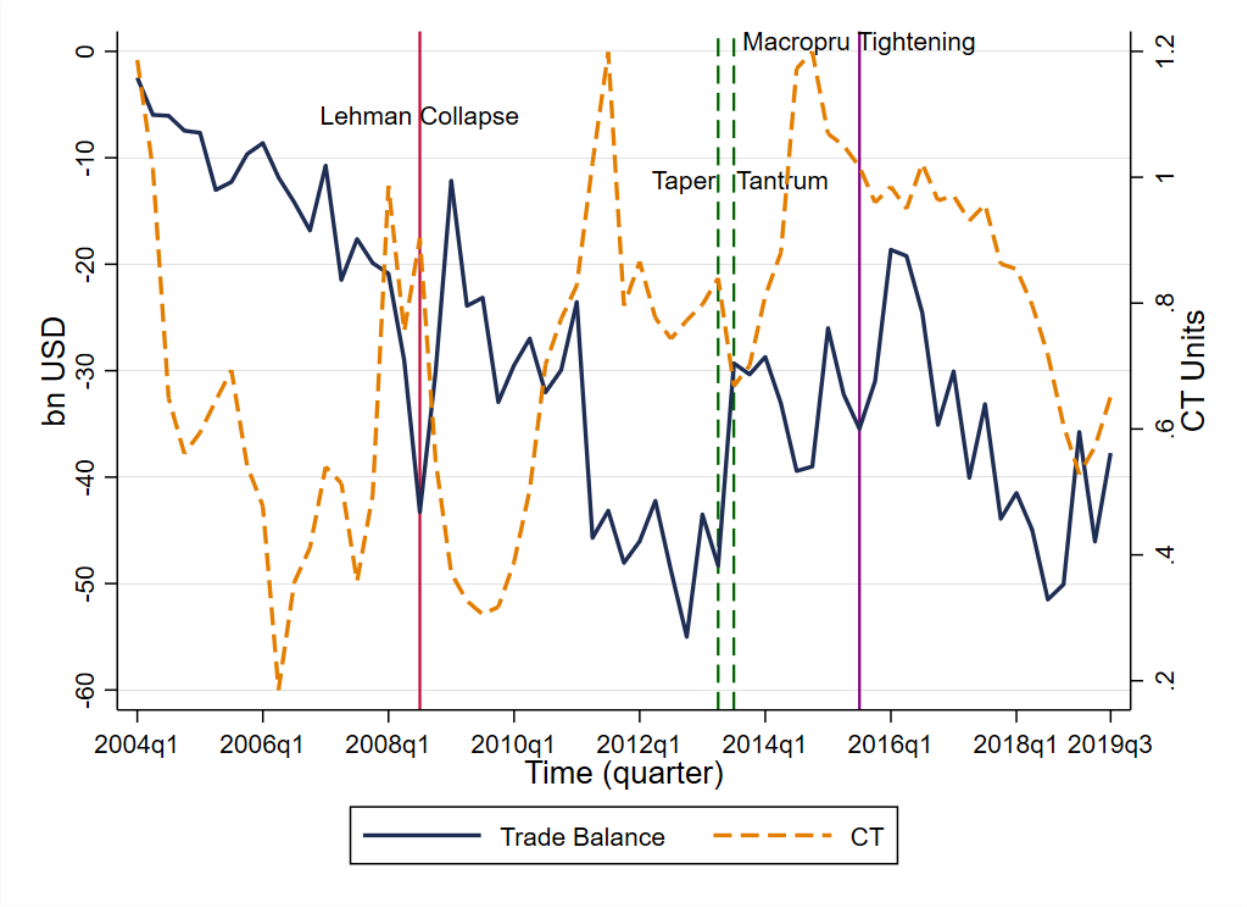


Figure 8: **Carry Trade and Trade Balance**
The figure plots India's quarterly trade balance, in billions of dollars, against CT, a proxy for the difference in short-term rates between India and the U.S. CT is defined as the difference in 3-month interest rates between India and the U.S. scaled by the implied volatility of 3-month FX options. The sample period is from January 2004 to September 2019.

The following table shows the correlation between the monthly CT index and trade balance. Significance levels: *(p<0.10), **(p<0.05), *** (p<0.01).

ρ (monthly)	Jan 04-Sep 19	Jan 04-Aug 08	Sep 08-Sep 13	Oct 13-Oct 15	Nov 15-Sep 19
ρ(Trade Bal, CT)	-0.310***	0.004	-0.590***	-0.466**	0.546***

Table 1: **Summary Statistics**

Panel A provides statistics on foreign currency debt issuance by Indian corporates as per data from the Reserve Bank of India (RBI). The sample has the 1,786 firms that can be matched to the Prowess database and is from January 2004 to September 2019. Panel B provides summary statistics on the balance sheet of firms that appear both in Prowess and in the RBI data. The foreign currency borrowing is as per Prowess. Panel C provides daily market returns data and the monthly CT index.

Panel A: Foreign Currency Debt Facilities

	N	Mean	Median	St. Dev.	P5	P95
Amount (mn USD)	5,821	59.359	13.000	154.089	0.852	300.000
Maturity (Years)	5,821	6.344	5.500	2.879	3.000	11.417
No. of facilities (per firm)	1,786	3.259	2	4.653	1	10

Panel B: Firm Balance Sheets

	N	Mean	Median	St. Dev.	P5	P95
Total Assets (bn INR)	17,516	26.19	4.57	74.49	0.19	116.64
Cash/Assets	17,510	0.052	0.00	0.31	0.00	0.09
Fixed/Total Assets	17,248	0.354	0.341	0.203	0.038	0.721
Current/Total Assets	17,467	0.377	0.370	0.208	0.044	0.737
Total Debt (bn INR)	16,586	10.18	1.447	29.825	0.036	48.129
Foreign Currency Debt (bn INR)	7,432	4.61	0.719	13.022	0.034	19.845
Long-Term/Total Debt	16,584	0.668	0.727	0.298	0.049	1.000
Foreign Currency/Total Debt	7,432	0.370	0.290	0.291	0.029	0.990
Debt/Assets	16,585	0.372	0.353	0.232	0.037	0.756
Dividends/Total Assets	8,290	-0.016	-0.010	0.020	-0.050	-0.001
Return on Assets	15,560	0.150	0.141	0.132	-0.023	0.367
Exports/Sales (%)	17,401	16.282	2.966	25.586	0.000	80.287
Total Sources$_t$/Total Assets$_{t-1}$	14,313	0.220	0.150	0.337	-0.035	0.644
ECB Amt$_t$/Total Assets$_{t-1}$ (Issue Years)	2,536	0.339	0.096	1.136	0.016	1.004
Other Sources$_t$/Total Assets$_{t-1}$	14,313	0.185	0.136	0.304	-0.090	0.586

Panel C: Returns Data

	N	Mean	Median	St. Dev.	P5	P95
Stock return (%)	1958649	0.050	-0.094	3.209	-4.623	5.024
NIFTY Return (%)	4,266	0.064	0.082	1.440	-2.120	2.127
USDINR Return (%)	4,266	-0.010	0.000	0.417	-0.702	0.617
NIFTY β	1881607	0.856	0.808	0.531	0.145	1.743
FX β	1881607	0.108	0.111	1.158	-1.393	1.571
CT	192	0.739	0.780	0.258	0.322	1.158

Table 2: **Determinants of Issuance: Carry Trade and the Post-crisis Period**

This table shows results from logistic and OLS regressions used to predict the issuance of foreign currency debt. All observations are at the firm-month level. The dependent variable in the first four columns takes the value 1 if a firm makes at least one issuance in the month, and 0 otherwise. In the next four columns, the dependent variable is the log of 1 plus the amount borrowed by a firm in a given month. In the last two columns, it is the maturity (in years) of issuances. The independent variable, *CT*, captures the difference in 3-month interest rates between India and the U.S. scaled by the implied volatility of 3-month FX options. *CT*PostCrisis* is the value of *CT* interacted with a dummy that takes the value 1 if the month is between September 2008 and September 2013, and 0 otherwise. *CT*PostTaper* is the value of *CT* interacted with a dummy that takes the value 1 if the month is after September 2013, and 0 otherwise. The INRUSD and NIFTY market returns are included in all specifications. These independent variables are one-month lagged values. Firm-level controls include total assets, debt to asset ratio, ratio of exports to sales, and cash to asset ratio. These are measured at the end of the previous fiscal year. Firm-clustered standard errors are in parentheses. Significance levels: *(p<0.10), **(p<0.05), *** (p<0.01)

	Issue (0/1)		Log(1+FC Borr)	
	(1)	(2)	(3)	(4)
CT	0.448***	-0.266	0.145***	-0.095
	(0.106)	(0.183)	(0.035)	(0.070)
CT*post-crisis		1.286***		0.466***
		(0.228)		(0.085)
CT*post-Taper		0.004		0.041
Tantrum		(0.314)		(0.087)
FX Return	0.007	0.008	0.003	0.003
	(0.010)	(0.010)	(0.003)	(0.003)
NIFTY return	-0.001	-0.001	-0.001	-0.000
	(0.004)	(0.004)	(0.001)	(0.001)
Post-crisis	-0.122	-0.937***	-0.049*	-0.335***
	(0.079)	(0.165)	(0.028)	(0.058)
Post-Taper	-0.899***	-0.641**	-0.257***	-0.204***
Tantrum	(0.115)	(0.282)	(0.033)	(0.074)
Firm Controls	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes
Observations	123326	123326	133106	133106
PseudoR^2	0.016	0.018		
Adj.R^2			0.028	0.029

Table 3: **Macroprudential Policies and Borrower Interest Cost Distribution**

This table shows results from OLS regressions associating the interest cost distribution of foreign currency borrowers with macroprudential policy. All observations are at the month level. Panel A (Panel B) analyzes the right (left) side of the interest cost distribution. For foreign currency borrowers who issue in a given month, $\frac{P90-P50}{\sigma}$ ($\frac{P10-P50}{\sigma}$) measures the difference in interest costs between the borrower at the 90th (10th) percentile and the median borrower scaled by the standard deviation of the interest costs. Pre-crisis covers the period between January 2004 and August 2008; Post-crisis is the period between September 2008 and September 2013; Post-taper tantrum is the period between October 2013 and October 2019. Significance levels: *(p<0.10), **(p<0.05), *** (p<0.01)

Panel A: Right Side

	Interest Cost Distribution		
	$\frac{P90-P50}{\sigma}$		
	Pre-crisis	Post-crisis	Post-taper
High AIC	-0.016	-0.194*	0.235**
	(0.160)	(0.107)	(0.099)
Constant	1.238***	1.408***	1.166***
	(0.141)	(0.084)	(0.069)
Observations	53	97	92
R^2	0.000	0.033	0.058

Panel B: Left Side

	Interest Cost Distribution		
	$\frac{P10-P50}{\sigma}$		
	Pre-crisis	Post-crisis	Post-taper
High AIC	-0.162	-0.141	-0.079
	(0.146)	(0.107)	(0.097)
Constant	-0.955***	-1.050***	-1.043***
	(0.129)	(0.084)	(0.067)
Observations	53	97	92
R^2	0.023	0.018	0.007

Table 4: **Carry Trade and Macroprudential Policies in the Post-crisis Period**

This table shows results from logistic and OLS regressions used to predict the issuance of foreign currency debt between September 2008 and March 2019. All observations are at the firm-month level. The dependent variable in the first two columns takes the value 1 if a firm makes at least one issuance in the month, and 0 otherwise. In the next two columns, the dependent variable is the log of 1 plus the amount borrowed by a firm in a given month. The independent variable, *CT*, captures the difference in 3-month interest rates between India and the U.S. scaled by the implied volatility of 3-month FX options. *High AIC* is a dummy that takes the value 1 if the maximum All-In-Cost interest rate spread was above its sample median for the post-crisis period, indicating looser policy. *CT*Hi AIC* is the value of *CT* interacted with *High AIC*. The INRUSD and NIFTY market returns are included in all specifications. These independent variables are one-month lagged values. Firm-level controls include total assets, debt to asset ratio, ratio of exports to sales, and cash to asset ratio. These are measured at the end of the previous fiscal year. Firm clustered standard errors are in parentheses. Significance levels: *(p<0.10), **(p<0.05), *** (p<0.01)

	Issue (0/1)		Log(1+FC Borr)	
	(1)	(2)	(3)	(4)
CT [β_1]	-2.035***	-2.062***	-0.633***	-0.645***
	(0.304)	(0.301)	(0.107)	(0.107)
High AIC	-2.118***	-2.126***	-0.633***	-0.646***
Spread	(0.268)	(0.281)	(0.098)	(0.101)
CT*Hi AIC	2.459***	2.464***	0.733***	0.743***
Spread [β_2]	(0.319)	(0.325)	(0.110)	(0.112)
FX Return	-0.008	-0.008	-0.001	-0.001
	(0.010)	(0.010)	(0.003)	(0.003)
NIFTY return	-0.005	-0.005	-0.002	-0.002
	(0.005)	(0.005)	(0.001)	(0.001)
$Pr(\beta_1 + \beta_2 = 0)$	0	.0001	0	.0001
Firm Controls	Yes	Yes	Yes	Yes
Firm FE	No	Yes	No	Yes
Observations	179523	134364	179523	179523
PseudoR^2	0.012	0.008		
Adj.R^2			0.003	0.028

Table 5: **Carry Trade, Macroprudential Policies, and Interest Costs in the Post-crisis Period**

This table shows results from logistic and OLS regressions used to predict the issuance of foreign currency debt between September 2008 and March 2019. All observations are at the firm-month level. The dependent variable in the first two columns takes the value 1 if a firm makes at least one issuance in the month, and 0 otherwise. In the next two columns, the dependent variable is the log of 1 plus the amount borrowed by a firm in a given month. The independent variable, *CT*, captures the difference in 3-month interest rates between India and the U.S. scaled by the implied volatility of 3-month FX options. *High AIC* is a dummy that takes the value 1 if the maximum All-In-Cost interest rate spread was above its sample median for the post-crisis period, indicating looser policy. *CT*Hi AIC* is the value of *CT* interacted with *High AIC*. *Int Cost* is the ratio of total interest expense to debt outstanding. Industry-year and firm fixed effects are included in all specifications. Firm-level controls include log of total assets, ratio of debt to assets, ratio of exports to sales, and cash to asset ratio measured at the end of the previous fiscal year. Firm clustered standard errors are in parentheses. Significance levels: *(p<0.10), **(p<0.05), *** (p<0.01)

	Issue (0/1)		Log(1+FC Borr)	
	(1)	(2)	(3)	(4)
CT	0.414**	-2.344***	0.126**	-2.372***
	(0.203)	(0.555)	(0.051)	(0.422)
Int Cost	-0.020	0.049	-0.003**	0.007
	(0.014)	(0.022)	(0.001)	(0.006)
High AIC Spread		-4.330***		-3.486***
		(0.524)		(0.501)
CT*Hi AIC		2.799***		2.796***
		(0.583)		(0.465)
CT*Int Cost	0.011	-0.064**	0.002	-0.008
	(0.016)	(0.032)	(0.002)	(0.007)
Hi AIC*Int Cost		-0.120***		-0.013**
		(0.029)		(0.006)
CT*Hi AIC*Int Cost		0.120***		0.013*
		(0.037)		(0.007)
Controls	Yes	Yes	Yes	Yes
Fixed Effects	Firm, Year	Firm, Year	Firm, Ind-Year	Firm, Ind-Year
Observations	119045	119045	165724	165724
PseudoR^2	0.016	0.048		
Adj.R^2			0.030	0.038

Table 6: **Maturity, Trade Credit, and Domestic Debt in the Post-crisis Period**

This table shows results from OLS regressions used to explain maturity of foreign currency borrowing, changes in trade credit, and changes in INR debt between September 2008 and March 2019. All observations are at the firm-month level. The dependent variable in the first two columns is the maturity (in years) of foreign currency debt issuances. In the next two columns, it is the difference in trade credit received between the end of fiscal year t and the end of fiscal year $t-1$. Trade credit received is defined as the ratio of accounts payable to total assets. In the last two columns, it is the difference in domestic currency (INR) debt (scaled by assets) between the end of fiscal year t and the end of fiscal year $t-1$. In the first two columns, the sample covers issuance months only while in the next two it only includes firms with above-median ratio of imports to raw materials. The independent variable, *CT*, captures the difference in 3-month interest rates between India and the U.S. scaled by the implied volatility of 3-month FX options. *High AIC* is a dummy that takes the value 1 if the maximum All-In-Cost interest rate spread was above its sample median for the post-crisis period, indicating looser policy. *CT*Hi AIC* is the value of *CT* interacted with *High AIC*. *Int Cost* is the ratio of total interest expense to debt outstanding. Industry-year and firm fixed effects are included in all specifications. Firm-level controls include log of total assets, ratio of debt to assets, ratio of exports to sales, and cash to asset ratio measured at the end of the previous fiscal year. Firm clustered standard errors are in parentheses. Significance levels: *(p<0.10), **(p<0.05), *** (p<0.01)

	Dependent Variable					
	Maturity (years)		Δ TC Received		Δ INR Debt	
	(1)	(2)	(3)	(4)	(5)	(6)
CT	0.680	0.365	-0.010*	-0.017**	0.013	0.019
	(0.448)	(0.645)	(0.005)	(0.009)	(0.012)	(0.013)
Int Cost		-0.011		-0.001		0.001*
		(0.040)		(0.001)		(0.001)
High AIC Spread	1.794***	1.534**	-0.012**	-0.017*	0.020	0.044***
	(0.457)	(0.744)	(0.006)	(0.009)	(0.014)	(0.017)
CT*Hi AIC	-1.095**	-0.448	0.015**	0.021**	-0.019	-0.031*
	(0.551)	(1.050)	(0.006)	(0.009)	(0.014)	(0.017)
CT*Int Cost		0.018		0.001		-0.001
		(0.051)		(0.001)		(0.001)
Hi AIC*Int Cost		0.022		0.001		-0.003***
		(0.075)		(0.001)		(0.001)
CT*Hi AIC*Int Cost		-0.079		-0.001		0.002
		(0.100)		(0.001)		(0.001)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Ind-Year FE and Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	2390	2191	80006	78577	174641	165579
Adj.R^2	0.502	0.461	0.271	0.269	0.411	0.328

Table 7: **Forward-looking β and Foreign Currency Debt Issuance**

The table has results from the OLS estimation of the following equation:

$$FX\beta_{it} = \alpha + \beta_1 Issue_{i,t-1} + \nu_t + \eta_i + \varepsilon_{it}$$

The dependent variable is the β estimated for firm i from the market model in a 60-month trading window starting in month t. The independent variable is a dummy that takes value 1 if firm i issued foreign currency debt in month $t-1$. Fixed effects are as indicated. The sample period is from January 2004 to September 2019. Standard errors clustered at both firm and month level are reported in brackets. Significance levels: *(p<0.10), **(p<0.05), *** (p<0.01)

	β (forward looking)					
	FX			NIFTY		
Issue	-0.026	-0.081**	-0.069**	0.010	0.026	0.024
	(0.020)	(0.035)	(0.030)	(0.011)	(0.017)	(0.015)
Issue*PostCrisis		0.118**			-0.030	
		(0.048)			(0.025)	
Issue*PostTaper		-0.051			-0.015	
		(0.166)			(0.067)	
Issue*Hi AIC			0.100**			-0.032
			(0.048)			(0.026)
Time FE	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.161	0.161	0.161	0.203	0.203	0.203
Obs.	62,431	62,431	62,431	62,431	62,431	62,431

Table 8: β **and Foreign Currency Debt Issuance by CT measure and Interest Cost**

The table has results from the OLS estimation of the following equation:

$$FX\beta_{it} = \alpha + \beta_1 Issue_{i,t-1} + \nu_t + \eta_i + \varepsilon_{it}$$

The dependent variable is the β estimated for firm i from the market model in a 60-month trading window starting in month t . The independent variable is a dummy that takes value 1 if firm i issued foreign currency debt in month $t-1$. In Panel A, the dependent variable of interest is based on the weighted average value of the CT measure at the time of issuance. The sample in this panel only includes firms with at least 4 issuances over the sample period. In Panel B, the dependent variable of interest is based on the firm's implied interest cost.Fixed effects are as indicated. The sample period is from Jan 2004 to Sep 2019. Standard errors clustered at both firm and month level are reported in brackets. Significance levels: *(p<0.10), **(p<0.05), *** (p<0.01)

Panel A: Firm CT

	β (forward looking)			
	Low CT Index Issuers		High CT Index Issuers	
	FX β	NIFTY β	FX β	NIFTY β
Issue	0.051	-0.009	-0.123**	0.043
	(0.037)	(0.020)	(0.053)	(0.031)
Issue*Hi AIC	-0.076	0.015	0.135	-0.087
	(0.071)	(0.035)	(0.087)	(0.059)
Time FE	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes
R^2	0.338	0.427	0.316	0.429
Obs.	13,157	13,157	9,092	9,092

Panel B: Interest Cost

	β (forward looking)			
	Low Int Cost Firms		High Int Cost Firms	
	FX β	NIFTY β	FX β	NIFTY β
Issue	-0.016	-0.020	-0.123***	0.061**
	(0.037)	(0.017)	(0.045)	(0.024)
Issue*Hi AIC	0.032	0.026	0.133*	-0.088
	(0.060)	(0.028)	(0.070)	(0.060)
Time FE	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes
R^2	0.442	0.516	0.132	0.145
Obs.	29,013	29,013	27,339	27,339

Table 9: **Event Study of Taper and Post-taper Events: CT Measure and Interest Costs**

The sample consists of companies that are present in the RBI data and that have stock return data to estimate the model. A multivariate market model is used for estimation with the NIFTY return proxying for the market return while INRUSD return proxies for FX return. The estimation window is 180 calendar days and ends 5 calendar days before the announcement date. In the event study, cumulative abnormal return (CAR) is calculated over 5 trading days post the event date. June 19, 2013 is a date on which likelihood of tapering went up; October 03, 2018 is a date when the rupee fell sharply owing to a spike in oil prices; and March 12, 2020 was the date after the U.S. imposed travel restrictions from Europe owing to the COVID-19 pandemic. The returns are in percentage points. In Panel A, firms are sorted into terciles based on the weighted average value of the CT measure at the time of issuance. The sample in this panel only includes firms with at least four issuances over the sample period. In Panel B, firms are sorted into terciles based on their implied interest cost. Robust standard errors are in parentheses. Significance levels: *(p<0.10), **(p<0.05), *** (p<0.01)

Panel A: Firm CT

	CAR[1,5]		
	06/19/13	10/03/18	03/12/20
Low CT Issuer	-0.582	1.308	-1.006
	(1.092)	(1.377)	(1.422)
Mid CT Issuer	-0.579	2.158**	-0.817
	(0.568)	(1.018)	(1.307)
High CT Issuer	-2.092***	3.336***	-0.195
	(0.600)	(0.724)	(1.250)
Pr(H-L==0)	.2045	.1656	.6704
Observations	184	173	168
R^2	0.051	0.097	0.005

Panel B: Interest Cost

	CAR[1,5]		
	06/19/13	10/03/18	03/12/20
Low Int Cost	-0.500	1.805***	-2.614***
	(0.393)	(0.541)	(0.812)
Mid Int Cost	-0.472	3.314***	-0.432
	(0.532)	(0.545)	(0.802)
High Int Cost	-0.900**	3.522***	-1.707**
	(0.449)	(0.660)	(0.751)
Pr(H-L==0)	.502	.0451	.4133
Observations	439	474	474
R^2	0.013	0.142	0.033

Table 10: **Firm Outcomes and Foreign Currency Debt Issuance in the Post-crisis Period**

This table shows results from a OLS regression relating firm outcomes to the firm's propensity to issue foreign currency debt when the CT index is high. All observations are at the firm-year level. The dependent variable, Y_{it}, can be (i) gross investment (change in gross fixed assets from year t-1 to t) in year t, (ii) cash holdings at end of year t, (iii) debt at end of year t, and (iv) profits in year t. All dependent variables are scaled by year t assets. In Panel A, the independent variable of interest is the interaction of *PostTaper*, a dummy taking the value 1 in the period from October 2013 onwards with the weighted firm-level CT measure. In Panel B, the independent variable of interest is the interaction of *Hi AIC*, a dummy taking the value 1 if the maximum All-In-Cost interest rate spread is above its sample median with the weighted firm-level CT measure. We include only firms that issue at least 4 times. Industry-Year and firm fixed effects are included in all specifications. Standard errors clustered at the firm level are in brackets. Significance levels: *(p<0.10), **(p<0.05), *** (p<0.01)

Panel A: Post-taper

	Investment		Cash		Leverage		ROA	
Post-Taper × Hi Firm CT	-0.038*		-0.025***		0.023		0.006	
	(0.020)		(0.008)		(0.020)		(0.010)	
Post-Taper × Firm CT		-0.145**		-0.071**		0.085		0.010
		(0.066)		(0.028)		(0.059)		(0.028)
Ind-Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	3007	3007	3191	3191	3190	3190	3021	3021
R^2	0.288	0.289	0.470	0.470	0.657	0.657	0.515	0.515

Panel B: Impact of Macroprudential policies

	Investment		Cash		Leverage		ROA	
Hi AIC × Hi Firm CT	0.032*		0.025***		-0.021		-0.006	
	(0.019)		(0.010)		(0.020)		(0.010)	
Hi AIC × Firm CT		0.113		0.087**		-0.108		-0.017
		(0.070)		(0.040)		(0.076)		(0.031)
Ind-Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	3007	3007	3191	3191	3190	3190	3021	3021
R^2	0.288	0.288	0.470	0.470	0.657	0.657	0.515	0.515

Regulating Carry Trades: Evidence from Foreign Currency Borrowing of Corporations in India

Internet Appendix

A Foreign Currency Debt Maturity Dates and Exchange Rates

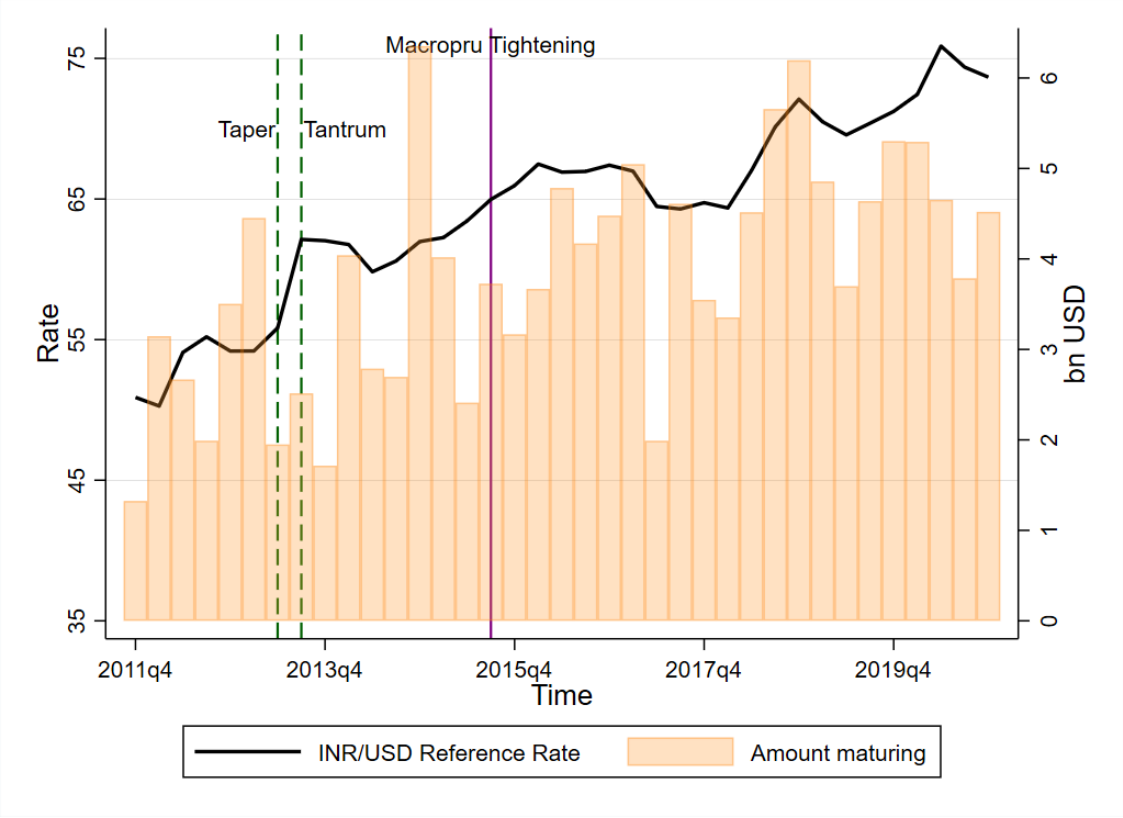


Figure A.1: **Foreign Currency Debt Maturity Dates and INR/USD Exchange Rate** The line shows the evolution of the INR/USD Reference Rate while the bars indicate the issuance volume of foreign currency debt due to mature in that quarter. The figure covers the period from the third quarter of 2011 (three years after the global financial crisis) to the fourth quarter of 2020.

Table A.1: **Foreign Currency Debt Maturity Dates and Exchange Rates**

This table shows results from an OLS regression used to predict exchange rates. All observations are at the monthly level. The dependent variable is the change in the log of the USD/INR reference rate multiplied by 100. The independent variable is the change in the log of foreign currency debt issuances due to mature in that month. The sample period is from September 2011 (three years after the global financial crisis) to September 2020. Newey-West standard errors with four lags are in brackets. Significance levels: *(p<0.10), **(p<0.05), *** (p<0.01)

	Δ Log (Exch Rate) ($\times$ 100)		
Δ Log (Amt. Maturing)	-0.419***		
	(0.156)		
Δ Log (Amt. Maturing issued Post-crisis)		-0.331*	
		(0.168)	
Δ Log (Amt. Maturing issued Post-taper)		-0.027***	
		(0.007)	
Δ Log (Amt. Maturing Issued Hi AIC)			-0.392**
			(0.157)
Δ Log (Amt. Maturing Issued Lo AIC)			-0.018
			(0.011)
Constant	-0.354**	-0.355**	-0.353**
	(0.175)	(0.176)	(0.176)
F-Stat	7.187	10.582	4.854
Obs.	109	109	109

B Rupee-Denominated Bonds and Foreign Investment in Domestic Bonds

In this section, we look at changes in macroprudential policy targeting domestic currency debt. We focus on two key changes: guidelines on the issuance of rupee-denominated bonds in overseas markets and the relaxation of limits on foreign investment in domestic corporate bonds. The rupee bond guidelines were introduced in September 2015 and the first set of bonds were issued in the third quarter of 2016. To rule out the decline in foreign currency debt issuance we document is not just substitution to overseas rupee bonds, we collect data on the latter. Appendix Figure B.1 shows the evolution of rupee bond issuance since 2016, along with the foreign currency debt issuance over the same period. The figure shows that rupee bond issuance is significantly lower than foreign currency debt and the volume of rupee bonds has declined significantly over time. The volume of non-financial rupee bond issuance averages only 5% of the volume of foreign currency debt issuance from 2016 to 2019. Many rupee bond issuers are financial firms, a category we exclude in our analysis.

The RBI imposes capital controls through the imposition of limits on foreign investment in Indian debt and equity markets. In Appendix Figure B.2a, we plot foreign investment against the maximum limits. The limits were fixed from 2013 to 2017 but in early 2018, the RBI started gradually loosening them and has continued to loosen them. Foreign investment in domestic debt reached its peak in August 2019, at almost the maximum limit, but has declined since then and is well below 50% of the maximum limit at the moment. In Appendix Figure B.2b, we plot net foreign investor flows in domestic debt over our entire sample period. The graph indicates that flows have become significantly larger and more volatile since the financial crisis. There were significant outflows due to the taper tantrum, but these reversed soon after. Importantly, the macroprudential tightening of foreign currency borrowing in November 2015 is not accompanied by significant inflows. This enables us to rule out that the results we document are an artifact of foreign investors substituting foreign currency

corporate debt with domestic currency debt.

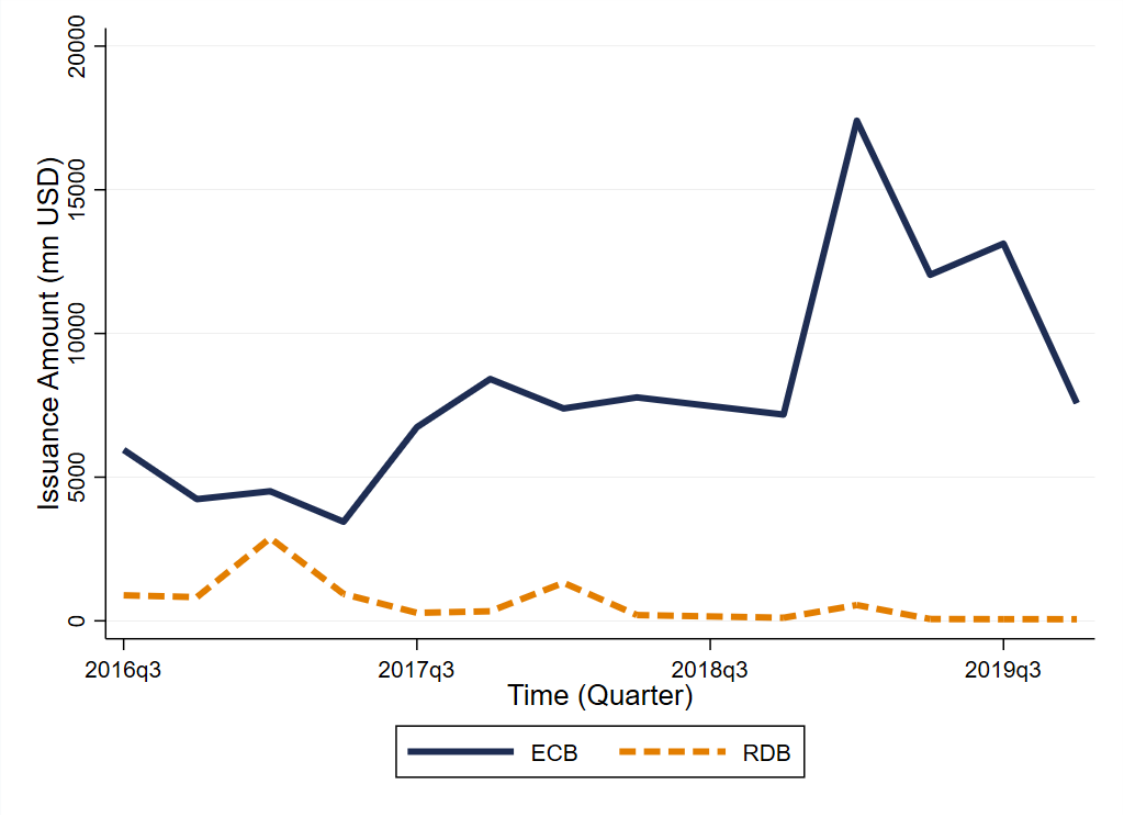
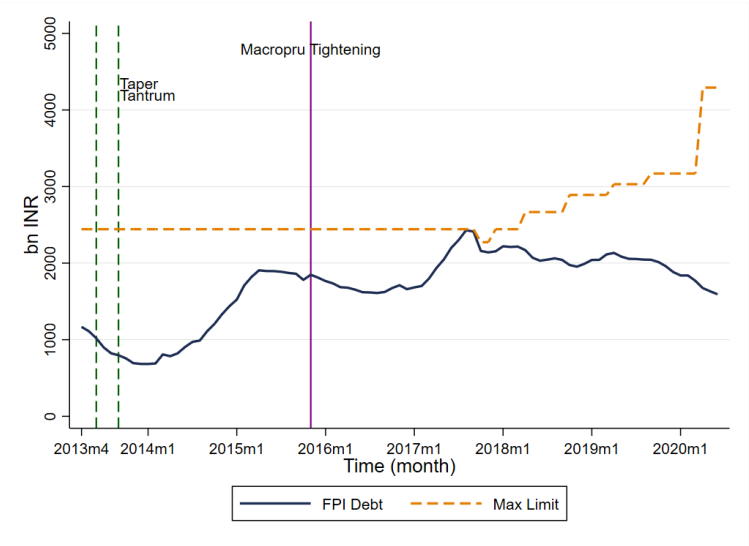


Figure B.1: **Foreign Currency Debt and Rupee-Denominated Bonds**
The figure shows the evolution of the issuance of foreign currency debt and rupee-denominated bonds from September 2016 to December 2020.

(a) Foreign Investment in Domestic Debt and Maximum Limits



(b) Net Foreign Investment Flows in Domestic Debt

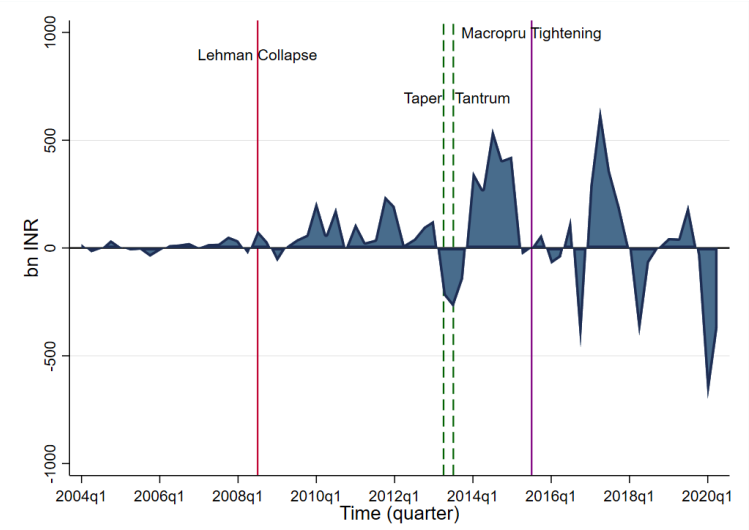


Figure B.2: **Foreign Investor Domestic Debt Holdings and Flows**
The figure depicts the evolution of the stock and flows of foreign investor positions in domestic corporate debt. Figure (a) depicts the stock of foreign investor holdings along with the maximum regulatory limits monthly from April 2013 to June 2020. Figure (b) depicts net foreign investment flows quarterly from January 2004 to June 2020.

C Macroprudential Policies in the Pre-crisis Period

Table C.1: **Carry Trade and Macroprudential Policies in the pre-crisis period**

This table shows results from logistic and OLS regressions used to predict the issuance of foreign currency debt between January 2004 and August 2008. All observations are at the firm-month level. The dependent variable in the first two columns takes the value 1 if a firm makes at least one issuance in the month, and 0 otherwise. In the next two columns, the dependent variable is the log of 1 plus the amount borrowed by a firm in a given month. The independent variable, *CT*, captures the difference in 3-month interest rates between India and the US scaled by the implied volatility of 3-month FX options. *High AIC Spread (Pre-crisis)* is a dummy that takes the value 1 if the All-In-Cost Interest Rate spread was above its sample median for the pre-crisis period from Jan 2004 to Aug 2008. *CT*Hi AIC* is the value of *CT* interacted with *High AIC Spread (Pre-crisis)*. The INRUSD and NIFTY market returns are included in all specifications. These independent variables are one-month lagged values. Firm-level controls include total assets, debt to asset ratio, ratio of exports to sales, and cash to assets ratio. These are measured at the end of the previous fiscal year. Firm clustered standard errors are in brackets. Significance levels: *(p<0.10), **(p<0.05), *** (p<0.01)

	Issue (0/1)		Log(1+FC Borr)	
	(1)	(2)	(3)	(4)
CT [β_1]	0.073	0.029	0.023	0.009
	(0.259)	(0.265)	(0.084)	(0.084)
High AIC	0.447**	0.382*	0.138**	0.133*
Spread	(0.197)	(0.205)	(0.063)	(0.068)
CT*Hi AIC	-0.714**	-0.711**	-0.227**	-0.228**
Spread [β_2]	(0.330)	(0.341)	(0.106)	(0.108)
FX Return	0.006	0.007	0.001	0.002
	(0.023)	(0.023)	(0.007)	(0.007)
NIFTY return	0.002	0.001	0.001	0.001
	(0.005)	(0.006)	(0.002)	(0.002)
$Pr(\beta_1 + \beta_2 = 0)$	.0028	.0021	.0031	.002
Firm Controls	Yes	Yes	Yes	Yes
Firm FE	No	Yes	No	Yes
Observations	45756	21291	45756	45756
PseudoR^2	0.043	0.009		
Adj.R^2			0.008	0.031

Table C.2: **Carry Trade, Macroprudential Policies and Interest Costs in the Pre-crisis Period**

This table shows results from logistic and OLS regressions used to predict the issuance of foreign currency debt between January 2004 and August 2008. All observations are at the firm-month level. The dependent variable in the first two columns takes the value 1 if a firm makes at least one issuance in the month, and 0 otherwise. In the next two columns, the dependent variable is the log of 1 plus the amount borrowed by a firm in a given month. The independent variable, *CT*, captures the difference in 3-month interest rates between India and the US scaled by the implied volatility of 3-month FX options. *High AIC Spread (Pre-crisis)* is a dummy that takes the value 1 if the All-In-Cost Interest Rates spread was above its sample median for the pre-crisis period from January 2004 to August 2008. *Int Cost* is the ratio of total interest expense to debt outstanding. One-month lagged INRUSD and NIFTY market returns are included in all specifications. Firm-level controls include total assets, debt to asset ratio, ratio of exports to sales, and cash to assets ratio. These are measured at the end of the previous fiscal year. Firm clustered standard errors are in brackets. Significance levels: *(p<0.10), **(p<0.05), *** (p<0.01)

	Issue (0/1)		Log(1+FC Borr)	
	(1)	(2)	(3)	(4)
CT	1.789***	2.395***	0.450***	0.675***
	(0.415)	(0.486)	(0.119)	(0.144)
Int Cost	0.043**	0.035	0.003	0.004
	(0.017)	(0.025)	(0.003)	(0.004)
High AIC		0.990**		0.381***
Spread (Pre-Crisis)		(0.412)		(0.128)
CT*Hi AIC		-1.102*		-0.480**
		(0.668)		(0.188)
CT*Int Cost	-0.050*	-0.017	-0.003	-0.002
	(0.028)	(0.030)	(0.004)	(0.005)
Hi AIC*Int Cost		0.027		-0.001
		(0.036)		(0.005)
CT*Hi AIC*Int Cost		-0.079		-0.003
		(0.061)		(0.007)
Controls	Yes	Yes	Yes	Yes
Fixed Effects	Firm, Year	Firm, Year	Firm, Ind-Year	Firm, Ind-Year
Observations	19290	19290	39784	39784
PseudoR^2	0.013	0.016		
Adj.R^2			0.033	0.033