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

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Abstract

We show that local central bank policies attenuate global financial cycle (GFC)'s spillovers. For 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. After U.S. Federal Reserve Taper Tantrum (followed by strong Emerging Markets FX depreciation and volatility increase), Brazilian banks with larger ex-ante reliance on foreign debt strongly cut credit supply, thereby reducing firm-level employment. However, a large FX intervention program supplying derivatives against FX risks—*hedger of last resort*—halves the negative effects. Finally, a 2008-2015 panel exploiting GFC shocks and local related policies confirm these results.

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

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1 Introduction

Financial crises follow periods of high local credit growth, partly financed with foreign global liquidity (Gourinchas and Obstfeld (2012), Jordà, Schularick, and Taylor (2013)). Rey in her Jackson Hole speech (Rey (2013)) argues that a global financial cycle (GFC) is affecting local credit markets and bank risk-taking in emerging markets, and that US monetary policy is a significant driver. Shin (2016) argues that the dollar has became the key barometer of the banking sector's appetite for leverage, with bank lending around the world coming under pressure when the dollar appreciates. Relatedly, Gopinath and Stein (2018) show the importance of the dollar as the dominant currency in both trade invoicing and global finance. Moreover, since the Great Recession following the global financial crisis, emerging markets have experienced large shifts in foreign exchange (FX) market conditions.

A key question that we analyze in this paper is whether local Emerging Market Economies (EMEs) central banks can successfully apply policies to reduce the spillovers of the GFC on their local credit cycles and their economies at large. Since there are limitations with local tightening of monetary policies as these policies can further amplify the local cycles, alternative macroprudential and capital account policies have been advocated (Rey (2013), Blanchard (2016), Blanchard, Ostry, Ghosh, and Chamon (2017)). Importantly, given the reaction of FX markets to the GFC, many central banks in EMEs have intervened in FX markets in the last years to provide the private sector with insurance against FX risks (Domanski, Kohlscheen, and Moreno (2016)).

Our most important contribution to the literature is to show that local central bank policies can attenuate the GFC's spillovers. There have been several papers showing how GFC factors affect EMEs, but scant evidence on how local policies diminish the negative spillovers. 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 (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. However, the announcement of the intervention program in Brazil consisting of supplying FX derivatives against FX risks—*hedger of last resort*—reduces by half the negative effects. In the last part, we confirm the results analyzing a panel from 2008 to 2015 and exploiting time-varying changes in FX and Brazilian FX policies on derivatives.

Brazil provides an excellent setting to investigate the GFC effects on EMEs and whether local EMEs policies can attenuate the spillovers. In addition to excellent micro administrative datasets on credit, employment and banks' foreign claims, Brazil is a large, representative emerging economy, which has been subject to large external shocks and where the local central bank (Banco Central do Brasil, BCB) implemented the largest ever 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 30% of its International Reserves) in the peak of the program in 2015. Other central banks in EMEs adopted similar programs in the following years (e.g. Mexico in February 2017 and Turkey in November 2017). We build our sample matching three administrative registers: the debt register of foreign credit flows to institutions domiciled in Brazil, the credit register 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 US Federal Reserve, 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. Between May 22 and end-June, on average, currencies across emerging markets depreciated by 3%, spreads rose by 1%, and equities fell by 7% (Mishra, Moriyama, and N'Diaye (2014)). In some countries, the FX depreciation was massive (Brazil 12.5%, India 9.9%, South Africa 8.9%, Turkey 7.6%, Russia 4.6% (Eichengreen and Gupta (2015)).

In light of deep depreciation of the Brazilian real (BRL) and high FX volatility, the supply side of FX derivatives markets disrupted. On August 22, 2013 the BCB responded announcing a major program of FX intervention. The program consisted of daily sales of USD 500 million worth of currency non-deliverable forwards (USD forwards settled in BRL, more widely known as BCB swaps) in the Brazilian stock exchange (B3). In this program, by supplying FX derivatives, the BCB provided the markets insurance against further depreciation of the BRL, with the aim of satisfying the excess demand of hedging, and therefore acting as a *hedger of last resort* (BCB (2014)). Differently from traditional sterilized FX interventions in the spot market, this intervention does not reduce the country's international reserves but it reduces the BCB 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) and Figure 3).[1]

In the last part, we analyze the effects of quarterly changes in the FX market conditions (FX level and volatility, either using Brazilian or EME FX) using a panel dataset over 2008-2015 (both for loan level 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. US monetary policy). Moreover, we also explore whether these GFC effects on credit are reduced after the intervention of the BCB in FX derivatives, as well as other local policies.

We address our questions by analyzing the supply of credit by domestic banks in Brazil with different *ex-ante* reliance of foreign debt and the associated firm-level real effects. In the first part, we adopt a difference-in-difference methodology around two consecutive shocks related to the US tapering speech and the announcement of the BCB intervention program in the FX derivatives market. In the second part, we analyze the panel exploiting FX shocks (both in levels and volatility) and local policies.

We are able to identify the transmission of the external shocks and local policy changes to the real economy thanks to the specific conditions of the Brazilian market and to the granularity of the data. First, domestic banks cover most of the credit market and their credit supply should be less affected by GFC factors. We exclude from the analysis two foreign banks as these banks are likely to be affected by different channels. On this, we follow di Giovanni, Kalemli-Ozcan, Ulu, and Baskaya (2017) 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.

Second, we analyze only loans in BRL, which represent almost the totality of the loans extended by Brazilian domestic banks to local companies (note that US loans are mechanically

[1] As one can see from Figure 1, the BCB started offering BCB swaps earlier than August 22 but, only on this date, it announced the commitment to provide swaps every day for the next year. Only this announcement which was unanticipated caused a large reaction on the exchange rate.

more affected by US FX or monetary policy). Less than 1% of the firms in the sample obtain loans indexed to the US Dollar (results are robust to including these loans). Third, because of loan-level data from the Credit Registry of the BCB, we can control for firm-level credit demand shifts using firm or firm-time fixed effects (following, e.g., Khwaja and Mian (2008)) and focus on credit supply changes to firms related to banks with differential *ex-ante* foreign debt. We can also control for other bank characteristics associated with banks with larger foreign debt (size, exposure to exporter firms and state owned dummy). 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 foreign debt). 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%) and a partial reversal after the BCB announcement (half the size). We show that the GFC shock and the policy introduction have both real effects. In particular, we find that the total employment at the firm level follows a similar pattern as for 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 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.

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 (avoiding Brazilian influence), instead of using the FX rate of the

Brazilian Real (BRL) against the U.S. Dollar, we use the FX rate of an index of the emerging market currencies, excluding Brazil, against the U.S. Dollar. However, all our results are robust if we use the bilateral FX rate between Brazil and the US. 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 growth and political uncertainty in Brazil.

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 after the intervention affect less credit supply or employment. Therefore, results suggest that the policy of supplying FX derivatives mitigates the spillovers of global financial conditions on EMEs local economy.

Why do banks with larger *ex-ante* foreign debt reduce credit supply after episodes of U.S. Dollar appreciation? And why is this channel attenuated after the intervention of the BCB? Basel II regulation on market risk imposes additional charges on unmatched FX exposures (those that exceed 5% of regulatory capital), so banks have high incentives to hedge their foreign debt buying FX derivatives. Banks unhedged FX exposures are subjected to capital requirements under the market risk Basel framework.[2] Banks hedge their foreign debt mostly by rolling monthly forward contracts and futures despite the average maturity of their foreign debt being, on average, much longer. Large global banks and foreigners typically supply FX derivatives in B3 and OTC markets. Domestic commercial banks buy these derivatives for balance sheet hedging. After local currency depreciation episodes (accompanied by an increase in the volatility of the FX rate), banks struggle to find hedging instruments or find them at a higher price.[3] For example, just after the Bernanke speech, there was hardly any supplier of hedging

[2]Consistently, we find that the unmatched FX exposure is small and, in any case, in all regressions we control for the net FX exposure (including all on- and off- balance sheet FX exposures).

[3]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. Sushko, Borio, McCauley, and McGuire (2017) show that implied volatility of the FX rate is positively associated with the deviations of covered interest parity (the difference between the forward premium and the interest rate differential). In Table

instruments in the market (see Figure 2). Hence, after local currency depreciation, banks with larger shares of foreign debt reduce credit supply since they experience an increase in the cost of rolling over their FX derivatives. The BCB intervenes “to provide liquidity to the FX currency markets [...] A sale of forward FX by the BCB will compress forward points against spot. This will lower the cost of hedging” (Garcia and Volpon (2014)).[4] The BCB provides the insurance against GFC shocks that banks need. In the words of Barroso (2019), "the stated purpose of the intervention was not to lean against the wind of the exchange rate, but to smooth the impact of external turbulence on private balance sheets".

Note that, in our panel setting, the results are not coming just from the fact that the central bank is able to reduce the depreciation of the currency and so has a mechanical positive impact on the balance sheet of banks with FX debt. We show, that, once the derivative policy intervention is in place, shocks in FX of similar size (as before) matter less for credit supply and employment. In other words, the derivative policy attenuates the spillovers of GFC shocks.

The strategy by the BCB to act as a *hedger of last resort*, which has been recently replicated by Turkey and Mexico, has potential limitations. First, it works insofar as economic agents believe they can go from forwards to spot U.S. Dollars, i.e. convertibility risk is negligible. This has not been an issue in Brazil, because of its large international reserves. Second, there are fiscal costs (or gains) since margin payments between the BCB and the market affect the country’s fiscal balance. Third, hedger of last resort policy, like lender of last resort policies, can (hypothetically) increase moral hazard and incentivize domestic banks to take up riskier (foreign) funding than they otherwise would.

Our most important contribution to the literature is to show that local central bank policies can attenuate the global financial cycle’s spillovers. A substantial number of academic and policy institutions argue that the GFC affects EME (see, e.g., Rey (2013), Shin (2016)). Moreover,

A.2 we find similar results for Brazil.

[4]Garcia and Volpon (2014) show direct econometric evidence of this by analysing the evolution of “Cupom Cambial” (the USD rate on shore). They state that: “a sale of forward FX by the BCB will compress forward points against spot. This will lower the cost of hedging a short USD spot position, which is the same thing as saying that this has the effect of raising USD rates onshore. Higher onshore USD rates will provide incentives for banks that have access to multiple markets to bring USD onshore.” They calculate the spread between 3 month on-shore USD rates and 3 month Libor. The larger the spread the larger is the incentive for commercial banks to bring USD to Brazil. They show that increases in the amount of swaps sold by the BCB are positively associated with changes in the level of this spread.

a large literature on the bank lending channel shows EMEs dependence on the global financial conditions (Kalemli-Ozcan, Papaioannou, and Perri (2013), di Giovanni, Kalemli-Ozcan, Ulu, and Baskaya (2017), Cetorelli and Goldberg (2011), De Haas and Van Horen (2013), Cerutti, Claessens, and Ratnovski (2017), Schnabl (2012), Morais, Peydró, Roldán-Peña, and Ruiz-Ortega (2019), and Paravisini, Rappoport, and Schnabl (2015)). We corroborate these findings. However, none of these papers analyze how local unconventional policies, such as FX interventions, attenuate the spillovers of the global financial cycle on local credit markets and on the overall economy. We instead show that interventions in FX derivatives attenuate the impact of the global financial cycle 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-à-vis the much longer maturities of their foreign debt is a source of vulnerability[5] partially mitigated by *hedger of last resort* policies.

A growing literature on FX interventions has focused on sterilized FX interventions. The evidence on the effectiveness of these tools is a source of controversy though. According to Chang (2018): "The dominant view from academia is that sterilized foreign exchange (FX) intervention has a tiny, if any, impact on real variables, which makes it virtually useless as an independent macroeconomic policy tool." However, the most recent evidence suggests that these interventions may have, at least, some effects in smoothing and stabilizing exchange rates (Blanchard, Adler, et al. (2015), Fratzscher, Gloede, Menkhoff, Sarno, and Stöhr (2015) and on the provision of credit (Hofmann, Shin, and Villamizar-Villegas (2019)). In this paper, we focus on a different form of intervention and we show a potent channel of intervening in the derivative FX market. We also show with micro, administrative matched datasets that this intervention can be successfully used as a policy tool.

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

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. Section 4 discusses the results, and Section 5 concludes.

2 Derivatives, FX Interventions, and Tapering in Brazil

Due to historical restrictions to buy US dollars in the Brazilian spot market, the country's FX derivative markets developed more and became larger than the spot one.[6] The participants of the FX derivative markets in Brazil rely on option contracts, futures, forwards, and the on-shore dollar rate (also traded as a contract and known as "Cupom Cambial") at Brazil's main clearing, B3. On top of these derivatives, the BCB "swaps" (also auctioned on B3) and comparable OTC forwards constitute the core of this market. All of these FX derivatives are settled in BRL. Non-deliverable forwards (NDFs) against BRL are frequently traded offshore and, in this case, settled in USD.

The BRL emerges as the official Brazilian currency in 1994 as a currency peg on the USD. Between 1994 and 1999,[7] 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, but called here BCB swaps.[8] BCB swaps are fungible and daily negotiated at the B3, 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.

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

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

[8]We follow the phrasing BCB swaps to stick to the usual Brazilian jargon referring to such derivatives. As detailed by Garcia and Volpon (2014), the product is technically a domestic non-deliverable forward (NDF) settled in BRL. It is worth noticing that BCB swaps evolved overtime. In 1999, this instrument was introduced in the stock exchange B3 as a "standardized" currency swap. Differently from typical OTC contracts, these swaps are auctioned with standard maturities in units of USD 50,000 (and not freely negotiated between two parties). Since 2004, these instruments have daily adjustments more closely resembling a future contract than a forward. In Brazil, these derivatives are called "swap cambial com ajuste periódico" and traded in the stock exchange B3 under the code SCC or "swap cambial com ajuste periódico baseado em operações compromissadas de um dia" (code SCS).

BCB swaps are structured in such a way that, at maturity, the BCB pays to its counterparty the realized variation in the BRL/USD exchange rate. In return, the BCB receives the overnight money market rate minus an on-shore dollar rate (that trades at similar prices as those of "Cupom Cambial" and are embedded in auctions called by the BCB)[9]. In other words, the BCB assumes a short position in USD and, hence, is to incur losses if BRL depreciates (above the difference between the two interest rates) over the contract period. Whereas "traditional swaps" consist of selling dollar derivatives, the BCB can also take the opposite side auctioning "reverse swaps" and drawing (instead of introducing) 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.

Central banks in emerging markets intervene in the FX typically using sterilized interventions, i.e., offering derivatives settled in USD, USD repo lines or auctioning USD at the spot market (e.g., Mexico, Korea, Russia, and Brazil occasionally).[10] However, according to Subramanian (2013), "the international experience suggests that sterilized intervention to defend a currency, especially during crises, tends to be ineffective or counterproductive".[11] Since 2008, the BCB has more commonly intervened in the derivatives' market using the BCB swaps.

"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)). Because BCB swaps provide the markets with hedging instruments similar to OTC forwards, the policy targets firms and financial intermediaries that demand FX instruments for hedging, and not the market participants who use the currency for actual settlement.[12] The former include institutions with

[9]Auctions of BCB swaps ("traditional swaps") tend to increase the on-shore dollar rate creating arbitrage opportunities that attract USD inflows (Garcia and Volpon (2014))

[10]In the 2008 crisis, BCB auctioned USD 14.5 billion in the spot market and extended repo lines in dollars in several occasions (Pereira da Silva and Harris (2012)) The BCB has also auctioned at spot market between February and April of 2012 and used forwards in several occasions (Janot and Macedo (2016); Kohlscheen and Andrade (2014)). During 2013, the "repo lines" were part of the first phase of the intervention program. In these cases, the BCB auctioned these lines to currency dealers that distributed the "greenbacks" to the market as needed. The FX repo auctions immediately decrease international reserves but are offered with a repurchase agreement of the USD spot.

[11]Moreover, Kearns and Rigobon (2005) find evidence that these interventions have strong intra-day effects, but they are quite small on the subsequent days. Dominguez (2006) find similar effects for FX volatility.

[12]Firms in need of actual settlement find these resources through currency dealers authorized by the BCB (BCB (2002)) These dealers are institutions authorized to sell spot dollars, organize informal auctions, and partic-

needs of addressing their balance sheet exposures (e.g., banks that continually rollover foreign debt and related derivatives).

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. As an insurance mechanism, the FX derivative interventions can distort banks' (and firms') *ex-ante* incentives to rely upon risky funding. Analogously to liquidity provision, the BCB's actions as the ultimate provider of hedging may help to minimize the related hedging costs during periods of excessive volatility. In our analysis, we evaluate one of the implications of the policy: its effectiveness to protect domestic credit markets from global financial shocks.

The Tapering speech, the dollar and derivatives' market

In May 2013, after a prolonged period of unconventional monetary policy in the US, Ben Bernanke, the chairman of the Federal Reserve, 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 US and in global financial markets. In the following months, EMEs witnessed massive capital outflows. In most cases, capital outflow was substantial and local currency depreciation was steep and associated with an increase in FX volatility. Figure 1 illustrates the macroeconomic conditions in Brazil around the analyzed period.

[Figure 1 about here.]

The steep depreciation of the BRL and increased implied volatility had several implications for the derivatives' market. Prior to May, 2013, foreigners were net providers of FX derivatives (Figure 2). Firms ("others") were net buyers of such derivatives. These markets were balanced and the BCB was almost entirely absent. In Figure 2, we notice that since the Tapering speech, the foreigners started moving from net providers to buyers of FX protection. Similarly, we observe increased demand from firms. The BCB started offering BCB swaps immediately from

ipate in auctions of FX repo lines organized by the BCB.

that point and banks were the main buyers of those. By the end of June, the BCB also offered currency repo lines. By August, the full disruption in the supply side of derivatives forced the BCB to move from "random" auctions of swaps to announcing a program with daily auctions.

[Figure 2 about here.]

Increased hedging costs are likely to be relevant not only for local commercial banks but also for global financial intermediaries of dollar liquidity. To the extent the BCB policy offers abundant supply of hedging, it could soften this derivative supply shock mostly stemming from global investment banks (the usual providers of hedging) and, hence, alleviate dollar liquidity shortages to the domestic commercial banks and firms.

The Intervention Program

Because the initial policy steps since the Tapering were not effective, capital outflows continued, and by the end of June BRL lost more than 12% of its value against the US Dollar. 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 and an additional USD 1MM every Friday on repo lines. The volume of swaps effectively offered by the BCB after the announcement did not increase significantly, but the announcement in itself had strong effects. The markets welcomed this policy announcement, which led to a 10% to 19% appreciation of BRL (Chamon, Garcia, and Souza (2017) and Figure 3).

[Figure 3 about here.]

Later in 2013, depreciation resumed and, on December, 18, the BCB announced the second round of interventions. In the second wave, the BCB auctioned USD 200M daily in swaps and repo auctions only by demand. The impact of this second wave was more modest with an upper bound of the estimated effect around 5% of appreciation (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 is an important instrument to smooth FX ratio 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.

The policy could affect the local commercial banks in several ways. In broad terms, the Tapering Tantrum increased the funding costs of the domestic banks, both directly — by raising the opportunity costs of investing in Brazil and decreasing supply of USD in the spot market, and indirectly — by pushing up the hedging costs practiced by financial market intermediaries (Garcia and Volpon (2014)). On top, prudential regulation in Brazil imposes additional charges on large unmatched FX exposures (those that exceed 5% of regulatory capital). On-balance-sheet hedging (via foreign denominated assets) is costly due to the large interest rate differential; additionally, FX-denominated lending is 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. In April 2013, 70% of the derivatives held by banks were due in less than 30 days, whereas 71% of their foreign debt in more than one year (Figure 4).

[Figure 4 about here.]

The BCB had large international reserves by the time of the Taper Tantrum. The reserves represented a (long) FX position and during the intervention the BCB offered a fraction of this FX exposure (up to 1/3 in notional value) via swaps to the markets. When the BCB sells the swaps, it reduces its net FX position, a figure closely observed by market participants to assess convertibility risk.

This policy affected the fiscal balance. Whereas USD appreciation (depreciation) creates large market-to-market gains (losses) to the BCB international reserves, the BCB settles (receives) this difference with its swap counterparties in daily adjustments to the stock exchange in cash. This aspect is important in public sector accounting, because the cash payments (receipts) to the stock exchange are treated as government interest rate payments (revenues) affecting the country's overall fiscal balance. On the other hand, market-to-market gains with international reserves – reduced by the BCB swaps – are treated as an integral part of the BCB balance sheet thus not affecting the fiscal balance, but creating significant financial transfers from the Treasury to the BCB, in securities (or from the BCB to the Treasury, in cash). At year-end, the BCB paid BRL 2.3 billion to the market in 2013, BRL 10.6 billion in 2014, and BRL 102 billion in 2015. In 2015, by time the program is closed, 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. During 2016 and 2017, when the BRL mostly appreciates, cash transfers from the stock exchange to the BCB worth BRL 83.8 (2016) and 6.3 billion (2017) offset most of the related fiscal costs from the previous years.

3 Data and Identification Strategy

In this paper, we match three data sets: the credit register of corporate loans, a register of foreign claims hold by 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 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 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 represented 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 Brazilian Real (BRL). In our sample, as of the end of April 2013, less than 1% of firms have any liability indexed to a foreign currency. We 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 over 86% of total corporate credit extended by the bank 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 and policy shocks via banks' foreign debt (however, results do not change when we add back the two large foreign banks). As an additional exercise, we also analyze firm substitution between the 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.[13]

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.[14] Finally, we calculate our main bank treatment variable as the ratio of all these foreign claims to total liabilities at each end of quarter.

[13]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.

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

This 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 foreign 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) and the state ownership indicator. To capture some compositional effects of foreign debt, we additionally 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. We explicitly account for the maturity structure of the foreign bank debt by conditioning on the share of foreign debt with remaining maturity of less than one year (FX debt < 1y). Immediate refinancing needs may act as an a relevant driver of bank credit supply. The inclusion of this variable in the control list rules out concerns about the correlation of debt maturity with the level of foreign debt. We also include a control for the percentage of loans given to exporter/importer firms out of total loans (Exposure to trade). Variations in the FX rate can in fact change the net worth of these loans and impact, via this channel, the credit supply. This net exposure to the trade sector is a time-varying bank variable calculated as the share of credit to net exporters minus the share of credit to net importers.[15] Finally, we can also account for the net FX unhedged exposure (including all on and off balance sheet FX exposures normalized by total assets). Banks unhedged FX exposures are subjected to capital requirements under the market risk Basel framework. Furthermore, at the firm-bank level, we control for (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.

Tables 1 reports the summary statistics for the Tapering shock. We have 46 banks with

[15] 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. The trade sector (as all firms) fulfills "Sistema Cambio" to request FX transactions against the BCB or any FX dealer.

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 registry 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 tenure as of the end of April 2013 as controls. Moreover, we use the firm-employment growth rate as a dependent variable to trace the real effects of shrinking credit supply after the Tapering. The latter is defined as the change of the number of employees over the average number of firm workers during the each quarter (Table 1).

[Table 1 about here.]

Moving from the cross-sectional analysis to the full panel data allows explicitly estimation of credit supply dependence on GFC shocks. The main treatment macro-regressors 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.[16] To focus on the global financial shocks and mitigate concerns about endogeneity between Brazilian spot FX rates and the FX interventions, we do not include the Brazilian Real in the calculation of the EMEs 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 US Dollar). 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 rates in the US, we also consider the changes in the Wu-Xia Short Shadow (Federal Funds) Rate (Wu and Xia (2016)).

[16]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.

Finally, to measure the level of interventions of the BCB in the derivatives' markets, we use the ratio of the gross swaps position (notional value) of the BCB relative to its international reserves. It is worth noticing that prior to 2013, the BCB has 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 Table 2 and Figure 1). As alternative proxies of intervention, we use a dummy variable equal to one for the quarters following the policy announcement (2013Q3 onwards) or the quarterly changes in the level of the gross swaps position of the BCB in the derivatives' markets. Table 2 presents summary statistics of the panel data and Table A.1 reports the description of all the variables used in the paper.

[Table 2 about here.]

4 Results

4.1 The QE Tapering Shock and the FX Intervention Shock

Table 3 reports the baseline estimates of the credit supply dependence on foreign debt around 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. 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.[17] Cross-section specification in first differences eliminates any time-invariant level component of firm credit demand as well as the macroeconomic effects common to all firms and banks. Because we can introduce firm fixed effects, credit demand shifts are absorbed and the coefficients can be directly attributed to banks' supply decisions.

[Table 3 about here.]

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

All estimates in Table 3 indicate that the 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 differential in 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, Share in firm credit) and in column 4 we also add bank-level controls (Size, Capital, NPL, FX debt in loans, FX debt < 1y, State owned). In column 5 we further saturate the model with two additional bank-level variables: Exposure to trade and Net FX exposure. Finally, in column 6, we report Weighted Least Squares estimates of the model of column 5 to give more weight to larger observations. We use as weights the size of firm employment. The coefficient of Bank FX debt is statistically and economically significant in all these specifications. In Table A.3 we show this result is robust to changing the definition of the credit growth to include both the intensive and the extensive margin.

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, suggesting that higher refinancing needs in USD may force the bank to shrink its loan portfolio in BRL.

The variables Exposure to trade and Net FX exposure have the expected positive signs. Depreciation of the local currency, at least in the short-term, improves trade conditions of exporters and, hence, increase the net worth of banks that fund their operations. Also, banks that are net exposed to FX, or unhedged, face losses if net short of dollars, and gains if long in dollars. Reevaluation of their FX assets and liabilities directly materialize in credit supply. The median bank in our sample is modestly short in USD in April (Table 1).

While the baseline results suggest that the banks' *ex-ante* dependence on foreign 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 4, where the left panel (from columns 1 to 5) presents estimates for the total credit growth of banks included in the sample, while the right one (from column 6 to 10) 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 3 (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), in column 4 we also control for credit demand by including the firm fixed effects obtained in the previous bank-firm level regressions, and finally in column 5 we report WLS estimates. In these regressions 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.

[Table 4 about here.]

The estimates suggest that the credit supply shift was only partially offset: the estimated coefficient of Bank FX debt is negative and statistically significant at 1% level 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 only marginally smaller. This observation also suggests that neither foreign banks nor non-bank lenders were of a great help in offsetting the credit supply decrease of the domestic banks.

To estimate the effect of the BCB FX intervention program, we first 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 bank foreign debt.[18] The interaction shows 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. 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.

The left panel of Table 5 reports the regression results. 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 demonstrate lower credit growth rates 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 5 about here.]

The right panel of Table 5 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 BCB interventions has persistent results. Also in this case, we show in Table A.4 that results do not change if we change the dependent variable to include both the intensive and the extensive margin of credit.

Table 6 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 elasticity to foreign debt during the period immediately after the US monetary tightening shock are close to the ones obtained in Table 4. Also at the firm level, we find a positive effect of the FX interventions,

[18] The coefficients of the variable *Bank FX Debt* are exactly the same as in Table 3 since they 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).

suggesting that the policy is binding for firms (columns 1-3). This is true also if we consider the total credit including also other lenders not in our sample (columns 4-6). Finally, to quantify the transmission of these two shocks 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 7-9). 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%) after the Tapering shock but this effect is halved after the BCB intervention.

[Table 6 about here.]

4.2 Full Panel Data Analysis

In the previous section, we report a diff-in-diff analysis around the two subsequent shocks of May and August 2013. In this section, we present a full panel between 2008 and 2015 and we ask whether, outside those two specific episodes, 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 their 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 US (e.g. Morais, Peydró, Roldán-Peña, and Ruiz-Ortega (2019). We interact Wu-Xia Short Shadow Federal Funds rate (SSR) with banks' foreign debt to identify this latter effect. Since the correlation between quarterly changes in US monetary policy and quarterly changes in FX conditions in EMEs is not very high, we are able to estimate the effects of the two. As before, 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.

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 diff-in-diff 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.

Table 7 reports the baseline results for the panel data specifications. Column 1 indicates that the EME's FX rate was an important stand-alone factor for the credit supply of the domestic banks that rely on foreign debt. Column 2 shows that this result was robust to the inclusion of the US monetary policy interacted with the banks' foreign debt. As expected, tighter monetary policy in the US has a negative effect on the domestic banks which borrow more in Dollars. For a bank with the average level of foreign debt, a 25bp increase in the US SSR is equivalent to a -1% annual growth rate of credit supply.

[Table 7 about here.]

The baseline results demonstrate that global financial shocks are relevant determinants of the local credit supply. The strengthening of the US dollar against the EMEs' currencies has economically and statistically important negative effects on the credit supply. A positive shock in the FX index of one standard deviation accounts for a shift in the subsequent local credit growth rates of approx. -2.5% per year for a domestic bank with the average level of foreign debt. The effect is almost twice as high when estimated conditionally on other macroeconomic variables interacted with bank foreign debt dependence (column 3).

In columns 4–6, we report similar specifications with foreign debt interacted with the implied volatility of EMEs currencies. Rising uncertainty typically accompanies local currency devaluations (quarterly changes in the level of FX and in the volatility of FX have a 0.8 correlation) and this can clearly 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 a 5% higher foreign debt contracts credit by an additional annualized 3.2% 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 5).

We implement a set of robustness checks and report the results in Table 8. Brazil is an important exporter of soybeans, iron ore, petroleum, meat and sugar, and as such, it is subject to worldwide commodity price shocks. Falls in commodity price also trigger FX rate adjustments that are frequently accompanied by an increased level of uncertainty. If we run the baseline regression with the commodity price index instead of the FX index we find similar results. We report the corresponding estimates in column 1. As commodity price changes and FX shocks are strongly negatively correlated, the estimated parameters have the opposite sign. The economic and statistical relevance of the effect is similar to the previous estimates. 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 2 and 3). We also introduce policy uncertainty measure (Baker, Bloom, and Davis (2016)) as an additional interaction with bank foreign debt variable (columns 4 and 5). Finally, 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 6 and 7). None of these estimates change the baseline results significantly.

[Table 8 about here.]

In another robustness exercise, we 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). 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[19] which could be more directly related to our story. Results reported in Table 9 show that including interactions with FX debt and lagged changes in macroprudential regulation (or capital controls regulation, specifically) does not significantly change our main results.

[Table 9 about here.]

[19]We construct the index on the basis of the description of capital regulation changes in Brazil offered by Chamon and Garcia (2016)

Furthermore, to be reassured on our cost-of-hedging channel, we also include additional double interaction with FX debt and changes in aggregate capital flows, considering both a price and a quantity dimension. We interact foreign debt with lagged changes in (log of) external debt of Brazil and with lagged changes in the cost of foreign finance (calculated as interest payments on aggregate external debt relative to the levels of aggregate external debt). Results reported in Table 10 indicate that the effects of FX rate and volatility are robust to the inclusion of these additional interactions. Thus, the effects of FX shocks preserve their magnitude and statistical significance when controlling for these additional interactions. This table shows that our results are not driven just by changes in capital flows.

[Table 10 about here.]

In the last part of our analysis, we explore the effects of BCB interventions in the panel setup. We want to explore 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 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. The estimates reported in Table 11 show that the coefficient on the triple interaction of bank foreign debt, FX rate, and FX interventions is positive and statistically significant. The result indicates that the BCB is able to offset the otherwise-negative effect of FX shocks on the exposed banks. In Table A.6 we show that this result does not hinge on a specific definition of the central bank intervention. Results do not change if we proxy the FX intervention with just a dummy variable for the months after the announcement of the intervention at the end of August 2013 or if we take the quarterly changes in the level of the notional amount of the BCB swaps.

[Table 11 about here.]

Next, in order to make sure that our policy intervention variable is not capturing other interventions by the central bank we include further triple interactions both with lagged changes in macroprudential tools and capital controls that we discuss above. Evidence reported in Table 12 shows that our results are robust to the inclusion of these additional triple interactions.

[Table 12 about here.]

Finally, symmetrically to what we have done in the first part of the paper, 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 13 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 more exposed to banks with larger FX debt see a reduction in total credit 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 which means 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 and the triple interaction between bank FX debt, changes in FX and BCB intervention is positive and significant.

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.

[Table 13 about here.]

5 Conclusions

In this paper, we show that global financial conditions are transmitted to EMEs' firms via foreign debt of domestic banks, but central banks' interventions in FX can alleviate this channel. Central banks may intervene either in the spot markets (sterilized interventions) or in the derivatives' markets. We focus on the latter case in Brazil, where a massive intervention program with daily auctions was implemented on August, 2013. 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.

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Figure 1: Macroeconomic conditions in Brazil around the Tapering speech.

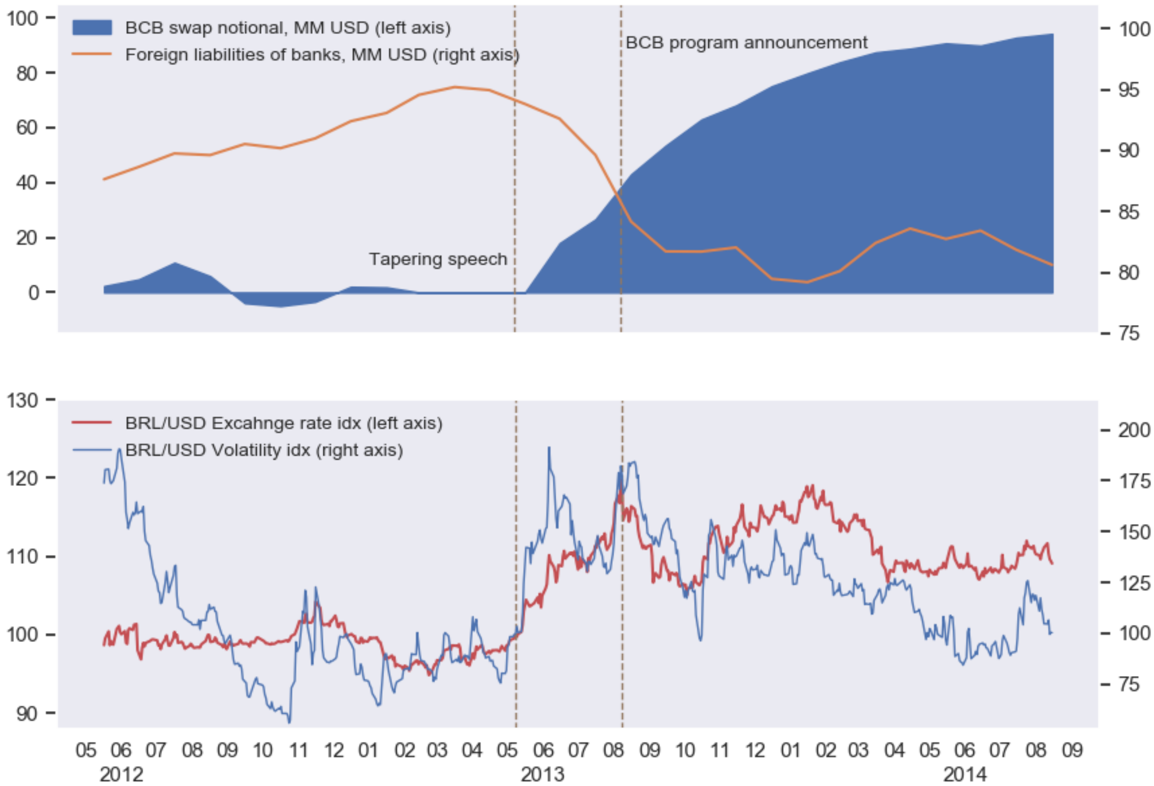
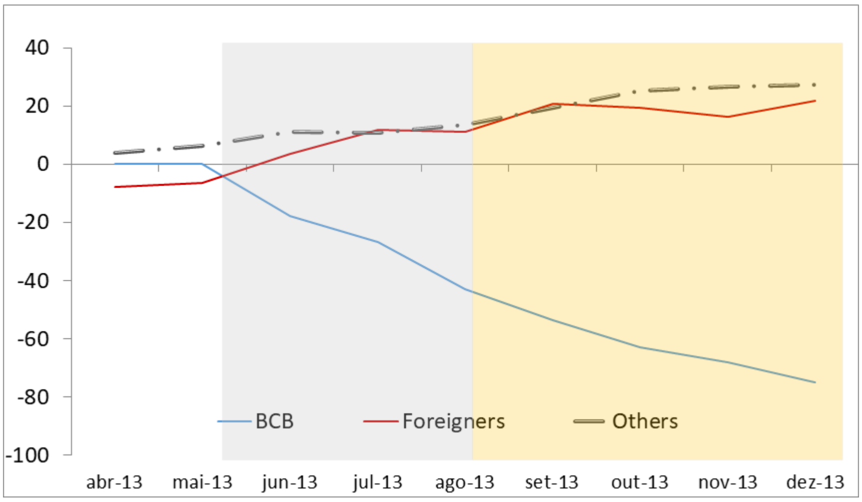
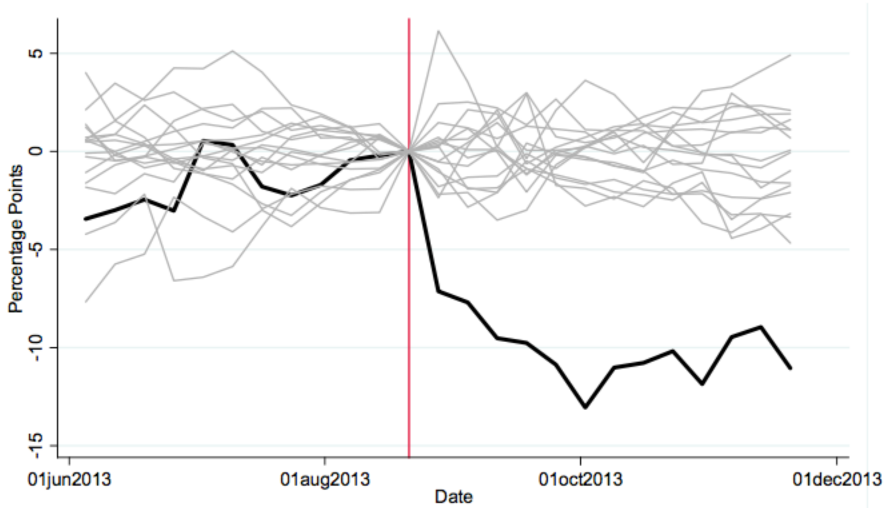


Figure 2: FX derivatives players and their net exposures.



Source: B3. Gray area represents the time window between the tapering speech prior to the swaps program. The yellow are represents the first phase of the program. The values are in billions of BRL.

Figure 3: Effects of the the Aug, 22 intervention in BRL/USD exchange rate



Source: Chamon, Garcia, and Souza (2017) The thick dark line indicates the gap between the actual BRL and synthetic (in log differences) while the light gray lines indicate the gap for other currencies

Figure 4: Maturity composition of foreign debt and FX derivatives.

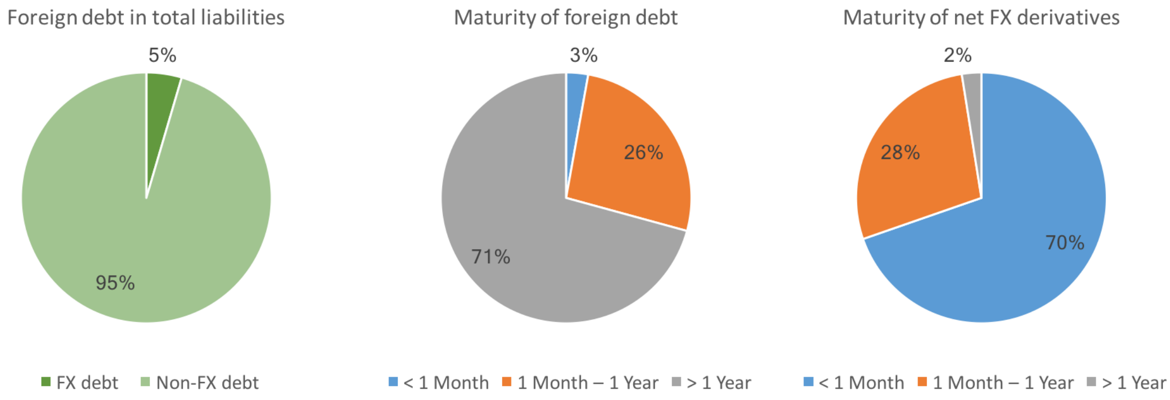


Table 1: Summary statistics, firm-bank level, QE tapering

	# obs.	Mean	SD	10%	25%	50%	75%	90%
				Firm-bank level				
Δ Credit	450700	–0.02	0.34	–0.27	–0.13	–0.05	0.02	0.29
Δ_{DH} Credit	518685	–0.02	0.69	–0.38	–0.14	–0.05	0.04	0.51
Bank-level variables:								
Bank FX debt	450700	0.05	0.03	0.00	0.03	0.04	0.06	0.08
FX debt in loans	450700	0.50	0.47	0.00	0.01	0.29	1.00	1.00
Capital	450700	0.09	0.03	0.04	0.08	0.08	0.11	0.11
Size	450700	6.17	1.23	4.54	6.42	6.58	6.77	6.77
NPL	450700	0.06	0.03	0.02	0.02	0.07	0.08	0.08
FX debt < 1y	450700	0.23	0.15	0.00	0.10	0.27	0.37	0.37
State owned	450700	0.48	0.50	0.00	0.00	0.00	1.00	1.00
Exposure to trade	450700	–0.01	0.05	–0.06	–0.06	–0.02	0.06	0.06
Net FX exposure	450700	–0.01	0.01	–0.02	–0.02	–0.01	0.00	0.00
Loan-level variables:								
Unused credit line	450700	0.19	0.27	0.00	0.00	0.06	0.29	0.62
Share in firm credit	450700	0.40	0.29	0.03	0.14	0.35	0.62	0.84
Default	450700	0.01	0.12	0.00	0.00	0.00	0.00	0.00
				Firm level				
Δ Total credit	180679	0.01	0.26	–0.19	–0.10	–0.03	0.08	0.28
Δ Total credit (incl. other lenders)	180679	0.01	0.24	–0.18	–0.09	–0.03	0.08	0.27
Δ Employment	180679	–0.01	0.21	–0.22	–0.06	0.00	0.06	0.19
Weighted average of bank-level variables:								
Bank FX debt	180679	0.05	0.02	0.02	0.03	0.05	0.06	0.07
FX debt in loans	180679	0.50	0.22	0.28	0.37	0.50	0.56	0.69
Capital	180679	0.09	0.02	0.06	0.07	0.09	0.10	0.11
Size	180679	6.18	0.73	5.15	5.87	6.55	6.62	6.68
NPL	180679	0.06	0.01	0.05	0.05	0.06	0.07	0.08
FX debt < 1y	180679	0.23	0.08	0.13	0.17	0.22	0.30	0.32
State owned	180679	0.48	0.29	0.00	0.33	0.50	0.67	1.00
Exposure to trade	180679	–0.01	0.03	–0.04	–0.03	0.00	0.00	0.02
Net FX exposure	180679	–0.01	0.00	–0.02	–0.02	–0.01	–0.01	–0.01
Weighted average of loan-level variables:								
Unused credit line	180679	0.20	0.20	0.00	0.04	0.14	0.30	0.50
Default	180679	0.01	0.09	0.00	0.00	0.00	0.00	0.00
Firm-level controls:								
log of Total credit	180679	5.93	1.42	4.27	5.00	5.84	6.70	7.69
log of Total employment	180679	2.52	1.38	1.10	1.61	2.30	3.26	4.33
average log of Tenure	180679	2.93	0.67	2.12	2.49	2.91	3.35	3.78
average log of Wage	180679	7.09	0.34	6.70	6.84	7.04	7.28	7.53

Table 2: Summary statistics, firm-bank panel, full sample

	Mean	SD	10%	25%	50%	75%	90%
			Firm-bank level				
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
FX debt < 1y	0.26	0.26	0.00	0.03	0.19	0.36	0.67
FX debt in loans	0.52	0.45	0.00	0.02	0.65	1.00	1.00
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
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	–0.04	–0.03	–0.01	0.00	0.00
Loan-level variables:							
Unused credit line	0.18	0.28	0.00	0.00	0.02	0.26	0.63
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 idx	0.01	0.04	–0.04	–0.02	0.00	0.03	0.06
Δ EME FX vol	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 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 Policy uncertainty	0.03	0.42	–0.55	–0.25	–0.06	0.40	0.49
Δ Commodity price	0.00	0.07	–0.06	–0.03	0.00	0.06	0.10
Δ External debt	0.03	0.04	–0.02	0.01	0.04	0.06	0.08
Δ Capital controls	–0.03	1.17	–2.00	0.00	0.00	0.00	1.00
Δ Macro-pru idx	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
Δ BCB FX intv	0.01	0.04	–0.02	0.00	0.00	0.02	0.06

Table 3: QE tapering: credit supply, firm-bank level

	(1)	(2)	(3)	(4)	(5)	(6)
Bank FX debt	-1.07^{***}	-0.92^{***}	-1.07^{***}	-0.80^{***}	-0.75^{***}	-0.75^{***}
	(0.26)	(0.20)	(0.20)	(0.18)	(0.15)	(0.18)
Loan-level controls:						
Unused credit line			0.16^{***}	0.13^{***}	0.13^{***}	0.13^{***}
			(0.01)	(0.01)	(0.01)	(0.01)
Default			-0.05^{***}	-0.04^{***}	-0.04^{***}	-0.04^{***}
			(0.01)	(0.01)	(0.01)	(0.01)
Share in firm credit			-0.03^{*}	-0.08^{***}	-0.08^{***}	-0.07^{***}
			(0.02)	(0.02)	(0.02)	(0.02)
Bank-level controls:						
Size				0.02^{***}	0.03^{***}	0.02^{***}
				(0.00)	(0.00)	(0.00)
Capital				0.21^{*}	0.47^{***}	0.50^{***}
				(0.11)	(0.13)	(0.15)
NPL				0.02	−0.10	−0.19
				(0.12)	(0.10)	(0.12)
FX debt in loans				0.07^{***}	0.07^{***}	0.06^{***}
				(0.01)	(0.01)	(0.01)
FX debt < 1y				-0.17^{***}	-0.16^{***}	-0.15^{***}
				(0.03)	(0.03)	(0.03)
State owned				0.03^{***}	0.02	0.02
				(0.01)	(0.01)	(0.02)
Exposure to trade					0.19^{***}	0.18^{***}
					(0.06)	(0.06)
Net FX exposure					1.73^{*}	1.82^{*}
					(0.86)	(1.08)
Firm FE	no	yes	yes	yes	yes	yes
WLS	no	no	no	no	no	yes
R^2	0.01	0.41	0.42	0.43	0.43	0.41
# observations	111855	111855	111855	111855	111855	111855
# firms	45352	45352	45352	45352	45352	45352
# banks	46	46	46	46	46	46
# industries	73	73	73	73	73	73

The table reports estimates of versions 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, $\theta_f$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. 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 2-digit CNAE industry ($^{*} p < 0.1,^{**} p < 0.05,^{***} p < 0.01$).

Table 4: QE tapering: total credit, firm level

	Δ Total credit					Δ Total credit (incl. other lenders)				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Bank FX debt	-1.29^{***}	-1.23^{***}	-0.90^{***}	-0.87^{***}	-0.88^{***}	-1.12^{***}	-1.07^{***}	-0.77^{***}	-0.74^{***}	-0.69^{***}
	(0.31)	(0.24)	(0.27)	(0.16)	(0.19)	(0.24)	(0.19)	(0.22)	(0.14)	(0.16)
Credit demand				0.87^{***}	0.86^{***}				0.75^{***}	0.72^{***}
				(0.02)	(0.02)				(0.02)	(0.02)
Industry × State FE	no	yes	yes	yes	yes	no	yes	yes	yes	yes
Controls	no	no	yes	yes	yes	no	no	yes	yes	yes
WLS	no	no	no	no	yes	no	no	no	no	yes
R^2	0.01	0.13	0.16	0.63	0.63	0.01	0.13	0.16	0.55	0.54
# observations	44854	44854	44854	44854	44854	44854	44854	44854	44854	44854
# main banks	43	43	43	43	43	43	43	43	43	43
# industries	71	71	71	71	71	71	71	71	71	71

The table reports estimates of versions 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 institutioins. 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, 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. 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 2-digit CNAE industry ($^{*}p < 0.1, ^{**}p < 0.05, ^{***}p < 0.01$).

Table 5: 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	–1.07***	–0.92***	–0.87***	–0.89***	–1.07***	–0.92***	–1.02***	–1.05***
	(0.26)	(0.20)	(0.15)	(0.18)	(0.26)	(0.20)	(0.13)	(0.16)
FX intv (0/1) × Bank FX debt	0.49**	0.43***	0.44***	0.40**	0.57***	0.51***	0.52***	0.48***
	(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	224333	224333	224333	224333	450700	450700	450700	450700
# firms	48731	48731	48731	48731	54094	54094	54094	54094
# banks	46	46	46	46	46	46	46	46
# industries	73	73	73	73	73	73	73	73

The table reports estimates of versions 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, 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 2-digit CNAE industry ($^{*}p < 0.1, ^{**}p < 0.05, ^{***}p < 0.01$).

Table 6: QE tapering vs. FX interventions: firm level

	Δ Total credit			Δ Total credit (incl. other lenders)			Δ Employment		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Bank FX debt	–0.93***	–0.91***	–0.94***	–0.78***	–0.76***	–0.76***	–0.14***	–0.14***	–0.21***
	(0.25)	(0.18)	(0.19)	(0.21)	(0.16)	(0.17)	(0.02)	(0.02)	(0.04)
FX intv (0/1) × Bank FX debt	0.75***	0.63***	0.65***	0.66***	0.57***	0.58***	0.07*	0.07*	0.09**
	(0.16)	(0.10)	(0.10)	(0.13)	(0.08)	(0.07)	(0.04)	(0.04)	(0.04)
Credit demand		0.86***	0.85***		0.74***	0.72***		0.02***	0.02***
		(0.03)	(0.03)		(0.02)	(0.02)		(0.00)	(0.00)
Industry × State × Time FE	yes	yes	yes	yes	yes	yes	yes	yes	yes
Controls	yes	yes	yes	yes	yes	yes	yes	yes	yes
WLS	no	no	yes	no	no	yes	no	no	yes
R^2	0.15	0.64	0.63	0.15	0.55	0.54	0.13	0.13	0.15
# observations	180679	180679	180679	180679	180679	180679	180679	180679	180679
# firms	53995	53995	53995	53995	53995	53995	53995	53995	53995
# main banks	45	45	45	45	45	45	45	45	45
# industries	73	73	73	73	73	73	73	73	73

The table reports estimates of versions 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 (middle panel)), or growth rate of employment (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, State owned, Exposure to trade, Net FX exposure (bank-firm and bank level variables are aggregated to the firm level by taking the weigted 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. Weights in columns 3, 6, and 9 are proportional to (log of) firm employment. Standard errors (in parenthesis) are calculated under two-way clustering by main bank and 2-digit CNAE industry ($^{*} p < 0.1$, $^{**} p < 0.05$, $^{***} p < 0.01$).

Table 7: GFC shocks, full panel

	(1)	(2)	(3)	(4)	(5)	(6)
Bank FX debt × Δ EME FX idx	−4.16***	−4.18***	−8.59***			
	(1.35)	(1.16)	(3.02)			
Bank FX debt × Δ EME FX vol				−0.54**	−0.91***	−1.98***
				(0.21)	(0.19)	(0.59)
Bank FX debt × Δ US shadow rate		−0.26***	−0.09		−0.40***	−0.39***
		(0.06)	(0.11)		(0.08)	(0.08)
Firm × quarter FE	yes	yes	yes	yes	yes	yes
Controls	yes	yes	yes	yes	yes	yes
Macro interactions	no	no	yes	no	no	yes
R^2	0.43	0.43	0.43	0.43	0.43	0.43
# observations	3900653	3900653	3900653	3900653	3900653	3900653
# firms	132754	132754	132754	132754	132754	132754
# banks	68	68	68	68	68	68
# industry-quarters	7351	7351	7351	7351	7351	7351

The table reports estimates of versions of the equation

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

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. 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, State owned, Exposure to trade, Net FX exposure, Share in firm credit, Default indicator, and Unused credit line; additional macroeconomic variables interacted with Bank FX debt in columns 3 and 6 include: (changes in) BRA money rate, Inflation, IBC BR, and VIX. Standard errors (in parenthesis) are calculated under two-way clustering by bank and (3-digit CNAE) industry-quarter ($^{*} p < 0.1$, $^{**} p < 0.05$, $^{***} p < 0.01$).

Table 8: GFC shocks, full panel, robustness checks

		Except 2013 Q2-3		Policy uncertainty		Extra interactions	
		idx	vol	idx	vol	idx	vol
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Bank FX debt × Δ Commodity price	2.48***						
	(0.75)						
Bank FX debt × Δ EME FX shock		–4.40***	–0.93***	–8.61***	–1.98***	–4.28***	–0.88***
		(1.24)	(0.21)	(2.98)	(0.59)	(1.26)	(0.21)
Bank FX debt × Δ Policy uncertainty				–0.07	–0.05		
				(0.08)	(0.09)		
Δ EME FX shock × Size						0.00	0.00
						(0.01)	(0.00)
Δ EME FX shock × State owned						0.00	0.01
						(0.04)	(0.01)
Δ EME FX shock × Exposure to trade						0.87	0.17*
						(0.74)	(0.10)
Firm × quarter FE	yes	yes	yes	yes	yes	yes	yes
Controls	yes	yes	yes	yes	yes	yes	yes
Macro interactions	no	no	no	yes	yes	no	no
R^2	0.43	0.43	0.43	0.43	0.43	0.43	0.43
# observations	3900653	3619659	3619659	3900653	3900653	3900653	3900653
# firms	132754	132567	132567	132754	132754	132754	132754
# banks	68	68	68	68	68	68	68
# industry-quarters	7351	6858	6858	7351	7351	7351	7351

The table reports estimates of versions of the equation

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

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, State owned, Exposure to trade, Net FX exposure, Share in firm credit, Default indicator, and Unused credit line; additional macroeconomic variables interacted with Bank FX debt in columns 3 and 6 include: (changes in) BRA money rate, Inflation, IBC BR, and VIX. Standard errors (in parenthesis) are calculated under two-way clustering by bank and (3-digit CNAE) industry-quarter ($^{*} p < 0.1$,$^{**} p < 0.05$,$^{***} p < 0.01$).

Table 9: GFC shocks, full panel, control for macroprudential policies

	(1)	(2)	(3)	(4)
Bank FX debt × Δ EME FX idx	–3.15***	–3.88***		
	(0.99)	(1.07)		
Bank FX debt × Δ EME FX vol			–0.69***	–0.85***
			(0.16)	(0.18)
Bank FX debt × Δ Macro-pru idx	0.03**		0.04***	
	(0.01)		(0.01)	
Bank FX debt × Δ Capital controls		0.04		0.07**
		(0.03)		(0.03)
Firm × quarter FE	yes	yes	yes	yes
Controls	yes	yes	yes	yes
R^2	0.43	0.43	0.43	0.43
# observations	3900653	3900653	3900653	3900653
# firms	132754	132754	132754	132754
# banks	68	68	68	68
# industry-quarters	7351	7351	7351	7351

The table reports estimates of versions of the equation

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

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, 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 (3-digit CNAE) industry-quarter ($^{*}p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$).

Table 10: GFC shocks, full panel, control for aggregate external debt

	(1)	(2)
Bank FX debt × Δ EME FX idx	−6.73**	
	(2.76)	
Bank FX debt × Δ EME FX vol		−1.08***
		(0.37)
Bank FX debt × Δ External debt	−3.09	−1.02
	(2.70)	(1.81)
Bank FX debt × Δ Cost of foreign finance	−4.76	−1.06
	(3.47)	(2.69)
Firm × quarter FE	yes	yes
Controls	yes	yes
R^2	0.43	0.43
# observations	3900653	3900653
# firms	132754	132754
# banks	68	68
# industry-quarters	7351	7351

The table reports estimates of versions of the equation

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

where $\Delta\text{Credit}_{f,b,t}$ is quarterly log growth rate of credit provided to firm f by bank b, $\text{Bank FX Debt}_{b,t}$ 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 lagged bank- and loan-level control variables (Capital, Size, NPL, FX debt in loans, FX debt < 1y, 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 (3-digit CNAE) industry-quarter ($^{*}p < 0.1$,$^{**}p < 0.05$,$^{***}p < 0.01$).

Table 11: Global financial cycle shocks and FX Interventions, full panel

	(1)	(2)	(3)	(4)
Bank FX debt × Δ EME FX idx	−6.22***	−10.44***		
	(2.05)	(3.49)		
Bank FX debt × Δ EME FX idx × BCB FX intv	18.27**	18.36***		
	(8.98)	(6.62)		
Bank FX debt × Δ EME FX vol			−1.48***	−2.66***
			(0.34)	(0.75)
Bank FX debt × Δ EME FX vol × BCB FX intv			6.28***	8.20***
			(1.63)	(1.74)
Bank FX debt × BCB FX intv	0.69	0.69	0.21	0.06
	(0.49)	(0.44)	(0.40)	(0.35)
Firm × quarter FE	yes	yes	yes	yes
Controls	yes	yes	yes	yes
Macro interactions	no	yes	no	yes
R^2	0.43	0.43	0.43	0.43
# observations	3900653	3900653	3900653	3900653
# firms	132754	132754	132754	132754
# banks	68	68	68	68
# industry-quarters	7351	7351	7351	7351

The table reports estimates of versions of the equation

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

where $\Delta \text{Credit}_{f,b,t}$ is quarterly log growth rate of credit provided to firm f by bank b, 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, State owned, Exposure to trade, Net FX exposure, Share in firm credit, Default indicator, and Unused credit line); additional macroeconomic variables interacted with Bank FX debt in columns 3 and 6 include: (changes in) BRA money rate, Inflation, IBC BR, and VIX. Standard errors (in parenthesis) are calculated under two-way clustering by bank and (3-digit CNAE) industry-quarter ($^{*} p < 0.1, ^{**} p < 0.05, ^{***} p < 0.01$).

Table 12: GFC shocks and FX Interventions, full panel, additional triple interactions

	idx	idx	vol	vol
	(1)	(2)	(3)	(4)
Bank FX debt × Δ EME FX shock	−8.36***	−5.72***	−1.54***	−1.16***
	(2.58)	(1.74)	(0.31)	(0.26)
Bank FX debt × Δ EME FX shock × BCB FX intv	20.60**	16.08**	4.57***	6.29***
	(8.47)	(7.42)	(1.50)	(1.55)
Bank FX debt × BCB FX intv	0.73	0.72	0.40	0.25
	(0.51)	(0.49)	(0.41)	(0.40)
Bank FX debt × Δ EME FX shock × Δ Macro-pru idx	−0.66***		−0.12***	
	(0.20)		(0.04)	
Bank FX debt × Δ Macro-pru idx	0.00		0.05***	
	(0.01)		(0.01)	
Bank FX debt × Δ EME FX shock × Δ Capital controls		0.33		0.47*
		(1.18)		(0.27)
Bank FX debt × Δ Capital controls		0.04		0.07*
		(0.05)		(0.04)
Firm × quarter FE	yes	yes	yes	yes
Controls	yes	yes	yes	yes
R^2	0.43	0.43	0.43	0.43
# observations	3900653	3900653	3900653	3900653
# firms	132754	132754	132754	132754
# banks	68	68	68	68
# industry-quarters	7351	7351	7351	7351

The table reports estimates of versions of the equation

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

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, 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 (3-digit CNAE) industry-quarter ($^{*} p < 0.1, ^{**} p < 0.05, ^{***} p < 0.01$).

Table 13: GFC shocks and FX Interventions, firm panel

	Δ Total credit		Δ Employment	
	(1)	(2)	(3)	(4)
Bank FX debt × Δ EME FX idx	–3.20		–0.59**	
	(2.37)		(0.29)	
Bank FX debt × Δ EME FX idx × BCB FX intv	27.86*		6.12**	
	(16.27)		(2.96)	
Bank FX debt × Δ EME FX vol		–0.70*		–0.21***
		(0.41)		(0.07)
Bank FX debt × Δ EME FX vol × BCB FX intv		6.06**		1.61***
		(2.30)		(0.46)
Bank FX debt × BCB FX intv	–1.45	–1.61	–0.14	–0.14
	(1.37)	(1.26)	(0.20)	(0.18)
Industry × quarter FE	yes	yes	yes	yes
Firm FE	yes	yes	yes	yes
Controls	yes	yes	yes	yes
R^2	0.19	0.19	0.18	0.18
# observations	1597427	1597427	1597427	1597427
# firms	132754	132754	132754	132754
# main banks	66	66	66	66
# industry-quarters	7140	7140	7140	7140

The table reports estimates of versions of the equation

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

where $\Delta \text{Y}_{f,t}$ is quarterly log growth rate of either total credit provided to firm f (left panel), or employment at firm f (right panel), Bank FX $\text{Debt}_{f,t}$ is weighted average of shares of foreign debt in total liabilities of all active lenders of firm f, $\theta_{i,t}$ is industry-quarter 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 lagged bank- and loan-level control variables (Capital, Size, NPL, FX debt in loans, FX debt < 1y, State owned, Exposure to trade, Net FX exposure, Default indicator, and Unused credit line) aggregated to firm-time level via weighted averaging, as well as firm-quarter controls (log of Total credit, log of Total employment, average log of Tenure, average log of Wage). Standard errors (in parenthesis) are calculated under two-way clustering by main bank and (3-digit CNAE) industry-quarter ($^{*} p < 0.1$,$^{**} p < 0.05$,$^{***} p < 0.01$).

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