Hedger of Last Resort: Evidence from Brazilian FX Interventions, Local Credit, and Global Financial Cycles

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Abstract

We show that FX interventions attenuate global financial cycle (GFC)'s spillovers. We exploit GFC shocks and Brazilian central bank interventions in FX derivatives using three matched administrative registers: credit, foreign credit to banks, and employer-employee. After U.S. Taper Tantrum (followed by Emerging Markets FX turbulence), Brazilian banks with more foreign debt cut credit supply, thereby reducing firm-level employment. A subsequent large policy intervention supplying derivatives against FX risks—*hedger of last resort*—halves the negative effects. A 2008-2015 panel exploiting GFC shocks and FX interventions confirms these results and the hedging channel. However, the policy entails fiscal and moral hazard costs.

JEL classification: E5; F3; G01; G2

Keywords: foreign exchange; monetary policy; central bank; bank credit; hedging

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1 Introduction

A global financial cycle (GFC) stemming from U.S. monetary policy changes affects local credit markets and bank risk-taking in emerging markets (Rey (2013)). The U.S. Dollar (USD) plays a central role in the GFC (Shin (2016), Jiang, Krishnamurthy and Lustig (2021)) and since the Great Recession—and also recently during the COVID-19 crisis and post-crisis period—emerging markets have experienced large shifts in foreign exchange (FX) market conditions.

In response to external shocks, central banks around the world have intervened in FX markets, despite the fact that the empirical evidence on the effectiveness of FX intervention remains limited (Maggiori (2022)). This may have come as no surprise since dynamic macroeconomic models often predict that FX intervention should be irrelevant (see, e.g., Backus and Kehoe (1989)), however a recent theoretical literature, based on more realistic assumptions of financial market imperfections, has shown that FX interventions can be effective (see, e.g., Cavallino (2019), Amador et al. (2020), Fanelli and Straub (2020), Davis, Devereux and Yu (2020), Hassan, Mertens and Zhang (2021), Bianchi and Lorenzoni (2021)). Maggiori (2022) stresses the similarity between quantitative easing and FX intervention arguing that the nature of both tools is to transfer risk from the private sector to the central bank.[1] Further, the IMF which has traditionally discouraged these type of interventions changed their policy stance, based on the conceptual model of Basu et al. (2020), which includes FX intervention as a stabilization tool.

In this paper, we analyze whether central banks in Emerging Market Economies (EMEs) can successfully apply FX policies to reduce the spillovers of the GFC on local credit cycles and their economies at large. Since the softening (tightening) of local monetary policies in response to a tightening (booming) GFC can amplify their local cycles, alternative macroprudential and capital account measures have been advocated (Rey (2013), Blanchard (2016), Blanchard et al. (2017), Bianchi and Lorenzoni (2021), Maggiori (2022)). Importantly, given FX markets' reaction to the GFC during the Taper

[1] Since the key mechanism is to transfer risk, FX intervention can be implemented with derivatives (instead of the traditional sterilized spot interventions). In fact, interventions in the derivatives markets are becoming more common among central banks. For a transfer of risk from the private to the public sector in other settings see, e.g., Gorton (2012), Tirole (2012), Philippon and Skreta (2012), and Faria-e Castro, Martinez and Philippon (2017).

Tantrum and to the Covid-19 pandemic, many central banks in EMEs have intervened in FX markets to provide the private sector with insurance against FX risks (Domanski, Kohlscheen and Moreno (2016), IMF (2020)). Recently, given the tightening of US monetary policy due to inflation, FX interventions around the world have again been advocated (Georgieva (2022), Gourinchas (2022)).

Our most important contributions to the literature are to show that FX interventions can be effective and that they can also attenuate the GFC's spillovers. There have been several papers showing how the GFC affects EMEs, but scant evidence on how local policies in general—and FX interventions, in particular—diminish the negative spillovers (Miranda-Agrippino and Rey (2021)). Moreover, despite that central banks around the world have extensively used FX interventions, empirical evidence on their success has been weak (see, e.g., Maggiori (2022), Chang (2018)). For empirical identification, we exploit GFC shocks and Brazilian interventions in FX derivatives using three matched administrative registers: credit, foreign credit flows to banks, and employer-employee.

We find that, after the U.S. Federal Reserve Taper Tantrum (followed by a strong EME FX depreciation and volatility increase), Brazilian banks with larger ex-ante reliance on foreign debt strongly cut credit supply, thereby reducing firm-level employment. A subsequent announcement by the Central Bank of Brazil (*Banco Central do Brasil*, BCB) of an intervention program consisting of supplying FX derivatives against FX risks—*hedger of last resort*—is able to reduce by half the negative effects. Yet, the policy entails fiscal and moral hazard costs. The channel driving our results is based on FX hedging availability. We show that to comply with prudential regulation, banks hedge their FX debt, so their net worth is not directly affected by changes in the FX rate (see also Bruno and Shin (2015)). However, they hedge their FX exposure by purchasing and rolling-over short-term FX derivatives. External shocks to the FX market affect the availability of hedging, and banks react by changing their credit supply. A further panel analysis from 2008 to 2015 that exploits time-varying changes in FX and Brazilian FX intervention policies offers external validity and helps us to control for other mechanisms, in particular, the capital flow channel. In addition, the panel analysis shows that, despite large fluctuations in the FX rate both before and after the central bank intervention, FX shocks affect credit supply and employment less after the central bank intervenes in the

FX hedging market.

Brazil provides an excellent setting to investigate the GFC effects on EMEs and whether FX interventions can attenuate the spillovers. In addition to having exceptional administrative micro-level datasets on credit, banks' foreign claims and employment, Brazil is a large, representative emerging economy, which has been subject to large external shocks and where the local central bank implemented a large intervention program in the FX derivatives market (in August 2013). The open positions of the BCB in these derivatives sum close to 7% of the Brazilian GDP (or 33% of its international reserves). Other central banks in EMEs adopted similar programs in the following years, e.g., Mexico in February 2017, Turkey in November 2017, Chile in November 2019 and several other countries during the Covid-19 pandemic, e.g., Colombia, Dominican Republic, Georgia, Indonesia and Mexico (IMF (2020)).[2] We build our sample matching three administrative registers: the credit register from the BCB, the debt register of foreign credit flows to institutions domiciled in Brazil also from the BCB, and the matched employer-employee dataset from the Ministry of Labor and Employment.

The first shock we exploit is on May 22, 2013, when the Chairman of the U.S. Federal Reserve System, Ben Bernanke, raised the possibility of tapering its security purchases (QE) in his testimony before the Joint Economic Committee of the U.S. Congress. While expansionary unconventional monetary policies by the Federal Reserve were not expected to last forever, the tapering speech did surprise the markets. Following this speech, currencies across emerging markets depreciated and, in some countries, this depreciation was substantial (Indonesia and Argentina 20%, Turkey 15%, Brazil 14%, India 12%, South Africa 10% (Sahay et al. (2014)). The market reaction to the Bernanke's speech became known as the Taper Tantrum.

In light of high FX volatility and steep depreciation of the Brazilian real (BRL), FX derivatives' markets became distressed. On August 22, 2013 the BCB responded announcing a major program of FX intervention. The central bank committed to daily sales of USD 500 million worth of currency non-deliverable forwards (USD forwards settled in BRL, more widely known as "BCB swaps") during the following year. In this program,

[2]During the Covid-19 pandemic, the BCB used FX swaps in certain days but did not announce a program of FX interventions as the one explored in this paper.

by committing to supply FX derivatives, the BCB provided the markets insurance against further depreciation of the BRL, with the aim of satisfying excess demand for hedging instruments (BCB (2014)), and therefore acting as a *hedger of last resort*.[3] Unlike traditional sterilized FX interventions in the spot market, this type of intervention does not reduce the country's international reserves, but it reduces central bank's net FX position. The markets welcomed the announcement of this program, which caused appreciation of the BRL relative to other EMEs currencies (Chamon, Garcia and Souza (2017)).

We address our questions by: (i) analyzing the supply of credit from domestic banks in Brazil with different ex-ante reliance of foreign debt and the associated firm-level real effects; (ii) exploiting two consecutive events related to the U.S. tapering speech and the announcement of the BCB intervention program in the FX derivatives market.

Moreover, for external validity and further robustness checks, we analyze the effects of quarterly changes in the FX market conditions (FX level and volatility, either using Brazilian or EMEs FX index) using a panel dataset over 2008–2015 (both at loan- and firm-level) and controlling for several other macro variables, both local (e.g., business cycle and other policy variables) and related to the GFC (e.g., capital inflows). We also explore whether these GFC effects on credit change after the intervention of the BCB in FX derivatives, as well as other local policies. The panel also allows us to exploit periods of mild FX shocks as well as periods of strong FX shocks both before and after the Brazilian FX public policy.

For identification, we exploit external shocks, local FX interventions, the specific conditions of the Brazilian market, and the granularity of our matched datasets. First, we analyse domestic banks, which cover most of the Brazilian credit market.[4] Second, we analyze only loans in BRL, which represent almost the totality of the loans extended by Brazilian domestic banks to local companies. Less than 1% of the firms in the sample obtain loans indexed to the USD (results are robust to including these loans). Third, because

[3]The BCB, as some other central banks, intervened in the FX derivative markets in the past. What is unprecedented in the August 2013 intervention in Brazil is the publicly announced commitment to a large scale program, both in terms of the amounts and the intervention duration.

[4]We exclude from the analysis two foreign banks as these banks are likely to be affected by different channels. On this, we follow Baskaya et al. (2017a) and Baskaya et al. (2017b) who analyze domestic banks in Turkey which are more reliant on external non-core funding. In our case, the market share of excluded banks is around 13%. However, all our results are robust if we add back the foreign banks.

of loan-level data from the Credit Registry of the BCB, and following Khwaja and Mian (2008), we can control for firm-level shifts in fundamentals (including credit demand) using firm fixed effects (or firm-time fixed effects when we analyze the panel)[5] and focus on changes in credit supply by banks with differential ex-ante foreign debt. We also control (in levels and interactions) for other bank characteristics that may be associated with banks with larger foreign debt (size and exposure to firms involved in international trade). Finally, the employer-employee dataset allows us to have a better understanding of the real effects of both GFC and of the alleviating FX intervention policies.

We find the following robust results. After the tapering speech by Bernanke, banks with larger ex-ante foreign debt reduce credit supply to firms as compared to the other banks (i.e., analyzing loan-level data, we look at changes in lending to the same firm by banks with different levels of foreign debt).[6] Specifically, we find that one standard deviation in banks' ex-ante foreign debt leads to 2.2 percentage points (p.p.) lower quarterly credit growth. However, this credit supply reduction is partially reversed following the announcement of the intervention by the BCB: the sensitivity of credit growth to bank foreign funding decreases by half in absolute terms after the BCB commits to the intervention program. These loan-level results also hold at the firm level: firms more exposed to banks with more foreign debt experience a reduction of their total credit after the Bernanke speech (1.8 p.p.) and a partial reversal after the BCB announcement (half the size).

We show that the GFC shock and the FX hedging policy both have real effects. In particular, we find that total employment at the firm level follows a pattern similar to the one of the firm total credit: after the Bernanke speech, firms more exposed to banks with more foreign debt reduce employment by 0.4 p.p. The announcement of the hedging

[5]When we analyse data at the firm-level, we can control for firm-level credit demand by adding industry-state-time fixed effects, and industry-time and firm fixed effects in the panel analysis. Also, we include the fixed effects estimated in the loan-level regressions as a proxy for time-varying firm demand shocks potentially related to BRL depreciation.

[6]Placebo tests show that these effects are not present before the shock. Additionally, the panel results also serve as a further placebo check since the panel covers quarters without significant FX shocks. Furthermore, following Oster (2019) and Altonji, Elder and Taber (2005), a stable estimate of the main effect accompanied by a very large increase in R-squared due to the inclusion of many observable variables and fixed effects suggests that omitted variable and self-selection problems (further unobservables) do not drive our results.

policy by the BCB, consistently with previous results, decreases by half the reduction in employment by firms more exposed to banks with large FX debt. By analyzing changes in the average tenure of each firm employees, we find that the margin of adjustment is on less tenured workers.

Analyzing the full panel with quarterly data from 2008 to 2015, we find that after EME FX depreciation, banks with larger ex-ante foreign debt reduce the supply of credit to firms. We obtain similar results if, instead of the level of the FX rate, we use the volatility of the FX rate (quarterly changes in the level of FX and in the volatility of FX have a 0.8 correlation). To focus on GFC shocks, instead of using the FX rate of the BRL against the USD, we use an index of the EMEs' currencies, excluding Brazil, against the USD.[7] Furthermore, we show that the effects of changes in the FX rate on the credit supply of banks with larger foreign debt are attenuated in the sub-period after the intervention of the BCB. Despite large fluctuations in the FX market conditions before *and also after* the BCB intervention, changes in the FX global shocks after the local FX intervention affect less credit supply or employment. Therefore, results suggest that the policy of supplying FX derivatives mitigates the spillovers of GFC on EMEs.

We further investigate the channel driving our results. Basel II regulation on market risk imposes additional charges on unmatched FX exposures, so banks have strong incentives to hedge their foreign debt by buying FX derivatives. Consistently, we find that the unmatched FX exposure is negligible, with an average bank in our Tapering sample having net FX exposure of -0.2% of its assets.[8] Since banks comply with this regulation, their net worth is not directly affected by changes in the FX rate. Yet, we show that banks hedge their FX liabilities primarily by rolling monthly forward contracts and futures despite the average maturity of their foreign debt being, on average, much longer (see also Borio, McCauley and McGuire (2017)). In normal times, large global banks and foreigners take net short FX positions satisfying hedging demand of domestic com-

[7] However, all our results are robust if we use the bilateral FX rate between Brazil and the U.S. Results also hold if we control for foreign debt interactions against a set of macroeconomic variables including, among others, monetary policy in the U.S., monetary policy in Brazil, VIX, economic activity, aggregate debt flows to the banking sector, as well as changes in capital controls and other macroprudential policies.

[8] In any case, we control for the net FX positions in all regressions (as well as for its polynomials in unreported regressions), and, when we control for it, our coefficients of interest do not change.

mercial banks. In fact, we find that before the Tapering episode, the net FX position of the foreign financial companies is on average negative. However, their net FX position is significantly positively correlated with FX rate volatility. This is consistent with these regular suppliers of hedging instruments being less willing to take large short FX positions in times of FX market turbulence, thus decreasing the availability of hedging for local institutions.[9] After the Bernanke speech there is a jump in FX rate volatility, and we show that there was hardly any (private) market participant selling hedging instruments and taking short USD positions, i.e., exposing themselves to further risks of BRL depreciation (the net position of the foreigners switched from negative to positive). Hence, our results suggest that during FX market turbulence, banks with larger shares of foreign debt are more constrained in rolling over their FX derivatives and cut credit supply. The BCB intervenes "to provide liquidity to the FX currency markets" (BCB (2014)). After the announcement banks with more FX debt were able to partially restore their credit supply and, in the following quarters, GFC shocks mattered less since the BCB guaranteed the provision of the insurance.

An objection to the hedging channel could be that the observed local credit dynamics are driven exclusively by capital flows. To shed more light on this hypothesis, we do several tests. First, we explore the register of foreign credit claims to Brazilian banks: namely, we analyze the change in foreign funding around the central bank announcement in terms of ex-ante bank characteristics. Our results show that after the FX intervention banks with more FX debt ex-ante did not experience differential inflow of foreign funding. Moreover, when we look at changes in FX hedging around the FX intervention, we do find that banks with more FX debt ex-ante significantly increase their FX hedging via instruments provided by the BCB, consistently with the hedging channel. Second, in our baseline loan-level specifications, results do not change if we exclude the maturing share of FX debt from our treatment variable. Using only the debt not maturing is equally

[9]Newspapers articles often mention an increase in the cost of hedging after episodes of depreciation/increased volatility in the FX rate for emerging markets. Here are some examples from Brazil, China and India. "Brazil Real hedging cost jumps as Latin American currencies sink" September 2016, Bloomberg. "Chinese companies that have borrowed heavily in dollars face sharply higher currency hedging costs at a time when the yuan's rising volatility means they need to hedge more" Reuters, January 2015. "Hedging cost of domestic corporate houses have increased by 1-2 percent due to the ongoing rupee volatility" Zeenews India, June 2012. A systematic empirical relation is shown by Sushko et al. (2017).

representative of hedging demand without being correlated with the effects of capital inflows.[10] Third, when we analyze the panel, we control for capital flows explicitly by including an additional double interaction of FX debt with changes in aggregate external debt flows to the banking sector, considering both price and quantity dimensions. The effects of FX rate or volatility are robust to the inclusion of these additional interactions and our main coefficients of interest remain of similar size, which reassures us that our results are not driven by these changes in capital flows. Fourth, we show that, once the hedging policy is in place, shocks in FX of similar size (as before) matter less for credit supply and employment. In other words, our results suggest the policy intervention attenuates the spillovers of GFC shocks by guaranteeing the availability (and affordability) of hedging instruments.

This strategy of acting as a *hedger of last resort*, which has been recently replicated by several countries, has some limitations. First, it works insofar as economic agents believe they can go from forwards to spot USD, i.e., convertibility risk is negligible. This has not been an issue in Brazil, because of its large international reserves. Second, the *hedger of last resort* policy, similarly to the *lender of last resort* policy, can entail fiscal and moral hazard costs. Because the BCB provides insurance against depreciation of BRL, ex-post depreciation leads to payments from the BCB to its counterparties, which affects the country's fiscal balance.[11] At year-end, the BCB paid BRL 2.3 billions to the market in 2013, BRL 10.6 billions in 2014, and BRL 102 billions in 2015 (respectively, 0.05%, 0.19% and 1.73% of GDP) but, in 2016 and 2017, a large part of these losses were offset by the appreciation of the BRL. The second type of cost is associated with moral hazard, where the policy may incentivize fragile banks to take on more risks. To explore these potential costs, we reexamine our baseline results by splitting the sample between ex-ante riskier and safer firms and find that less capitalized banks (i.e., banks more prone to moral hazard problems, see, e.g., Holmstrom and Tirole (1997)) with more FX debt also lend more to riskier borrowers after the policy intervention.

[10] Alternatively, we do not change the treatment variable but we include controls for the maturity of the FX debt, which are likely to capture the effect of the capital flows channel, and, again, our estimated coefficient of interest does not change.

[11] In public sector accounting, these payments are treated as interests paid by the Treasury on its local currency gross national debt.

Contribution to the literature

Our most important contributions to the literature are to show that FX interventions can be effective and also that they can attenuate the GFC's spillovers. Despite that central banks around the world have extensively used FX interventions, empirical evidence on their success is limited (see, e.g., Maggiori (2022), Chang (2018)). Moreover, despite that there have been several papers showing how the GFC affects EMEs, there is scant evidence on how local policies in general—and FX interventions, in particular—diminish the negative spillovers (Miranda-Agrippino and Rey (2021)).

A very recent theoretical literature has shown both under which conditions FX intervention can be effective and how it can be used optimally (see, e.g., Cavallino (2019), Amador et al. (2020), Fanelli and Straub (2020), Davis, Devereux and Yu (2020), Hassan, Mertens and Zhang (2021), Bianchi and Lorenzoni (2021)). Recently, international organizations which traditionally discouraged these type of interventions changed their policy stance. For example, the current Integrated Policy Framework of the IMF now includes FX intervention as a stabilization tool. However, the empirical evidence on the effectiveness of FX intervention remains very limited (Maggiori (2022)).[12] According to Chang (2018): "The dominant view from academia is that sterilized FX intervention has a tiny, if any, impact on real variables, which makes it virtually useless as an independent macroeconomic policy tool." The most recent evidence suggests that sterilized FX interventions in the spot market may have, at least, some effects in smoothing and stabilizing exchange rates (Blanchard, Adler and Filho (2015), Fratzscher et al. (2019)) and on the provision of credit (Hofmann, Shin and Villamizar-Villegas (2019)). In this paper, we show a potent channel of intervening in the derivative FX market. We also show with micro administrative matched datasets that this FX intervention can be successfully used as a policy tool, albeit with potential fiscal and moral hazard costs.

A substantial number of academic and policy institutions argue that the GFC affects EMEs (see, e.g., Rey (2013), Shin (2016)). Moreover, a large empirical literature on the bank lending channel shows EMEs' dependence on global financial conditions (Kalemli-Ozcan, Papaioannou and Perri (2013), Baskaya et al. (2017a), Cetorelli and Goldberg (2011), De Haas and Van Horen (2013), Cerutti, Claessens and Ratnovski (2017), Schnabl

[12] See also Obstfeld (1982), Sarno and Taylor (2001), Menhoff (2013), Taylor (2014).

(2012), Morais et al. (2019)). We corroborate these findings. However, none of these papers analyze how local unconventional policies, such as FX interventions, attenuate the spillovers of the GFC on local credit markets and on the overall economy. We instead show that interventions in FX derivatives attenuate the impact of the GFC on credit supply and the related real effects. In the model of Bruno and Shin (2015), who analyze the impact of the changes in the FX rate considering the currency mismatch of the non-financial firms, local banks do not play any significant role as they are assumed to be fully hedged. Despite being fully hedged and compliant with market risk prudential regulation, episodes of depreciation of the local currency may still be relevant for credit markets of domestic banks in local currency. As we point out in this paper, the short-term nature of the average hedging instruments used by commercial banks vis-á-vis the much longer maturities of their foreign debt is a source of vulnerability partially addressed by *hedger of last resort* policies.[13]

The paper proceeds as follows. Section 2 provides institutional details regarding the derivatives, FX interventions in Brazil and the Tapering episode. Section 3 describes the different matched datasets and the identification strategy. Section 4 discusses the results, and Section 5 concludes.

2 Derivatives, FX Interventions, and Tapering in Brazil

Due to historical restrictions to buy USD in the Brazilian spot market, the country's FX derivative markets developed more and became larger than the spot one.[14] The participants of the FX derivative markets in Brazil rely on option contracts, futures, forwards, and the on-shore dollar rate at Brazil's main exchange.[15] In addition to these instruments, the "BCB swaps" and comparable OTC forwards constitute the core of this market. All of these FX derivatives are settled in BRL.

The BRL emerges as the official Brazilian currency in 1994 as a currency peg on the

[13]Borio, McCauley and McGuire (2017) are concerned with this particular type of maturity mismatch and claim the practice of rolling short-term hedges "can generate or amplify funding and liquidity problems during times of stress."

[14]Garcia et al. (2014) show that FX price discovery takes place in the Brazilian derivatives market.

[15]The on-shore dollar rate is also traded as a contract and known as "*Cupom Cambial*."

USD. Between 1994 and 1999,[16] the BCB intervened in the derivative's market directly buying or selling futures in the stock exchange, particularly in times of instability such as in the Asian and Russian crises. After 1999, to give more transparency to its role in the derivatives markets, BCB developed its own instrument, generically called "*swaps cambiais*" in Brazil, to which we refer as "BCB swaps" in this paper.[17,18] BCB swaps are fungible and daily negotiated at the stock exchange, but only the BCB can issue the contract and call auctions at the primary market. There are no restrictions to take part on the auctions, but financial institutions tend to absorb more than 70% of the volumes at the primary market. BCB swaps are structured in such a way that the BCB pays to its counterparties the realized variation in the BRL/USD exchange rate when the BRL depreciates further against the USD, and receives analogous payments from its counterparties when the exchange rate moves in the opposite direction. In return for this swap of cash-flows, the counterparties pay to the BCB the overnight money market rate net of an on-shore dollar rate. In other words, the BCB assumes a short position in USD and, hence, incurs losses if BRL depreciates (above the difference between the two interest rates) and books gains if the BRL appreciates.[19] Notice that this type of intervention does not require sterilization since everything is settled in BRL.

The BCB interventions in the FX derivatives' market target firms and financial intermediaries that demand FX instruments for hedging, and not the market participants who use the currency for actual settlement. The former include institutions with needs of ad-

[16] In 1999, Brazil adopts an inflation targeting regime.

[17] We use the expression "BCB swaps" since this is the term used by practitioners in Brazil. As detailed by Garcia and Volpon (2014), the product is technically a domestic non-deliverable forward settled in BRL.

[18] During times of market stress, central banks can establish and rely on swap lines against each other. The Fed, in particular, created swap lines designed to improve liquidity conditions in USD funding markets and support foreign central banks. In these cases, foreign central banks withdraw USD from the New York Fed (against their currencies) and return the USD in the future at a fixed exchange rate, which alleviates pressure against their international reserves. Worth noticing, if these central banks want to transfer the U.S. liquidity to local financial institutions, they would do it at their own risk using another transaction (e.g., a repo). Fed swap lines became available to the BCB in two occasions, during the great financial crisis (in 2007) and during the Covid-19 crisis (in 2020), but the BCB did not fall short of reserves in these occasions.

[19] The BCB can also take the opposite side, auctioning "reverse swaps" and drawing dollar liquidity in the derivatives market. Similarly, reverse swaps are settled in BRL and do not change the level of international reserves, but they increase the BCB net FX position. Auctions of reverse swaps are not common but few were put forward in 2011 and 2012.

dressing their balance sheet exposures (e.g., banks that continually rollover foreign debt and related derivatives). "The Forex interventions are not meant to establish a floor for the exchange rate, but to provide the needed liquidity for the depreciation to take place without excess volatility and overshooting — which may entail unnecessary economic costs" (Garcia (2013)).

By supplying the markets with FX risk insurance, a central bank acts, effectively, as a hedger of last resort. This policy goes in parallel with its standard function of lender of last resort whereby the regulator aims at mitigating systemic risks by lending to the financial system in times of aggregate liquidity shocks. Both policies can be helpful but can entail fiscal costs for the taxpayers (particularly during crisis) and moral hazard costs by distorting incentives. In our analysis, we evaluate the policy's implications in terms of its effectiveness in protecting domestic credit markets from global financial shocks and assess its potential fiscal and moral hazard costs.

The Tapering speech, the dollar and derivatives' market.

In May 2013, after a prolonged period of unconventional monetary policy in the U.S., Ben Bernanke, the chairman of the Federal Reserve System, in his Congressional speech announced that the monetary authority was considering to taper QE in the future in light of better economic outlook. This speech immediately launched a roller-coaster effect in the U.S. and in global financial markets. In the following months, FX volatility in EMEs increased substantially, accompanied by steep local currency depreciation. In most cases, EMEs witnessed massive capital outflows. Figure A.1 in the Online Appendix illustrates the macroeconomic conditions prevailed in Brazil during the analyzed period.

The steep depreciation of the BRL and increased volatility had several implications for the derivatives' market. Before May 2013, large global banks and foreigners took net short FX positions satisfying hedging demand of domestic commercial banks. In fact, we find that the net FX position of the foreign financial companies was, on average, negative. However, the correlation between foreigners' net FX position and FX rate volatility was significantly positive (the unconditional correlation is 0.40, increasing to 0.65 when we condition for interest rates in Brazil and the U.S.).[20] This finding is consistent with

[20]Due to the availability of data on Over-The-Counter transactions, these correlations are calculated using monthly data from January 2010 to April 2013.

the regular suppliers of hedging instruments being less willing to take large short FX positions whenever FX rate volatility increased. As we show in Figure A.1, Panel C, in the months before the Tapering episode, foreign financial intermediaries and, occasionally, domestic non-financial corporations were net providers of FX derivatives, and the market's buying side was comprised of domestic financial institutions that took net long positions. This market was balanced almost entirely in the absence of BCB, and when the central bank intervened, it did so with modest volumes. However, after the jump in the FX rate volatility that followed the Tapering speech, there was hardly any market participant selling FX derivatives and taking short USD positions. The BCB started offering swaps immediately from that point, and domestic banks were the main buyers. By the end of June, the BCB also offered currency repo lines. However, uncertainty about interventions' volume and duration did not alleviate the distress in the FX markets, which forced the BCB to move from irregular injections of FX liquidity to announcing a regular program of daily auctions of BCB swaps in August (BCB (2014)).

The Intervention Program.

On August, 22, three months after the Bernanke speech, a formal program was announced where the BCB committed to daily sales of USD 500M of swaps from Monday to Thursday during the following year.[21] The volume of swaps effectively offered by the BCB after the announcement did not increase significantly (see Figure A.1, Panel C), but the announcement in itself, by resolving the uncertainty regarding the provision of FX derivatives, had strong effects. The markets welcomed this policy announcement, which led to an appreciation of BRL against USD (Chamon, Garcia and Souza (2017)).

Later in 2013, depreciation resumed and, on December 18, the BCB announced the second round of interventions. In the second round, the BCB auctioned USD 200M daily in swaps and repo auctions only by demand. The impact of this second announcement had more modest effects on the BRL (Chamon, Garcia and Souza (2017)). In December 2014, the BCB announced auctions between USD 50 to 100M. The program effectively resumed on March, 31, 2015 (BCB (2015)). In his testimony in front of the Senate on March, 24, 2015, the Governor of the BCB, Alexandre Tombini, stated "the swap program

[21] An additional USD 1MM was announced to be auction off every Friday on repo lines.

is an important instrument to smooth FX rate effects [...] it allows the private sector to navigate in safety [in moments] when the dollar spikes from [BRL] 2.85 to 3.20" (Portal Brasil (2015)). This intervention program in the FX derivatives market was the largest of its kind, reaching 7% of the Brazilian GDP in its peak. During this intervention of the BCB, all private sectors stayed net long in USD making the central bank the hedger of last resort (Figure A.1, Panel C).

How could the FX hedging policy affect the local commercial banks? Prudential regulation in Brazil imposes additional charges on large unmatched FX exposures. On-balance sheet hedging (via foreign denominated assets) is limited to few Brazilian banks with off-shore operations. Additionally, FX-denominated lending is also limited to the trade sector and comprises a rather negligible part of the total assets of the domestic commercial banks. As a result, banks hedge their foreign debt predominantly using off-balance sheet (and short-term) instruments. In particular, domestic commercial banks use mostly FX Forwards and Futures that they roll over every month. It is worth noticing the large maturity mismatch between banks' foreign debt and the derivatives they use for balance sheet hedging (see Figure A.2 in the Appendix). In April 2013, almost 70% of the derivatives held by banks were due in less than 30 days, whereas 70% of their foreign debt in more than one year. With the announcement of the swap program on August, 22, the BCB effectively promised to promote the supply of FX derivatives selling BCB swaps as much as needed. Relative to other sectors, domestic financial institutions demonstrated the most significant increase in the net FX position upon program announcement in August.

The level of international reserves is considered an indicator of economic health in EMEs, and preserving reserves deploying derivatives that settle in local currency is at the heart of this policy. The BCB had large international reserves by the time of the Taper Tantrum. Technically, the reserves represented a long FX position ensuring the country against global shocks. During the intervention, the BCB shared a fraction of this FX exposure (up to 1/3 in notional value) via swaps with the markets. When the BCB sold the swaps, it reduced its net FX position (to 2/3 of international reverses). Yet, this figure was large enough to avoid market participants' concerns about convertibility risk. To a certain extent, the intervention policy was only possible, because the high level

of reserves ensured all players that convertibility was not an issue (Garcia and Volpon (2014)).

3 Data and Identification Strategy

In this paper, we match three data sets: the credit register of corporate loans, a register of foreign debt claims against institutions domiciled in Brazil (both administered by the BCB), and the formal employment registry (from the Brazilian Ministry of Labor and Employment). We augment this data with bank balance sheet and macroeconomic variables. Our final panel sample spans all calendar quarters from 2008 until the middle of 2015.

Financial regulation in Brazil instructs every financial institution to submit comprehensive information on each credit exposure larger than BRL 5,000 (equivalent to 2,500 USD at the April 2013 exchange rate) to the Credit Registry of the BCB (*Nova Central de Risco*). These data contain detailed characteristics of the underlying credit contracts, including credit volumes (either committed or drawn), interest rates, maturity, as well as monthly information on each loan performance matched by the borrower fiscal id. We further aggregate loan-level credit exposures at firm-bank level to calculate total committed credit provided by each bank to each firm. We perform this aggregation at the bank holding company level in order to mitigate any concerns about credit supply dependence of banks within the same group. We further trace the quarterly dynamics of this exposure over the whole sample period for each bank-firm pair present in the database. For computational reasons, we sample the data from the original database by firm (i.e., we collect a random sample of firms ever recorded in the credit registry and withdraw their credit histories from all financial institutions that ever lend to these firms). Our sample covers 30% of all the firms that have credit from at least one bank in at least one quarter during the sample period.

As we focus on credit supply in local currency, we drop firm-bank observations with at least one loan indexed in currencies other than BRL. In our sample, as of the end of April 2013, less than 1% of firms have any liability indexed to a foreign currency.[22] We

[22]This refers to credit provided by financial institutions authorized and regulated by the BCB.

also exclude from the loan-level analysis non-profit organizations and financial firms, as well as loans that are not originated by commercial banks. Since we aim to control for unobservable credit demand shifts using a fixed effect estimator, we further restrict the sample to include firms with at least two bank lenders in a given quarter. These firms represent about 65% of all firms and almost 90% of total corporate credit extended by the banking sector. Importantly, we exclude from our baseline analysis credit claims of foreign banks. With the exception of two larger institutions, most foreign banks in Brazil are involved in investment banking rather than in commercial activity. As of the end of April 2013, the two largest foreign banks involved in commercial activity accounted for 13% of the corporate credit in the economy. We include only domestic commercial banks in the baseline sample, because we want to identify the impact of global financial shocks and policy intervention via banks' foreign debt (however, results do not change when we add back the two large foreign banks). We also analyze potential substitution at the firm level between different sources of credit (including foreign, investment banks, and all remaining financial institutions). Our main dependent variable is the growth rate of firm-bank credit exposures (in log terms) winsorized at 1% and 99% percentiles. For robustness, we also adopt the Davis and Haltiwanger (1992) definition of growth rate, which includes both the intensive and extensive margin.[23]

We quantify our main bank treatment variable using data on bank's foreign debt. The original data on banks' foreign debt is extracted from the BCB register of foreign claims (*Registro de Operaçôes Financeiras* (ROF)) and it comprises contract-level data on bonds and loans issued by institutions domiciled in Brazil with the corresponding claims extended by identified foreign investors. We further recast the foreign debt variable in terms of BRL using end-of-quarter exchange rates.[24] Finally, we calculate our main bank treatment variable as the ratio of all these foreign claims to total liabilities at each end of quarter.

The foreign debt variable captures the exposure of each bank in our sample to time-varying FX (or global financial) risks. Part of these FX risks (stemming from bank's for-

Only few very large firms have direct access to credit and bond market overseas.

[23]This is calculated as the net flow of credit provided by each bank to each firm over one quarter relative to the average credit over the period.

[24]More than 93% of banks' foreign debt is nominated in USD.

eign debt) may be offset using security holdings or credit claims denominated or indexed in the corresponding foreign currency, i.e., using on-balance sheet hedging. However, we find that Brazilian commercial banks have negligible FX exposures on their asset side. As a consequence, most FX risks are indeed hedged using off-balance sheet instruments, obtained in the derivatives' markets. Hence, the bank level foreign debt is a good proxy of hedging demand.

We augment our database using the following bank observables: Size (log of bank assets), Capital (bank capital to its total assets), NPL (share of non-performing loans in the total credit portfolio of a bank), the state ownership indicator, and Exposure to trade. The latter is a control for the potential effects of terms of trade on banks' balance sheets mediated via exporting and importing firms. Variations in the FX rate can change these firms' net worth and impact the bank's overall credit supply, provided that the share of loans to these firms in its total portfolio is significant. The Exposure to the trade is a time-varying bank variable calculated as the share of credit to net exporters minus the share of credit to net importers.[25] In addition, to capture compositional effects of foreign debt, we condition the estimates on the bank-level share of external debt structured as loans versus bonds (FX debt in loans) also extracted from the foreign claims' registry. Finally, we can also account for the net FX unhedged exposure (including all on and off balance sheet FX exposures normalized by total assets).[26] Banks unhedged FX exposures are subjected to capital requirements under the Basel market risk framework. Consistently, we find that net FX exposures are close to zero, with an average bank having the FX exposure of -0.2% of total assets. Furthermore, at the firm-bank level, we control for the (log of) beginning-of-period credit exposure, the share of unused (undrawn) credit line to total exposure, and a default indicator to capture bank-firm specific determinants of the credit outcomes.

We explicitly account for the maturity structure of the foreign bank debt by condi-

[25] Firm's net exports/imports are calculated for each quarter in the sample as the difference between the total exports and the total imports in the preceding twelve months. Data on exports and imports come from *Sistema Cambio*, a special register for FX spot transactions. Firms in the trade sector (as any other firm) need to fulfill *Sistema Cambio* to request FX transactions against the BCB or any FX dealer.

[26] Data extracted from *Demonstrativo de Risco de Mercado* (DRM). DRM is a regulatory form fulfilled by all financial institutions in Brazil and provides details about underlying market risk factors to the Bank Supervision of the BCB.

tioning on the share of foreign debt with remaining maturity of less than one year or larger than 5 years (FX debt < 1y and FX Debt > 5y). The inclusion of these variables in the control list alleviates concerns about the correlation of debt maturity with the level of foreign debt.

Tables A.2 in the Appendix reports the summary statistics for the Tapering shock. We have 46 banks with non-zero credit claims on firms right before the tapering shock. The average corporate loan is extended by a bank with 5% of foreign debt in its total liabilities. At the end of April 2013, 23% of this foreign debt is short-term and 56% are loans (rather than bonds issued by the bank).

Finally, we augment the data with information on firms' employment status. The latter is derived from the employer-employee dabase of the Brazilian Ministry of Labor and Employment. The original data file collects information on each job spell defined by the work start and end dates matched by employer-employee tax numbers. We then calculate the stock of the active firm-level formal labor force as of the end of each quarter between April 2013 and April 2014 and other control variables. We use the (log of) the number of employees and their average (log) wage and tenure as of the end of April 2013 as controls (Table A.2).

We analyze the supply of credit by domestic banks in Brazil with different ex-ante reliance of foreign debt. First, we analyze how banks with larger FX debt react to the QE Tapering shock (May 22, 2013). We use one quarter around the shock, i.e., the dependent variable is the credit growth at the bank-firm level between April and July of 2013. Cross-section specification in first differences eliminates time-invariant component of firm credit as well as the macroeconomic effects common to all firms and banks. Because we can introduce firm fixed effects that absorb firm-level credit demand shifts, our results suggest that the coefficient on bank foreign debt is due to banks' supply decisions (Khwaja and Mian (2008)). We provide placebo test by running the same specification in the same quarter of the Taper Tantrum but during the previous three years.

To estimate the effect of the BCB FX intervention program, we add to the regressions the following quarter of credit growth dynamics. Namely, we expand the dataset in such a way that each bank-firm pair contains two observations corresponding to (1) the quarter around the Tapering shock (April 2013–July 2013) and (2) the next quarter of the

BCB interventions (July 2013–October 2013). To trace the policy effect, we augment the explanatory variables with a dummy variable indicating the period after policy announcement (the second quarter) and with an interaction of this indicator with the bank FX debt. To allow for rather conservative inference, we calculate the standard errors under the two-way bank and industry clustering with the latter defined by the first three digits of firm's CNAE attribute.[27]

We complement loan level regressions with regressions at firm level where the dependent variable is the change in total credit. Moreover, we use the firm-employment growth rate (defined as the change of the number of employees over the average number of firm workers during the each quarter) and the change in average tenure as dependent variables to trace the real effects of changes in credit supply. In these regressions, we cannot include firm fixed effects to control for demand but we can include a proxy for it by adding the fixed effects estimates from the within-firm regressions and a set of granular industry-state fixed effects. Nevertheless, as we discuss below, in the within-firm regressions, coefficients do not change significantly across specifications with and without firm fixed effects (despite large changes in R-squared), which suggests that omitted variables (further unobservables) do not drive our results (Oster (2019)).

Next, we analyze the full panel. In particular, we analyze whether outside the Tapering shock, banks with larger foreign debt change their credit supply in reaction to global shocks, and if FX interventions by the central bank can attenuate these effects. To this end, we estimate a series of panel regressions at the firm-bank level where the dependent variable is the growth of credit and the key explanatory variable is the interaction between the lagged bank foreign debt and the lagged FX shocks.[28] The latter are the changes in the currency index of emerging market economies (EMEs) or their implied volatility. We construct these EME FX indexes as the average of 20 local currency indices.[29] To focus on the global financial shocks, we do not include the Brazilian Real in the calculation

[27]The CNAE is the classification officially used by the Brazilian Statistics National System to classify industrial sectors. It closely resembles NAICS.

[28]We use two-way bank and industry-time clustering to make inferences robust to any non-zero correlation of the observations (contemporaneous or in time) that have a common bank.

[29]Bulgarian Lev, Chilean Peso, Colombian Peso, Czech Koruna, Hungarian Forint, Indian Rupee, Indonesian Rupiah, Malaysian Ringgit, Mexican Peso, Peruvian Sol, Philippines Peso, Polish Zloty, Romanian Leu, Russian Ruble, S. African Rand, Singapore Dollar, South Korean Won, Taiwan Dollar, Thai Baht, and Turkish Lira. Data extracted from Bloomberg.

of the EMEs FX index. We calculate the quarterly index changes as the difference in the average logs of its daily values (with positive differences indicating a strengthening of USD). The changes in the EME FX implied volatility is constructed similarly. As the recent literature documented a noticeable dependence of the local credit supply on the global financial cycle, in particular, money market rates in the US, we also consider the changes in the Wu-Xia Short Shadow (Federal Funds) Rate (Wu and Xia (2016)). The panel setup allows us to control for the role of capital flows (the capital flow channel) and macroprudential policies with changes in the aggregate foreign debt of Brazilian banks, the cost of this foreign funding, and an index of macroprudential policies. The panel results also serve as a further placebo check since the panel covers quarters without significant FX shocks.

Finally, by adding a triple interaction between FX debt, changes in FX and a central bank intervention variable, we analyze whether the impact of FX shocks are attenuated when the central bank intervenes. To measure the interventions of the BCB in the derivatives markets, we use a dummy variable equal to one for the quarters following the policy announcement (2013Q3 onwards).[30] Importantly for identification, we can analyze whether the central bank intervention can attenuate the impact of FX shocks on the Brazilian economy as there are large fluctuations in the FX market conditions both before and also after the BCB intervention. Table A.1 in the Appendix reports the description of all the variables used in the paper and Table A.3 presents summary statistics of the panel data.

4 Results

4.1 The QE Tapering Shock and the FX Intervention

Table 1 reports the baseline estimates of the credit supply dependence on foreign debt around the QE Tapering shock (May 22, 2013).

[30] Alternatively, we use the ratio of the gross swaps position (notional value) of the BCB relative to its international reserves. It is worth noticing that before 2013, the BCB also issued "reverse swaps" taking the opposite position than the one explored after the Tapering shock (i.e., drawing instead of introducing dollar liquidity from the derivatives markets). The period when the BCB used this instrument can be identified by the negative figures of the variable "FX intv (cont.)" (see also Figure A.1, Panel C).

[Table 1 about here.]

All estimates in Table 1 indicate that the ex-ante dependence on foreign debt has a negative effect on credit supply in the aftermath of the tapering talk. The coefficient of the foreign debt is negative and statistically different from zero at the conventional levels. The estimated economic effect of one standard deviation of foreign debt is -2.2 p.p. of quarterly credit growth. This estimate is robust to the inclusion of firm fixed effects (column 2) which absorb approximately 60% of the variation of the dependent variable. From column 3 to column 5 we incrementally add control variables which can potentially influence credit outcomes. In column 3 we include loan-level controls (Unused credit line, Default, Bank's share in firm credit) and in column 4 we also add bank-level controls (Size, Capital, NPL, FX debt in loans, FX debt < 1y, FX debt > 5y, State owned). In column 5 we further saturate the model with two additional bank-level variables: Exposure to trade and Net FX exposure. The coefficients of Bank FX debt are statistically significant and quantitatively similar in all the specifications. The stability of the coefficients accompanied by a large increase in *R*-squared due to the inclusion of control variables suggests that omitted variable and self-selection problems do not drive our results (Oster (2019), Altonji, Elder and Taber (2005)). In column 6, we report Weighted Least Squares estimates of the model of column 5 to give more weight to larger firms. We use as weights the size of firm employment. Finally, in Column 7 we show that this result is robust to changing the definition of the credit growth to include both the intensive and the extensive margin. Moreover, we run placebo tests and find that this result is not present before the Tapering episode. Specifically, we reproduce column 5 of Table 1 changing the time period: we analyse the same quarter of the Taper Tantrum but during the previous years (2012, 2011 and 2010). In this placebo exercise, the coefficient of Bank FX Debt is not significant either economically or statistically (Table A.6).[31]

While the baseline results suggest that the banks' ex-ante dependence on foreign

[31] Regarding additional variables we notice that firms with larger unused credit lines demonstrate higher credit growth rates, while firms that were in default or more indebted ex-ante demonstrated lower credit growth. Banks with foreign debt structured mostly under loan agreements (rather than bonds) have a lower contraction of their credit supply. Shorter maturities of foreign debt, on the contrary, affect bank credit supply negatively. The variables Exposure to trade and Net FX exposure have the expected positive signs.

debt had a negative effect on the credit supply, a firm could offset part of this shock by replacing the more affected banks by another (less or unaffected) lender. To check whether indeed it was the case, we run firm-level regressions with the growth rate of firm total credit as a dependent variable. The corresponding estimates are reported in Table A.7 in the Appendix, where the left panel (from columns 1 to 4) presents estimates for the total credit growth of banks included in the sample, while the right one (from column 5 to 8) reports the analogous set of regressions with total credit including also the one provided by all financial intermediaries — local or foreign, commercial or investment — and non-bank financial institutions as the dependent variable. All bank and loan-level explanatory variables are calculated as weighted averages of the ex-ante bank-firm credit exposure. In each panel we start by including Bank FX debt without additional variables, then in column 2 we add industry-state fixed effects, in column 3 we add the all series of firm and bank controls as in Table 1 (including also some firm level controls such as log of Total credit, log of Total employment, average log of Wage, and average log of Tenure) plus a proxy for firm demand (the firm fixed effects obtained in the previous bank-firm level regressions), and finally in column 4 we report WLS estimates. We calculate the standard errors under two-way clustering, allowing for potentially non-zero error correlation if the firms belong to the same industry or have the same main creditor.

The estimates suggest that the credit supply shift was only partially offset: the estimated coefficient of Bank FX debt is negative and statistically significant in all specifications. A one standard deviation increase in (weighted) bank reliance on foreign debt corresponds to 1.8 p.p. lower quarterly growth rates of credit. Furthermore, resorting to unaffected or less affected banks do not insulate firms from the shock. The estimates reported in the right panel are smaller but still statistically and economically significant. This observation also suggests that neither foreign banks nor non-bank lenders were able to offset the credit supply decrease of the domestic banks.

To trace the effect of the FX hedging policy, we add to the regressions the following quarter of credit growth dynamics and we augment the explanatory variables with a dummy variable indicating the period after policy announcement (the second quarter) and with an interaction of this indicator with bank foreign debt.[32] The interaction shows

[32]The coefficients of the variable *Bank FX Debt* are exactly the same as in Table 1 since they

whether the loan growth dynamics of the exposed banks changed significantly after the BCB policy was announced. We fix all other explanatory variables at their ex-ante levels. Table 2 reports the regression results. The first column does not include any controls, the second includes firm-time fixed effects to address potential demand shifts, the third includes a long list of loan and bank level controls, and the fourth reports WLS estimates.

According to these estimates, the FX interventions had a positive effect on the credit supply. Before the policy announcement, banks with high levels of foreign debt supply less credit in comparison to the less or non-exposed banks. In the first quarter following the policy announcement, this difference is partially mitigated, i.e., more exposed banks increase credit supply. In particular, in the first post-policy quarter, the credit supply sensitivity to foreign debt is estimated to be half as the one of the post-tapering quarter. In other words, the BCB policy reduced the credit growth differential across differently exposed banks, although, it was not able to completely offset the original shock.

[Table 2 about here.]

The right panel of Table 2 reports the results of a similar exercise but with three-quarters of credit growth observations encoded in the "post-policy" period. Quantitatively and statistically, the estimates are akin to the ones discussed above. The results suggest that the effect of the BCB intervention is persistent.

Table 3 presents firm level evidence on total credit in the context of policy evaluation. We concentrate on the period spanning the quarter of Tapering speech and the three quarters following the FX intervention program. The estimates of the credit supply sensitivity to foreign debt during the period immediately after the U.S. monetary tightening shock are close to the ones obtained in Table A.7. Also at the firm level, we find a positive effect of the FX interventions, suggesting that the policy is binding for firms (columns 1–2). This is true also if we consider the total credit including also other lenders not in our sample (columns 3–4). In Table A.8 we show that results do not change if we include additional interactions between the post-policy dummy and the only bank observables which are correlated with Bank FX debt in a bank cross-section regression: Size, State-owned indicator and Exposure to trade (see Table A.4, column 1).

represent the impact of having a larger foreign debt exposure when the dummy variable Post is equal to 0 (that is, around the QE Tapering shock).

To quantify the transmission to the labor market, we run a set of similar firm-level cross-section regressions but instead of having total credit growth as a dependent variable, we analyze the employment growth rates (columns 5–6 of Table 3). We show that firms which observe a lower credit growth due to their ex-ante exposure to banks with larger foreign debt also experience lower labor force growth (-0.4 p.p.) after the Tapering shock but this effect is halved after the BCB intervention. Finally, in columns 7–8 of Table 3 we have as a dependent variable the change in the average tenure of the employees of the firm. We find that average tenure increases for firms more exposed to banks with large FX debt after Taper Tantrum but it goes down after the intervention. This result suggests that the margin of adjustment is on less tenured workers.

[Table 3 about here.]

The results we described above are consistent with the hedging channel. However one could be concerned that what we observe is just related to capital inflows and outflows. To alleviate this concern, we explore the register of foreign credit claims to Brazilian banks: namely, we analyze the change in foreign funding around the central bank announcement in terms of ex-ante bank characteristics. At bank level, we show that banks with more or less FX debt ex-ante do not experience a different change in foreign funding around FX intervention (columns 2 and 3 of Table A.4). Moreover, we do find that banks with more FX debt ex-ante significantly increase their FX hedging via instruments provided by the BCB (columns 4 and 5 of Table A.4). Second, in our baseline loan-level specifications, results do not change if we exclude the share of FX debt maturing in the quarter following the Taper Tantrum from our treatment variable (Table A.5). Using only the debt not maturing may be equally representative of hedging demand without being correlated with the effects of capital inflows. Moreover, we control for capital flows directly in the next section using the panel setup.

4.2 Full Panel Data Analysis

In this section, we present the analysis of a full panel between 2008 and 2015, and we ask whether, outside the two specific episodes of May and August 2013, it is true that on

average, banks with larger foreign debt change their credit supply in reaction to global shocks (shocks in the FX rate), and if FX interventions can attenuate these effects.

Namely, we run a series of panel regressions with quarterly data where the dependent variable is the growth of credit (at the firm-bank level) and the key independent regressor is the interaction between the lagged bank foreign debt and the lagged changes in the currency index of emerging market economies (EMEs) or its implied volatility.

To attribute our results to the FX shocks, we introduce additional interactions between the bank foreign debt and several other explanatory variables. Recent literature documents a noticeable dependence between credit supply and the GFC and, in particular, to the Fed funds rates and the Fed balance sheet expansion in the U.S. (e.g. Morais et al. (2019)). We interact Wu-Xia Short Shadow Federal Funds rate with banks' foreign debt to capture this latter effect. Since the correlation between quarterly changes in U.S. monetary policy and quarterly changes in FX conditions in EMEs is not very high, we are able to estimate the effects of the two.[33]

Table 4 reports the baseline results for the panel data specifications. Column 1 indicates that the EME's FX rate is an important stand-alone factor for the credit supply of the domestic banks that rely on foreign debt. Column 2 shows that this result is robust to the inclusion of the U.S. monetary policy interacted with the banks' foreign debt. As expected, tighter monetary policy in the U.S. has a negative effect on the domestic banks which borrow more in Dollars. For a bank with the average level of foreign debt, a 25 b.p. increase in the U.S. shadow rate is equivalent to a 1 p.p. decrease in credit supply growth (in annualized terms).

[Table 4 about here.]

The baseline results demonstrate that global financial shocks are relevant determinants of the local credit supply. The strengthening of the USD against the EMEs' currencies has economically and statistically important negative effects on the credit supply.

[33] Since EME's currency devaluation can have a significant effect on firm's credit demand, we use firm-time fixed effects to identify changes in credit supply. Analogously to the previous analysis, we include the same list of additional time-varying lagged bank and firm-bank controls to account for other drivers of credit outcomes and capture potential confounding factors, as well as to boost the efficiency of the fixed effect estimator.

A positive shock in the FX index of one standard deviation accounts for a drop in the subsequent local credit growth rates of approximately 2.1 p.p. (in annualized terms) for a domestic bank with the average level of foreign debt. The effect is more than twice as high when estimated conditionally on other macroeconomic variables interacted with bank foreign debt dependence (column 3). In column 4 we control explicitly for capital flows. We include additional double interactions between FX debt and lagged changes in the (log of) foreign debt of Brazilian banks and lagged changes in the cost of these flows (calculated as the ratio of interest payments over aggregate foreign debt of the banking sector). The effects of FX rate are robust to the inclusion of these additional interactions which, again, reassures us that our results are not driven solely by changes in capital flows. The results do not change if instead we use aggregate external debt flows to the whole economy. This is additional evidence in favour of the hedging channel since banks with more FX debt react negatively to an FX shock also when we keep capital inflows constant.

In columns 5–8, we report similar specifications but instead of using the change in the level of FX we use the change in the implied volatility of EMEs currencies. Rising uncertainty typically accompanies local currency depreciation (quarterly changes in the level of FX and in the volatility of FX have a 0.8 correlation) and this can affect investors hedging costs. We find that, following positive shocks to the FX volatility, the growth rates of credit provided by the banks with higher foreign debt are lower than those of the non-exposed banks. After a one standard deviation shock to the FX volatility index, a bank with an average level of foreign debt contracts credit growth by an additional annualized 2 p.p. relatively to the same firm-time. The economic effect is twice as high in the specification controlling for other local and global macroeconomic conditions (column 7).[34]

[34]We implement a set of robustness checks and report the results in Table A.9. To make sure that all our results do not stem from the two large episodes of depreciation and appreciation of the previous analysis (QE Tapering and FX Intervention), we rerun the baseline regression omitting the second and the third quarters of 2013 (columns 1 and 2). We also check whether our results survive to the inclusion of the interaction between bank foreign debt and lagged quarterly changes in the index of macroprudential policies built by Pereira da Silva and Harris (2012) (columns 3 and 4). Since this index covers multiple and heterogeneous macroprudential tools we also construct, in the same spirit of Pereira da Silva and Harris (2012), an index which refers only to capital controls regulation (columns 5 and 6). Results show that including interactions with FX debt and

Finally, we explore the effects of BCB interventions in the panel setup. Since there are large fluctuations in the FX market conditions before and also after the BCB intervention, we can assess whether the negative impact of the changes in FX are attenuated when the central bank intervenes. To do this, we introduce a triple interaction between FX debt, changes in FX and a dummy variable equal to one for the quarters following the policy announcement (2013Q3 onwards). The estimates reported in the first 4 columns of Table 5 show that the coefficient on the triple interaction of bank foreign debt, FX rate (level in columns 1 and 2 and volatility in columns 3 and 4), and FX interventions is positive and statistically significant. The result suggests that, after the intervention, changes in FX matter less for the local credit cycle in Brazil. In columns 5–8 we show that we obtain similar results if we interact FX debt and FX rate with the level of the central bank intervention in the derivative market. The latter is measured as the ratio of the Bank swap notional amounts relative to its international reserves and it ranges up to 30% by the end of our sample. In 2011 and 2012, the BCB used the "reverse swap" instrument to mitigate the excess appreciation of BRL, although at a much smaller scale in comparison to the intervention in 2013. Hence, the policy variable defined in this way have also negative values. A higher and positive level of the BCB interventions indicates its increasing role as a hedger of last resort.

[Table 5 about here.]

Symmetrically to what we have done in the previous analysis, also in the panel setup we analyze whether the results that we find at the bank-firm level translate into aggregate results at the firm level. In Table A.10 we report estimates from firm level regressions where the dependent variable is the growth rate of firm total credit in column 1 and 2 and change in growth rate of employment in columns 3 and 4. We include industry-quarter and firm fixed effects in addition to a series of firm and bank characteristics. We find that firms borrowing from banks with larger FX debt experience a reduction in total credit

lagged changes in macroprudential regulation (or capital controls regulation, specifically) does not significantly change our main estimates. Furthermore, we include additional interactions of FX shocks with those bank variables which are correlated with FX debt (i.e., Size, State ownership indicator and Exposure to trade) (columns 7 and 8). None of these estimates change the baseline results significantly.

after an FX shock (lagged quarterly changes in the level or volatility of FX), and these effects are attenuated after the intervention of the central bank. This result indicates that firms can not easily replace the changes in credit supply by affected banks by borrowing more from unaffected lenders. Furthermore, these changes in total credit translate into real effects since we show that employment at the firm level follows a similar pattern: the double interaction between bank FX debt and changes in FX is negative and significant, while the triple interaction between bank FX debt, FX shocks and BCB intervention is positive and statistically significant. In columns 5–8 we replicate results using the continuous version of the BCB intervention variable, finding similar results.

The above results suggests, that after the FX intervention of the BCB, global financial shocks matter less for credit and employment outcomes. In other words, the *hedger of last resort* policy has been effective in decreasing local economy exposure to global financial conditions.

4.3 The Limitations of the Policy

The empirical evidence in the paper shows that the *hedger of last resort* policy is able to attenuate the spillovers of the GFC, but what are the limitations of this policy? First, the central bank's credibility is likely to depend on the level of its international reserves, although it does not employ them in its interventions directly. Thus, the policy works insofar as economic agents believe they can go from forwards to spot USD, i.e., convertibility risk is negligible. This has not been an issue in Brazil, because of its large international reserves. Second, the *hedger of last resort* policy, similarly to the *lender of last resort* policy, can entail fiscal and moral hazard costs.

This policy affects the fiscal balance of the country. USD appreciation creates mark-to-market gains to the BCB international reserves. Similarly, USD depreciation leads to losses to the BCB balance sheet in BRL. On the other hand, the BCB's incurs losses from its derivatives' portfolio in the first case, and gains in the second. Thus, the notional amounts committed in BCB swaps directly reduce FX exposure from its international reserves. BCB's payments to its swap counterparties are treated as government interest rate payments, worsening the country's fiscal balance in times of global distress. At year-end, the BCB pays BRL 2.3 billion (0.05% of GDP) to the market in 2013, BRL

10.6 billion (0.19% of GDP) in 2014, and BRL 102 billion (1.73% of GDP) in 2015. In 2015 the BCB has its largest position in swaps (and its lower "net FX position"), which is mostly rolled and decreases slowly in the following years as contracts expire. In the two following years, when the BRL mostly appreciates, cash transfers from the stock exchange to the BCB worth BRL 83.8 billion (1.34% of GDP) in 2016 and 6.3 billion (0.1% of GDP) in 2017 offset part of the related fiscal costs from the previous years. While in the long run, the intervention policy is likely to result in a net zero effect on the fiscal balance, it reduces the fiscal space in economic downturns associated with local currency depreciation.

The second type of costs is associated with moral hazard, where the policy may incentivize more risky behaviour, particularly among more fragile banks. To explore this possibility in Table 6 we reexamine the baseline results of the paper adding an interaction with bank capital and splitting the sample between ex-ante riskier and safer firms. We use bank capital since this is an established measure for the intensity of the agency conflict that besets banks' own borrowing from their financiers (Holmstrom and Tirole (1997), Freixas and Rochet (2008)). In column 1 we include the triple interaction between Bank FX debt, dummy for intervention and bank capital: we find that the expansion of credit supply by banks with more FX debt after the intervention is stronger for low capital banks. In columns 2–3 we split the sample between firms with low and high ex-ante interest rate and in columns 4–5 between large and small firms. We consider high interest rate and small size as proxies of firm risk. Consistently with the moral hazard hypothesis, we find that the expansion of credit supply following the intervention by more fragile and affected banks is stronger in the sample of high interest rate and smaller size firms after the policy.

[Table 6 about here.]

5 Conclusions

We show that FX interventions are effective and attenuate Global Financial Cycle's spillovers. Central banks may intervene either in the spot markets or in the derivatives' markets. We focus on the latter case in Brazil, where a large intervention program with daily

auctions was announced on August, 2013. Other central banks in EMEs adopted similar programs in the following years, e.g., Mexico in February 2017, Turkey in November 2017, Chile in 2019 and other countries during the Covid-19 pandemic (IMF (2020)). This *hedger of last resort* type of intervention allows local commercial banks (in demand for hedging) to adjust to the new macroeconomic conditions less costly by transferring part of these FX risks to the balance sheet of the local central bank (hedging channel).

We explore three matched administrative registers: credit, foreign credit flows to banks, and employer-employee. We find that, after the US Federal Reserve Taper Tantrum (with strong EME FX depreciation and volatility increase), Brazilian banks with larger ex-ante reliance on foreign debt strongly cut credit supply, thereby reducing firm-level employment. The subsequent announcement by the BCB of an intervention program consisting of supplying FX derivatives against FX risks—*hedger of last resort*—is able to reduce by half the negative effects. A 2008-2015 panel exploiting GFC shocks and FX interventions confirms these results. However, this policy entails both fiscal and moral hazard costs.

Our most important contributions to the literature is to show that FX interventions can be effective and also that they can attenuate the GFC's spillovers. Despite that central banks around the world have used significantly FX interventions, empirical evidence on their success is limited (see, e.g., Maggiori (2022)). Moreover, despite that there have been several papers showing how the GFC affects EMEs, there is scant evidence on how local policies in general—and FX interventions, in particular—diminish the negative spillovers (Miranda-Agrippino and Rey (2021)).

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Table 1: QE tapering: credit supply, firm-bank level

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Bank FX debt	−1.06***	−0.92***	−1.07***	−0.77***	−0.89***	−0.83***	−1.20***
	(0.26)	(0.20)	(0.19)	(0.22)	(0.24)	(0.27)	(0.41)
Loan-level controls:							
Unused credit line			0.16***	0.14***	0.13***	0.13***	−0.43***
			(0.01)	(0.01)	(0.01)	(0.01)	(0.02)
Default			−0.05***	−0.04***	−0.04***	−0.04***	−0.24***
			(0.01)	(0.01)	(0.01)	(0.01)	(0.02)
Bank share in firm credit			−0.03	−0.08***	−0.08***	−0.07***	−0.54***
			(0.02)	(0.02)	(0.02)	(0.02)	(0.04)
Bank-level controls:							
Size				0.03***	0.02***	0.02***	0.05***
				(0.00)	(0.00)	(0.00)	(0.01)
Capital				0.49**	0.46***	0.49***	1.33***
				(0.18)	(0.11)	(0.13)	(0.36)
NPL				0.13	−0.08	−0.17	−1.21***
				(0.17)	(0.10)	(0.12)	(0.26)
FX debt in loans				0.04***	0.08***	0.06***	0.15***
				(0.01)	(0.01)	(0.02)	(0.02)
State owned				0.03	0.00	0.01	0.03
				(0.02)	(0.02)	(0.02)	(0.04)
Exposure to trade				0.16**	0.17***	0.16**	0.15
				(0.08)	(0.06)	(0.06)	(0.14)
Net FX exposure				3.54**	1.16	1.46	3.17
				(1.44)	(1.00)	(1.16)	(3.10)
FX debt < 1y					−0.17***	−0.16***	−0.50***
					(0.03)	(0.04)	(0.07)
FX debt > 5y					0.03	0.02	−0.01
					(0.03)	(0.03)	(0.05)
Firm FE	no	yes	yes	yes	yes	yes	yes
WLS	no	no	no	no	no	yes	no
R^2	0.01	0.41	0.42	0.43	0.43	0.41	0.43
# observations	114182	114182	114182	114182	114182	114182	131077
# firms	46297	46297	46297	46297	46297	46297	51361
# banks	46	46	46	46	46	46	47
# industries	73	73	73	73	73	73	73

The table reports estimates of the equation

$$\Delta\text{Credit}_{f,b} = \beta_1 \text{Bank FX debt}_b + \gamma X_{f,b} + \theta_f + e_{f,b},$$

where $\Delta\text{Credit}_{f,b}$ is log growth rate of credit provided to firm f by bank b, over one quarter after Tapering Speech (end of April'13–end of July'13), Bank FX Debt$_b$ is bank's ex-ante share of foreign debt in its total liabilities, θ_f is firm fixed effect, and $X_{f,b}$ is a set of controls; all explanatory variables are measured as of the end of April'13. In column 7, credit growth rate is calculated as the net flow of credit provided by each bank to each firm during the quarter relative to the average credit over the period. Constant in column 1 is omitted. Weights in column 6 are proportional to (log of) firm employment. Standard errors (in parenthesis) are calculated under two-way clustering by bank and firm industry ($^{*}p < 0.1, ^{**}p < 0.05, ^{***}p < 0.01$).

Table 2: QE tapering vs. FX interventions: credit supply, firm-bank level

	+1 policy quarter				+3 policy quarters			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Bank FX debt	−1.06***	−0.92***	−1.14***	−1.13***	−1.06***	−0.92***	−1.18***	−1.19***
	(0.26)	(0.20)	(0.23)	(0.26)	(0.26)	(0.20)	(0.20)	(0.24)
FX intv (0/1) × Bank FX debt	0.48**	0.42***	0.44***	0.40**	0.57***	0.51***	0.52***	0.47***
	(0.22)	(0.16)	(0.16)	(0.18)	(0.16)	(0.11)	(0.12)	(0.14)
FX intv (0/1)	−0.03**				−0.04***			
	(0.01)				(0.01)			
Firm × Time FE	no	yes	yes	yes	no	yes	yes	yes
Controls	no	no	yes	yes	no	no	yes	yes
WLS	no	no	no	yes	no	no	no	yes
R^2	0.01	0.41	0.43	0.41	0.01	0.41	0.43	0.41
# observations	229327	229327	229327	229327	462677	462677	462677	462677
# firms	49907	49907	49907	49907	56002	56002	56002	56002
# banks	46	46	46	46	46	46	46	46
# industries	73	73	73	73	73	73	73	73

The table reports estimates of the equation

$$\Delta\text{Credit}_{f,b,t} = \beta_1 \text{Bank FX Debt}_b + \beta_2 \text{Bank FX Debt}_b \times \text{FX intv}(0/1)_t + \gamma X_{f,b} + \theta_{f,t} + e_{f,b,t},$$

where $\Delta\text{Credit}_{f,b,t}$ is quarterly log growth rate of credit provided to firm f by bank b, Bank FX Debt_b is bank's ex-ante share of foreign debt in its total liabilities, $\theta_{f,t}$ is firm-quarter fixed effect, and $X_{f,b}$ is a set of controls. FX intv_t is equal to one for periods t of active BCB FX intervention program, and zero otherwise. The left panel spans the period of end of April'13–end of October'13 (2 quarters with 1 quarter of the post-policy period). The left panel spans the period of end of April'13–end of April'14 (4 quarters with 3 quarters of the post-policy period). Constant in column 1 is omitted. Controls include the following variables: Unused credit line, Default, Share in firm credit, Size, Capital, NPL, FX debt in loans, FX debt < 1 year, FX debt > 5 years, State owned, Exposure to trade, Net FX exposure All explanatory variables are measured as of the end of April'13. Weights in columns 4 and 8 are proportional to (log of) firm employment. Standard errors (in parenthesis) are calculated under two-way clustering by bank and firm industry ($^{*}p < 0.1, ^{**}p < 0.05, ^{***}p < 0.01$).

Table 3: QE tapering vs. FX interventions: firm level evidence

	Δ Credit		Δ Total credit		Δ Employment		Δ Tenure	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Bank FX debt	−1.11***	−1.17***	−0.80***	−0.83***	−0.11*	−0.20***	0.23**	0.25**
	(0.20)	(0.19)	(0.22)	(0.21)	(0.07)	(0.07)	(0.12)	(0.11)
FX intv (0/1) × Bank FX debt	0.78***	0.77***	0.67***	0.65***	0.10*	0.11**	−0.13*	−0.14*
	(0.07)	(0.08)	(0.10)	(0.10)	(0.05)	(0.05)	(0.08)	(0.08)
Proxy for credit demand	0.90***	0.90***	0.77***	0.75***	0.02***	0.02***	−0.02***	−0.02***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.00)	(0.00)	(0.00)	(0.00)
Industry × State × Time FE	yes	yes	yes	yes	yes	yes	yes	yes
Controls	yes	yes	yes	yes	yes	yes	yes	yes
WLS	no	yes	no	yes	no	yes	no	yes
R^2	0.80	0.79	0.67	0.66	0.13	0.15	0.14	0.15
# observations	180679	180679	180679	180679	180679	180679	180679	180679
# firms	53994	53994	53994	53994	53994	53994	53994	53994
# main banks	45	45	45	45	45	45	45	45
# industries	73	73	73	73	73	73	73	73

The table reports estimates of the equation

$$\Delta Y_{f,t} = \beta_1 \text{Bank FX Debt}_f + \beta_2 \text{Bank FX Debt}_f \times \text{FX intv}(0/1)_t + \gamma X_f + \theta_{i,t} + e_{f,t},$$

where $\Delta Y_{f,t}$ is either log growth rate of total credit of a firm f (from all banks in the sample (left panel) or from all credit institutions (right panel)), Bank FX Debt$_f$ is a weighted average of firm lenders' ex-ante share of foreign debt in their total liabilities, $\theta_{i,t}$ is industry-state-time fixed effect, and X_f is a set of controls. Constant in column 1 is omitted. Controls include the following variables: Unused credit line, Default, Size, Capital, NPL, FX debt in loans, FX debt < 1 year, FX debt > 5 years, State owned, Exposure to trade, Net FX exposure (bank-firm and bank level variables are aggregated to the firm level by taking the weighted average of the corresponding values with weights proportional to the bank's share in firm total ex-ante credit liabilities), log of Total credit, log of Total employment, average log of Wage, and average log of Tenure. All explanatory variables are measured as of the end of April'13. Proxy for credit demand refers to estimated firm fixed effect from firm-bank regression. Weights in columns 2, 4, 6, and 8 are proportional to (log of) firm employment. Standard errors (in parenthesis) are calculated under two-way clustering by main bank and firm industry ($^{*}p < 0.1, ^{**}p < 0.05, ^{***}p < 0.01$).

Table 4: GFC shocks, full panel

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Bank FX debt × Δ EME FX index	−3.34***	−3.34***	−8.50***	−3.73***				
	(1.11)	(0.90)	(2.57)	(0.94)				
Bank FX debt × Δ EME FX iVol					−0.36*	−0.70***	−1.89***	−0.71***
					(0.18)	(0.16)	(0.58)	(0.18)
Bank FX debt × Δ US shadow rate		−0.27***	−0.05	−0.24***		−0.38***	−0.37***	−0.37***
		(0.07)	(0.11)	(0.06)		(0.08)	(0.08)	(0.07)
Bank FX debt × Capital flows (quantity)				−0.37				−0.01
				(0.40)				(0.43)
Bank FX debt × Capital flows (price)				0.06				0.05
				(0.08)				(0.08)
Firm × quarter FE	yes	yes	yes	yes	yes	yes	yes	yes
Controls	yes	yes	yes	yes	yes	yes	yes	yes
Macro interactions	no	no	yes	no	no	no	yes	no
R^2	0.43	0.43	0.43	0.43	0.43	0.43	0.43	0.43

The table reports estimates of the equation

$$\Delta\text{Credit}_{f,b,t} = \beta_1 \text{Bank FX Debt}_{b,t-1} + \beta_2 \text{Bank FX Debt}_{b,t-1} \times \Delta\text{EME FX}_{t-1} + \gamma X_{f,b,t-1} + \theta_{f,t} + e_{f,b,t},$$

where $\Delta\text{Credit}_{f,b,t}$ is quarterly log growth rate of credit provided to firm f by bank b, Bank FX $\text{Debt}_{b,t}$ is bank's share of foreign debt in its total liabilities, $\theta_{f,t}$ is firm-quarter fixed effect, and $X_{f,b,t}$ is a list of controls. The sample period is 2008Q1–2015Q2. In all columns, the estimates are conditioned on lagged bank- and loan-level control variables (Capital, Size, NPL, FX debt in loans, FX debt < 1y, FX debt > 5y, State owned, Exposure to trade, Net FX exposure, Bank share in firm credit, Default indicator, and Unused credit line). Capital flows (quantity) stands for change in (log of) end-of-quarter levels of aggregate external debt of the banking sector in Brazil. Capital flows (price) stands for change in interest payments on external debt to be paid during the following year normalized by the end-of-quarter levels of aggregate external debt of the banking sector in Brazil. Additional macroeconomic variables interacted with Bank FX debt in columns 3 and 7 include: changes in BRA money market rate, Inflation, IBC BR, and VIX. Standard errors (in parenthesis) are calculated under two-way clustering by bank and quarter-industry ($^{*}p < 0.1, ^{**}p < 0.05, ^{***}p < 0.01$).
observations: 3900653, # firms: 132754, # banks: 68, # industry-quarters: 7351

Table 5: GFC shocks and FX Interventions, full panel

	BCB FX intv: (0/1) indicator				BCB FX intv: continuous			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Bank FX debt × Δ EME FX index	−9.81***	−11.22***			−11.06***	−12.22***		
	(3.01)	(3.62)			(3.33)	(3.98)		
Bank FX debt × Δ EME FX index × BCB FX intv	4.07**	4.34**			23.35***	22.40***		
	(1.92)	(1.83)			(7.26)	(6.99)		
Bank FX debt × Δ EME FX iVol			−2.21***	−3.18***			−2.50***	−3.49***
			(0.67)	(1.03)			(0.73)	(1.07)
Bank FX debt × Δ EME FX iVol × BCB FX intv			1.19***	1.70***			7.55***	9.51***
			(0.44)	(0.59)			(2.21)	(2.64)
Firm × quarter FE	yes	yes	yes	yes	yes	yes	yes	yes
Controls	yes	yes	yes	yes	yes	yes	yes	yes
Macro interactions	yes	yes	yes	yes	yes	yes	yes	yes
Interactions with capital flows	no	yes	no	yes	no	yes	no	yes
R^2	0.43	0.43	0.43	0.43	0.43	0.43	0.43	0.43

The table reports estimates of the equation

$$\begin{aligned}\Delta\text{Credit}_{f,b,t} = {} & \beta_1 \text{Bank FX Debt}_{b,t-1} + \beta_2 \text{Bank FX Debt}_{b,t-1} \times \Delta\text{EME FX}_{t-1} + \beta_3 \text{Bank FX Debt}_{b,t-1} \times \text{FX intv}_{t-1} \\ & + \beta_4 \text{Bank FX Debt}_{b,t-1} \times \Delta\text{EME FX}_{t-1} \times \text{FX intv}_{t-1} + \gamma X_{f,b,t-1} + \theta_{f,t} + e_{f,b,t},\end{aligned}$$

where $\Delta\text{Credit}_{f,b,t}$ is quarterly log growth rate of credit provided to firm f by bank b, $\text{Bank FX Debt}_{b,t}$ is bank's share of foreign debt in its total liabilities, $\theta_{f,t}$ is firm-quarter fixed effect, and $X_{f,b,t}$ is a list of controls. The sample period is 2008Q1–2015Q2. In all columns, the estimates are conditioned on the interaction of lagged Bank FX debt and changes in the U.S. shadow rate, as well as on lagged bank- and loan-level control variables (Capital, Size, NPL, FX debt in loans, FX debt < 1y, FX debt > 5y, State owned, Exposure to trade, Net FX exposure, Bank share in firm credit, Default indicator, and Unused credit line). Additional macroeconomic variables interacted with Bank FX debt include: changes in BRA money market rate, Inflation, IBC BR, and VIX. In columns 2, 4, 6, and 8, Bank FX debt is additionally interacted with Capital flows (quantity) and Capital flows (price). Standard errors (in parenthesis) are calculated under two-way clustering by bank and quarter-industry ($^{*}p < 0.1, ^{**}p < 0.05, ^{***}p < 0.01$).
observations: 3900653, # firms: 132754, # banks: 68, # industry-quarters: 7351

Table 6: QE tapering vs. FX interventions: risk taking

	All firms	Interest rate		Firm size	
		Low	High	Large	Small
	(1)	(2)	(3)	(4)	(5)
Bank FX debt × FX intv (0/1)	0.32***	0.26**	0.30**	0.41***	0.03
	(0.10)	(0.11)	(0.13)	(0.11)	(0.13)
Bank FX debt × Capital × FX intv (0/1)	−9.71***	−3.31	−16.18***	−6.52*	−16.72***
	(3.01)	(2.04)	(3.65)	(3.30)	(2.49)
Capital × FX intv (0/1)	0.03	−0.04	0.12	0.03	0.17
	(0.08)	(0.08)	(0.12)	(0.10)	(0.12)
Firm × Time FE	yes	yes	yes	yes	yes
Bank FE	yes	yes	yes	yes	yes
Controls	yes	yes	yes	yes	yes
R^2	0.43	0.43	0.43	0.41	0.46
# observations	229327	113746	115580	129242	100080
# firms	49907	24584	25323	27044	24493
# banks	46	46	43	46	37
# industries	73	72	72	73	69

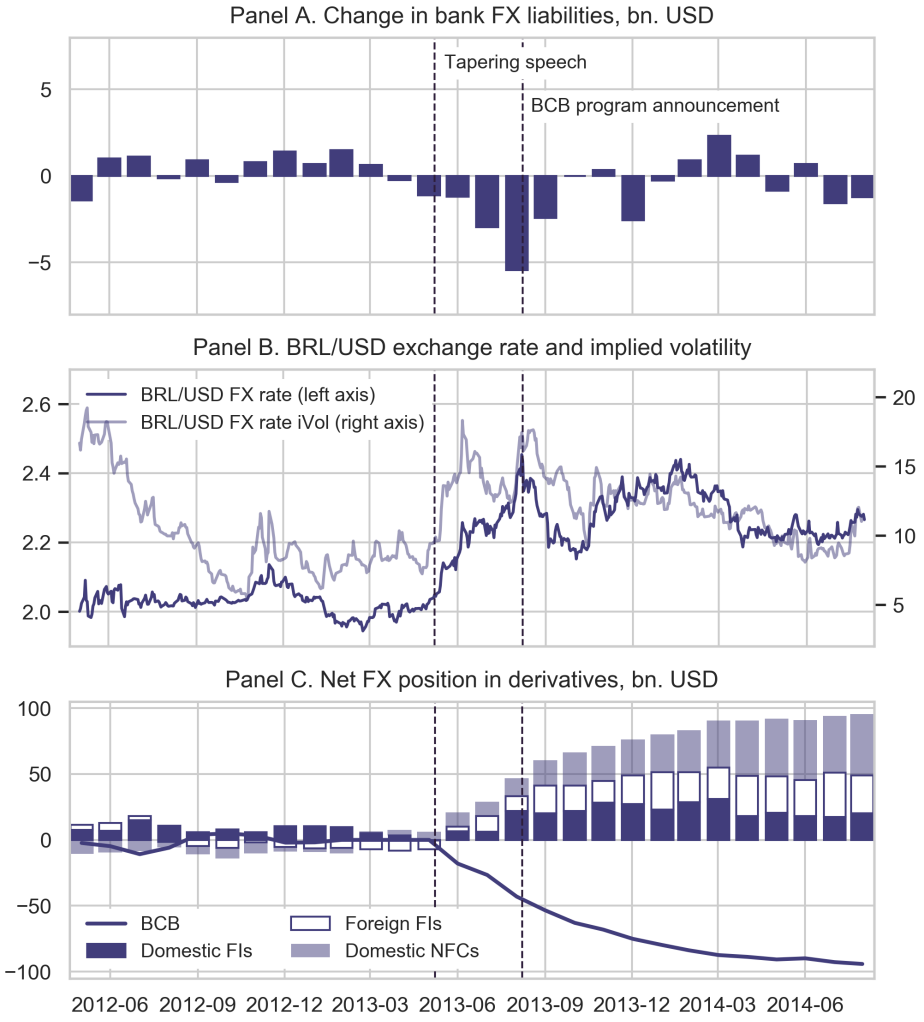
The table reports estimates of versions of the equation

$$\begin{aligned}\Delta\text{Credit}_{f,b,t} = {} & \beta_1 \text{Bank FX Debt}_b + \beta_2 \text{Bank FX Debt}_b \times \text{FX intv}(0/1)_t \\ & + \beta_3 \text{Bank FX Debt}_b \times \text{Capital}_b + \beta_4 \text{Bank FX Debt}_b \times \text{Capital}_b \times \text{FX intv}(0/1)_t \\ & + \beta_5 \text{Capital}_b + \beta_6 \text{Capital}_b \times \text{FX intv}(0/1)_t + \gamma X_{f,b} + \theta_{f,t} + e_{f,b,t},\end{aligned}$$

where $\Delta\text{Credit}_{f,b,t}$ is quarterly log growth rate of credit provided to firm f by bank b, Bank FX Debt_b is bank's ex-ante share of foreign debt in its total liabilities, Capital_b is bank's ex-ante capital, $\theta_{f,t}$ is firm-quarter fixed effect, and $X_{f,b}$ is a set of controls. FX intv_t is equal to one for the period t of active BCB FX intervention program, and zero otherwise. All regressions are estimated using the end of April'13–end of October'13 sample (2 quarters with 1 quarter of the post-policy period). Controls include the following variables: Unused credit line, Default, Share in firm credit, Size, NPL, FX debt in loans, FX debt < 1 year, FX debt > 5 years, State owned, Exposure to trade, Net FX exposure. All explanatory variables are measured as of the end of April'13. Bank FX debt and Capital are demeaned. Columns 2 and 3 report estimates of the same equation obtained on a subsample of firms with ex-ante average interest rates below the sample median (column 2) and above the sample median (column 3). Columns 4 and 5 report estimates of the same equation obtained on a subsample of firms with greater than ten employees (column 4) and not more than ten employees (column 5). Standard errors (in parenthesis) are calculated under two-way clustering by bank and firm industry ($^{*}p < 0.1, ^{**}p < 0.05, ^{***}p < 0.01$).

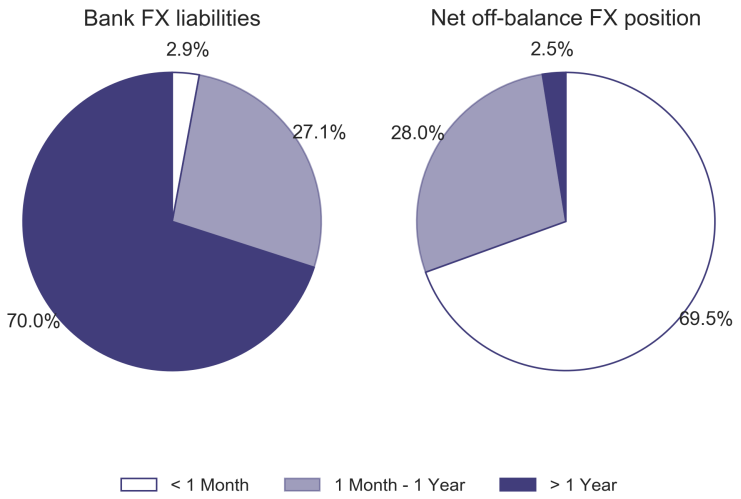
Online Appendix

Figure A.1: Bank FX debt, BRL/USD exchange rate, and the intervention by the Central Bank of Brazil.



Changes in the bank FX liabilities (upper panel, monthly series) are calculated based on the register of foreign claims on domestic financial institutions (ROF). Net FX positions in derivatives (lower panel, from Brazil stock exchange, monthly series) are aggregated by sector over all instruments with FX exposure, including BCB swaps. Vertical grid lines indicate middle-of-month dates. Net FX positions are end-of-month.

Figure A.2: Maturity composition of foreign debt and FX derivatives.



The maturity structure of bank FX liabilities is based on the register of foreign claims on domestic financial institutions (ROF). The maturity structure of off-balance FX positions is based on *Demonstrativo de Risco de Mercado* (DRM). DRM is a regulatory form fulfilled by all financial institutions in Brazil, which provides details about underlying market risk factors to the Bank Supervision of the BCB. Off-balance FX positions are net long exposures. The graphs reflect the aggregate values for the banks in our sample in April 2013.

Table A.1: Variables description

Variable	Level	Description
ΔCredit	*fbt*, *ft*	In the firm-bank-level regressions, quarterly log growth rate of credit outstanding. In the firm-level regressions, quarterly log growth rate of total credit liabilities to banks included the sample.
ΔTotal credit	*ft*	Quarterly log growth rate of total credit liabilities to all banks and non-bank credit institutions
ΔEmployment	*ft*	Quarterly log growth rate of firm's number of employees with non-temporary contracts
ΔTenure	*ft*	Quarterly change in the average (log) tenure of firms' employees with non-temporary contracts
Bank FX debt	*bt*	Share of foreign liabilities
Capital	*bt*	Book capital over total assets of a bank
Size	*bt*	Natural logarithm of total assets of a bank
NPL	*bt*	Share of non-performing (more than 90 days) loans in total credit portfolio of a bank in total liabilities of a bank
State owned	*bt*	Dummy variable indicating state ownership of a bank
Exposure to trade	*bt*	Bank's credit to net exporting firms minus minus credit to net importing firms over total credit portfolio of the bank. Net exporting (importing) firms are identified as firms whose net exports over 12 months preceding each month in the sample are positive (negative)
Net FX exposure	*bt*	Net FX position of a bank relative to its total assets
Unused credit line	*fbt*	Share of undrawn credit line in total credit commitments of a bank to a firm
FX debt in loans	*bt*	Share of loans in total foreign liabilities of a bank
FX debt < 1y	*bt*	Share of liabilities maturing within 1 year in total foreign liabilities of a bank
FX debt > 5y	*bt*	Share of liabilities maturing in at least 5 years in total foreign liabilities of a bank
Bank share in firm credit	*fbt*	Share of bank credit in total credit of a firm
Default	*fbt*	Dummy variable indicating if a firm is in default on any of its loans provided by a bank
Log of Total credit	*ft*	Natural logarithm of firm's total credit provided by banks included the sample
Log of Total employment	*ft*	Natural logarithm of firm's total number of employees
Average log of Tenure	*ft*	Average of natural logarithm of tenure of firm's employees with non-temporary contracts (in months)
Average log of Wage	*ft*	Average of natural logarithm of contract wage of firm's employees with non-temporary contracts

Table A.1: Variables description (cont.)

Variable	Level	Description
Δ EME FX index	t	Quarterly change of log of index of EME FX rates against US Dollar (positive values indicate depreciation of EME currencies). Quarterly changes are calculated using last month values of the EME FX index. Monthly index levels are calculated as average of daily values of EME FX indices (normalized to 1 on 30 April 2013)
Δ EME FX iVol	t	Quarterly change of log of 90 day Implied Volatility of EME FX rate against US Dollar. Quarterly changes are calculated using last month values of the EME FX implied volatility. Monthly volatility levels are calculated as average of daily implied volatility of EME FX rates
US shadow rate	t	US short-term shadow rate from Wu and Xia (2016), Quarterly average of monthly values
BR money rate	t	Brazilian money market rate, Quarterly average of monthly values
Inflation	t	Realized inflation in Brazil, year-over-year, Quarterly average of monthly values
IBC BR	t	Log of index of economic activity in Brazil, SA, Quarterly average of monthly values
VIX	t	Log of CBOE volatility index, Quarterly average of monthly values
Capital flows (quantity)	t	Change in (log of) end-of-quarter levels of aggregate external debt of the banking sector in Brazil
Capital flows (price)	t	Change in interest payments on external debt to be paid during the following year relative to the end-of-quarter levels of aggregate external debt of the banking sector in Brazil, %
Macro-pru index	t	Macroprudential index for Brazil calculated by Gambacorta and Murcia (2017), where each active tightening (easing) policy is assigned +1 (-1)
Capital controls index	t	Capital controls index, where each active tightening (easing) policy is assigned +1 (-1). See Chamon and Garcia (2016) for dates and description.
BCB FX intv	t	End-of-quarter notional amount of BCB swap intervention program over FX reserves
BCB FX intv (0/1)	t	Dummy variable indicating calendar quarters after (and including) Q3:2013

f = firm, b = bank, t = time.

Table A.2: Summary statistics, QE tapering

	Mean	SD	10%	25%	50%	75%	90%
			Firm-bank level				
Δ Credit	−0.02	0.34	−0.27	−0.13	−0.05	0.02	0.29
Bank FX debt	0.05	0.03	0.00	0.03	0.04	0.06	0.08
Capital	0.09	0.03	0.04	0.08	0.08	0.11	0.11
Size	6.17	1.23	4.54	6.42	6.58	6.77	6.77
NPL	0.06	0.03	0.02	0.02	0.07	0.08	0.08
FX debt in loans	0.50	0.47	0.00	0.01	0.29	1.00	1.00
State owned	0.48	0.50	0.00	0.00	0.00	1.00	1.00
Exposure to trade	−0.01	0.05	−0.06	−0.06	−0.02	0.06	0.06
Net FX exposure	0.00	0.01	−0.01	0.00	0.00	0.00	0.01
FX debt < 1y	0.23	0.15	0.00	0.10	0.27	0.37	0.37
FX debt > 5y	0.55	0.27	0.19	0.45	0.62	0.68	0.89
Unused credit line	0.19	0.27	0.00	0.00	0.06	0.29	0.61
Bank share in firm credit	0.40	0.29	0.03	0.14	0.35	0.62	0.84
Default	0.01	0.12	0.00	0.00	0.00	0.00	0.00
			Firm level				
Δ Credit	0.02	0.33	−0.22	−0.10	−0.03	0.09	0.35
Δ Total credit	0.02	0.30	−0.21	−0.10	−0.03	0.10	0.33
Δ Employment	0.00	0.22	−0.21	−0.06	0.00	0.06	0.21
Δ Tenure	0.02	0.31	−0.35	−0.10	0.07	0.19	0.33
Bank FX debt	0.05	0.02	0.02	0.03	0.05	0.06	0.07
log of Total credit	5.93	1.42	4.27	5.00	5.84	6.70	7.69
log of Total employment	2.52	1.38	1.10	1.61	2.30	3.26	4.33
average log of Tenure	2.93	0.67	2.12	2.49	2.91	3.35	3.78
average log of Wage	7.09	0.34	6.70	6.84	7.04	7.28	7.53

observations: 462677

Table A.3: Summary statistics, firm-bank panel, full sample

	Mean	SD	10%	25%	50%	75%	90%
Δ Credit	−0.01	0.38	−0.31	−0.14	−0.05	0.04	0.37
Bank-level variables:							
Bank FX debt	0.04	0.03	0.00	0.02	0.04	0.05	0.08
Capital	0.09	0.03	0.04	0.07	0.09	0.11	0.12
Size	5.90	1.29	4.12	5.81	6.35	6.62	6.81
NPL	0.06	0.03	0.03	0.04	0.07	0.08	0.09
FX debt in loans	0.52	0.45	0.00	0.02	0.65	1.00	1.00
State owned	0.44	0.50	0.00	0.00	0.00	1.00	1.00
Exposure to trade	0.01	0.06	−0.07	−0.02	0.00	0.04	0.08
Net FX exposure	−0.01	0.01	−0.03	−0.01	0.00	0.00	0.01
FX debt < 1y	0.36	0.28	0.00	0.11	0.32	0.57	0.79
FX debt > 5y	0.38	0.27	0.00	0.12	0.39	0.59	0.70
Loan-level variables:							
Unused credit line	0.18	0.28	0.00	0.00	0.02	0.26	0.63
Bank share in firm credit	4.72	1.54	2.80	3.63	4.64	5.67	6.66
Default	0.03	0.17	0.00	0.00	0.00	0.00	0.00
Macro-level variables:							
Δ EME FX index	0.01	0.04	−0.04	−0.02	0.00	0.03	0.06
Δ EME FX iVol	0.01	0.18	−0.21	−0.10	−0.03	0.12	0.19
Δ US shadow rate	−0.21	0.42	−0.58	−0.41	−0.14	−0.01	0.18
Δ BR money market rate	0.05	0.88	−1.14	−0.35	0.06	0.78	0.97
Δ Inflation	0.12	0.53	−0.53	−0.22	0.14	0.41	0.68
Δ IBC BR	0.00	0.02	−0.01	0.00	0.01	0.01	0.03
Δ VIX	−0.01	0.25	−0.25	−0.21	−0.03	0.09	0.19
Δ Commodity price	0.00	0.07	−0.06	−0.03	0.00	0.06	0.10
Δ External debt of banks	0.02	0.08	−0.06	−0.02	0.02	0.07	0.15
Δ Cost of ext. debt of banks	−0.04	0.49	−0.35	−0.13	−0.04	0.08	0.15
Δ Capital controls index	−0.03	1.17	−2.00	0.00	0.00	0.00	1.00
Δ Macro-pru index	0.12	3.23	−2.00	−1.00	0.00	1.00	2.00
BCB FX intv	0.05	0.12	−0.11	−0.01	0.00	0.06	0.26
BCB FX intv (0/1)	0.25	0.43	0.00	0.00	0.00	0.00	1.00

observations: 3900653

Table A.4: Determinants of levels of Bank FX debt, of changes in Bank FX debt and FX Hedging after the FX Intervention

	Bank FX debt	Δ Bank FX debt		Δ Bank FX hedging	
	(1)	(2)	(3)	(4)	(5)
Bank FX debt		–0.11	0.03	0.33**	0.28**
		(0.26)	(0.36)	(0.16)	(0.13)
Size	0.01***	–0.01	–0.01	0.00	0.00
	(0.00)	(0.01)	(0.01)	(0.00)	(0.00)
State owned	–0.04***	–0.02	–0.02	0.01	0.02**
	(0.01)	(0.03)	(0.05)	(0.01)	(0.01)
Exposure to trade	0.12**	–0.25	–0.30	0.03	0.03
	(0.05)	(0.21)	(0.22)	(0.04)	(0.04)
Capital	0.02		–0.11		0.00
	(0.02)		(0.09)		(0.02)
NPL	0.03		–0.24		0.03
	(0.03)		(0.20)		(0.03)
FX debt in loans	–0.01		0.06		–0.02
	(0.01)		(0.09)		(0.01)
Net FX exposure	–0.72		0.85		–2.00*
	(1.25)		(3.08)		(1.06)
Constant	0.03***	0.01	0.01	0.00	0.00
	(0.01)	(0.02)	(0.02)	(0.00)	(0.00)
R^2	0.43	0.08	0.16	0.27	0.46
# banks	46	46	46	46	46

The table reports estimates of the bank-level cross-section equations

$$\text{Bank FX debt}_b = \gamma_1 X_b + e_b,$$

in column (1), and

$$\Delta Y_b = \beta \text{Bank FX debt}_b + \gamma_2 X_b + e_b,$$

in columns (2)–(5), where Y is either Bank FX debt or Bank FX hedging. ΔBank FX debt$_b$ is log growth rate of Bank FX debt, ΔBank FX hedging$_b$ is the change in Net FX position in BCB swaps and USD futures (normalized by total assets) during the three months after the announcement of the FX intervention by the BCB. Bank FX debt$_b$ in column (1) and all explanatory variables in X_b are measured as of end-April, 2013. All explanatory variables are demeaned. Robust standard errors in parenthesis ($^* p < 0.1, ^{**} p < 0.05, ^{***} p < 0.01$).

Table A.5: QE tapering vs. FX interventions: credit supply, firm-bank level; excluding share of maturing debt

	+1 policy quarter				+3 policy quarters			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Bank FX debt†	−1.20***	−1.06***	−1.18***	−1.14***	−1.20***	−1.06***	−1.23***	−1.20***
	(0.30)	(0.23)	(0.26)	(0.29)	(0.30)	(0.23)	(0.23)	(0.26)
FX intv (0/1) × Bank FX debt†	0.50**	0.43**	0.45**	0.40**	0.60***	0.54***	0.54***	0.49***
	(0.24)	(0.17)	(0.17)	(0.19)	(0.17)	(0.12)	(0.12)	(0.15)
FX intv (0/1)	–0.03**				–0.04***			
	(0.01)				(0.01)			
Firm × Time FE	no	yes	yes	yes	no	yes	yes	yes
Controls	no	no	yes	yes	no	no	yes	yes
WLS	no	no	no	yes	no	no	no	yes
R^2	0.01	0.41	0.43	0.41	0.01	0.41	0.43	0.41
# observations	229327	229327	229327	229327	462677	462677	462677	462677
# firms	49907	49907	49907	49907	56002	56002	56002	56002
# banks	46	46	46	46	46	46	46	46
# industries	73	73	73	73	73	73	73	73

The table reports estimates of the equation

$$\Delta\text{Credit}_{f,b,t} = \beta_1 \text{Bank FX Debt}_b + \beta_2 \text{Bank FX Debt}_b \times \text{FX intv}(0/1)_t + \gamma X_{f,b} + \theta_{f,t} + e_{f,b,t},$$

where $\Delta\text{Credit}_{f,b,t}$ is quarterly log growth rate of credit provided to firm f by bank b, Bank FX Debt_b is bank's ex-ante share of foreign debt in its total liabilities, $\theta_{f,t}$ is firm-quarter fixed effect, and $X_{f,b}$ is a set of controls. FX intv_t is equal to one for periods t of active BCB FX intervention program, and zero otherwise. The left panel spans the period of end of April'13–end of October'13 (2 quarters with 1 quarter of the post-policy period). The left panel spans the period of end of April'13–end of April'14 (4 quarters with 3 quarters of the post-policy period). Constant in column 1 is omitted. Controls include the following variables: Unused credit line, Default, Share in firm credit, Size, Capital, NPL, FX debt in loans, FX debt < 1 year, FX debt > 5 years, State owned, Exposure to trade, Net FX exposure All explanatory variables are measured as of the end of April'13. Weights in columns 4 and 8 are proportional to (log of) firm employment. Standard errors (in parenthesis) are calculated under two-way clustering by bank and firm industry ($^{*}p < 0.1, ^{**}p < 0.05, ^{***}p < 0.01$).
† Bank FX debt excluding the debt to be repaid in May'13–July'13.

Table A.6: Placebo checks

	Baseline	Placebo		
	2013M4	2012M4	2011M4	2010M4
Bank FX debt	−0.83***	−0.22	−0.10	−0.08
	(0.27)	(0.19)	(0.11)	(0.24)
Loan-level controls:				
Unused credit line	0.13***	0.13***	0.12***	0.12***
	(0.01)	(0.02)	(0.01)	(0.01)
Default	−0.04***	−0.02	−0.03**	−0.01***
	(0.01)	(0.02)	(0.01)	(0.00)
Bank share in firm credit	−0.07***	−0.12***	−0.11***	−0.12***
	(0.02)	(0.02)	(0.01)	(0.01)
Bank-level controls:				
Size	0.02***	0.02***	0.00	0.00
	(0.00)	(0.00)	(0.01)	(0.01)
Capital	0.49***	0.15	0.13	0.02
	(0.13)	(0.13)	(0.20)	(0.46)
NPL	−0.17	−0.11	−0.03	0.04
	(0.12)	(0.14)	(0.14)	(0.38)
FX debt in loans	0.06***	−0.01	0.04***	0.03
	(0.02)	(0.01)	(0.01)	(0.06)
State owned	0.01	0.08***	0.05***	0.13***
	(0.02)	(0.02)	(0.01)	(0.03)
Exposure to trade	0.16**	−0.14*	−0.29***	−0.08
	(0.06)	(0.07)	(0.07)	(0.08)
Net FX exposure	1.46	0.52	−1.24*	−2.96**
	(1.16)	(0.57)	(0.70)	(1.34)
FX debt < 1y	−0.16***	0.00	0.02	0.01
	(0.04)	(0.03)	(0.01)	(0.10)
FX debt > 5y	0.02	−0.05***	0.01	0.13***
	(0.03)	(0.02)	(0.02)	(0.03)
Firm FE	yes	yes	yes	yes
R^2	0.41	0.42	0.42	0.41
# observations	114182	108622	110191	101487
# firms	46297	43656	44500	41024
# banks	46	47	49	52
# industries	73	80	80	79

The table reports estimates of the equation

$$\Delta\text{Credit}_{f,b} = \beta_1 \text{Bank FX debt}_b + \gamma X_{f,b} + \theta_f + e_{f,b},$$

where $\Delta\text{Credit}_{f,b}$ is log growth rate of credit provided to firm f by bank b, over three months following after the month indicated in the column header, Bank FX Debt_b is bank's *ex-ante* share of foreign debt in its total liabilities, θ_f is firm fixed effect, and $X_{f,b}$ is a set of controls; all explanatory variables are measured as of the end of the month indicated in the column header. Standard errors (in parenthesis) are calculated under two-way clustering by bank and firm industry ($^{*}p < 0.1, ^{**}p < 0.05, ^{***}p < 0.01$).

Table A.7: QE tapering: total credit, firm level

	Δ Credit				Δ Total credit			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Bank FX debt	−1.21***	−1.13***	−1.02***	−0.97***	−1.04***	−0.98***	−0.64**	−0.53*
	(0.27)	(0.27)	(0.24)	(0.27)	(0.21)	(0.21)	(0.25)	(0.28)
Proxy for credit demand			0.90***	0.90***			0.77***	0.75***
			(0.01)	(0.01)			(0.01)	(0.01)
Industry × State FE	no	yes	yes	yes	no	yes	yes	yes
Controls	no	no	yes	yes	no	no	yes	yes
WLS	no	no	no	yes	no	no	no	yes
R^2	0.01	0.13	0.80	0.79	0.01	0.13	0.68	0.67
# observations	44855	44855	44855	44855	44855	44855	44855	44855
# main banks	43	43	43	43	43	43	43	43
# industries	71	71	71	71	71	71	71	71

The table reports estimates of the equation

$$\Delta\text{Credit}_f = \beta_1 \text{Bank FX Debt}_f + \gamma X_f + \theta_i + e_f,$$

where ΔCredit_f is log growth rate of total credit liabilities of a firm f, over one quarter after Tapering Speech (end of April'13–end of July'13), Bank FX Debt_f is a weighted average of firm lenders' *ex-ante* share of foreign debt in their total liabilities, θ_i is industry-state fixed effect, and X_f is a set of controls. The left panel uses growth of credit of all local commercial banks as the dependent variable; the right panel uses growth of credit of all domestic commercial, foreign and investment banks and non-bank institutions. Constant in column 1 is omitted. Controls include the following variables: Unused credit line, Default, Size, Capital, NPL, FX debt in loans, FX debt < 1 year, FX debt > 5 years, State owned, Exposure to trade, Net FX exposure, log of Total credit, log of Total employment, average log of Wage, and average log of Tenure. All explanatory variables are measured as of the end of April'13. Proxy for credit demand refers to estimated firm fixed effect from firm-bank regression. Weights in columns 5 and 10 are proportional to (log of) firm employment. Standard errors (in parenthesis) are calculated under two-way clustering by main bank and firm industry ($^{*}p < 0.1, ^{**}p < 0.05, ^{***}p < 0.01$).

Table A.8: QE tapering vs. FX interventions: additional interactions

	Δ Credit		Δ Total credit	
	(1)	(2)	(3)	(4)
Bank FX debt	−1.32**	−1.08***	−0.92*	−0.74***
	(0.55)	(0.22)	(0.46)	(0.24)
FX intv (0/1) × Bank FX debt	0.72**	0.74***	0.56*	0.59***
	(0.33)	(0.13)	(0.29)	(0.11)
Size	0.01	0.00	0.01*	0.01*
	(0.01)	(0.00)	(0.01)	(0.00)
State owned	−0.04	−0.01	−0.03	0.00
	(0.03)	(0.02)	(0.02)	(0.02)
Exposure to trade	0.27	0.13*	0.24	0.13**
	(0.20)	(0.07)	(0.18)	(0.07)
FX intv (0/1) × Size	−0.01	0.00	−0.01***	0.00*
	(0.01)	(0.00)	(0.00)	(0.00)
FX intv (0/1) × State owned	0.02	0.00	0.01	0.00
	(0.01)	(0.01)	(0.01)	(0.01)
FX intv (0/1) × Exposure to trade	−0.26**	−0.01	−0.27**	−0.05
	(0.12)	(0.06)	(0.11)	(0.05)
Proxy for credit demand		0.90***		0.77***
		(0.01)		(0.01)
Industry × State × Time FE	yes	yes	yes	yes
Controls	yes	yes	yes	yes
R^2	0.16	0.80	0.16	0.67
# observations	214617	180679	215182	180679
# firms	54093	53994	54093	53994
# main banks	45	45	45	45
# industries	73	73	73	73

The table reports estimates of the equation

$$\Delta Y_{f,t} = \beta_1 \text{Bank FX Debt}_f + \beta_2 \text{Bank FX Debt}_f \times \text{FX intv}(0/1)_t + \gamma X_f + \theta_{i,t} + e_{f,t},$$

where $\Delta Y_{f,t}$ is either log growth rate of total credit of a firm f (from all banks in the sample (left panel) or from all credit institutions (right panel)), Bank FX Debt$_f$ is a weighted average of firm lenders' *ex-ante* share of foreign debt in their total liabilities, $\theta_{i,t}$ is industry-state-time fixed effect, and X_f is a set of controls. Controls include the following variables: Unused credit line, Default, Size, Capital, NPL, FX debt in loans, FX debt < 1 year, FX debt > 5 years, State owned, Exposure to trade, Net FX exposure (bank-firm and bank level variables are aggregated to the firm level by taking the weighted average of the corresponding values with weights proportional to the bank's share in firm total *ex-ante* credit liabilities), log of Total credit, log of Total employment, average log of Wage, and average log of Tenure. All explanatory variables are measured as of the end of April'13. Standard errors (in parenthesis) are calculated under two-way clustering by main bank and firm industry ($^{*}p < 0.1, ^{**}p < 0.05, ^{***}p < 0.01$).

Table A.9: GFC shocks, full panel, robustness checks

	Drop 2013 Q2-3		Macro-pru		Cap. controls		Bank vars.	
	(1) index	(2) iVol	(3) index	(4) iVol	(5) index	(6) iVol	(7) index	(8) iVol
Bank FX debt × Δ EME FX shock	−3.61***	−0.74***	−2.43***	−0.51***	−3.13***	−0.66***	−3.11***	−0.63***
	(1.00)	(0.18)	(0.75)	(0.14)	(0.83)	(0.15)	(0.86)	(0.16)
Bank FX debt × Δ Macro-pru			0.03**	0.04**				
			(0.01)	(0.01)				
Bank FX debt × Δ Cap. controls					0.03	0.05*		
					(0.03)	(0.03)		
Δ EME FX shock × Bank size							0.00	0.00
							(0.00)	(0.00)
Δ EME FX shock × State owned							0.02	0.01
							(0.01)	(0.01)
Δ EME FX shock × Exp. to trade							0.14*	0.14*
							(0.08)	(0.08)
Firm × quarter FE	yes	yes	yes	yes	yes	yes	yes	yes
Controls	yes	yes	yes	yes	yes	yes	yes	yes
R^2	0.43	0.43	0.43	0.43	0.43	0.43	0.43	0.43

The table reports estimates of the equation

$$\Delta\text{Credit}_{f,b,t} = \beta_1 \text{Bank FX Debt}_{b,t-1} + \beta_2 \text{Bank FX Debt}_{b,t-1} \times \Delta\text{EME FX shock}_{t-1} + \gamma X_{f,b,t-1} + \theta_{f,t} + e_{f,b,t},$$

where $\Delta\text{Credit}_{f,b,t}$ is quarterly log growth rate of credit provided to firm f by bank b, Bank FX $\text{Debt}_{b,t}$ is bank's share of foreign debt in its total liabilities, $\theta_{f,t}$ is firm-quarter fixed effect, and $X_{f,b,t}$ is a list of controls. In columns (1), (3), (5), and (7), ΔEME FX shock stands for a change in the EME FX rate index. In columns (2), (4), (6), and (8), ΔEME FX shock stands for a change in the EME FX rate volatility. The sample period is 2008Q1–2015Q2. In all columns, the estimates are conditioned on lagged bank- and loan-level control variables (Capital, Size, NPL, FX debt in loans, FX debt < 1y, FX debt > 5y, State owned, Exposure to trade, Net FX exposure, Share in firm credit, Default indicator, and Unused credit line). Standard errors (in parenthesis) are calculated under two-way clustering by bank and firm quarter-industry ($^{*}p < 0.1, ^{**}p < 0.05, ^{***}p < 0.01$).
In columns (1)–(2): # observations: 3619659, # firms: 132567, # banks: 68, # industry-quarters: 6858.
In columns (3)–(8): # observations: 3900653, # firms: 132754, # banks: 68, # industry-quarters: 7351.

Table A.10: GFC shocks and FX Interventions, firm panel

	BCB FX intv: (0/1) indicator				BCB FX intv: continuous			
	Δ Credit		Δ Employment		Δ Credit		Δ Employment	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Bank FX debt × Δ EME FX index	−8.48***		−0.66**		−8.63***		−0.54*	
	(2.18)		(0.31)		(2.54)		(0.31)	
Bank FX debt × Δ EME FX index × BCB FX intv	5.68*		2.11**		26.60*		7.21***	
	(3.30)		(0.86)		(13.68)		(2.70)	
Bank FX debt × Δ EME FX iVol		−1.89***		−0.22**		−1.99***		−0.20**
		(0.57)		(0.09)		(0.67)		(0.09)
Bank FX debt × Δ EME FX iVol × BCB FX intv		1.58***		0.49**		7.27**		1.58***
		(0.55)		(0.20)		(2.96)		(0.46)
Bank FX debt × BCB FX intv	−0.31	−0.37	−0.05	−0.03	−0.87	−1.32	−0.24	−0.21
	(0.46)	(0.44)	(0.06)	(0.06)	(1.71)	(1.62)	(0.21)	(0.22)
Industry × quarter FE	yes	yes	yes	yes	yes	yes	yes	yes
Firm FE	yes	yes	yes	yes	yes	yes	yes	yes
Controls	yes	yes	yes	yes	yes	yes	yes	yes
Macro interactions	yes	yes	yes	yes	yes	yes	yes	yes
R^2	0.19	0.19	0.18	0.18	0.19	0.19	0.18	0.18

The table reports estimates of the equation

$$\Delta Y_{f,t} = \beta_1 \text{Bank FX Debt}_{f,t-1} + \beta_2 \text{Bank FX Debt}_{f,t-1} \times \Delta\text{EME FX}_{t-1} + \beta_3 \text{Bank FX Debt}_{f,t-1} \times \text{FX intv}_{t-1} + \beta_4 \text{Bank FX Debt}_{f,t-1} \times \Delta\text{EME FX}_{t-1} \times \text{FX intv}_{t-1} + \gamma X_{f,t-1} + \theta_{i,t} + \psi_f + e_{f,t},$$

where $\Delta Y_{f,t}$ is either quarterly log growth rate of credit provided to firm f or growth rate in firm-level employment, Bank FX Debt$_{f,t}$ is firm-level average of bank's share of foreign debt in its total liabilities, $\theta_{i,t}$ is industry-quarter fixed effect, ψ_f is firm fixed effect, and $X_{f,t}$ is a list of controls. The sample period is 2008Q1–2015Q2. In all columns, the estimates are conditioned on the interaction of lagged Bank FX debt and changes in the U.S. shadow rate, as well as on firm-level average lagged bank- and loan-level control variables (Capital, Size, NPL, FX debt in loans, FX debt < 1y, FX debt > 5y, State owned, Exposure to trade, Net FX exposure, Default indicator, and Unused credit line) and firm characteristics (log of Total credit, log of Total employment, average log of Wage, and average log of Tenure). Additional macroeconomic variables interacted with Bank FX debt include: changes in BRA money market rate, Inflation, IBC BR, and VIX. Standard errors (in parenthesis) are calculated under two-way clustering by firm's main bank and quarter-industry ($^{*}p < 0.1, ^{**}p < 0.05, ^{***}p < 0.01$).
observations: 1597427, # firms: 132754, # main banks 66, # industry-quarters: 7140