Market Positioning and Exchange Rates*

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March 2026

Abstract

We study whether the market positioning of different participants in the Brazilian real (BRL) market affects the currency's sensitivity to domestic and global financial shocks. Leveraging the unique institutional structure of Brazil's FX markets and confidential supervisory data from the Banco Central do Brasil, we construct a comprehensive dataset covering the currency exposures of all major market participants, including their positions in derivatives. Using regressions of BRL returns and implied volatility on measures of sovereign risk and global currency shocks, we allow shock transmission to vary with pre-determined positioning by foreign investors and domestic banks. We find that BRL sensitivity to both domestic and external shocks rises significantly when foreign investors hold larger BRL exposures, consistent with theories emphasizing risk-bearing capacity and demand-driven asset pricing. In contrast, banks' FX exposure—shaped by strict regulatory limits and their role as liquidity providers—has no meaningful influence on the propagation of shocks. Our results highlight the importance of identifying which market participants bear currency risk, and provide evidence that positioning by risk-sensitive investors matters for exchange rate dynamics.

JEL Classification: F31, G15.

Keywords: Market positioning, foreign investors, currency risk exposure, demand-based asset pricing, intermediary asset pricing.

*For helpful comments and discussions, we thank our discussant and participants of Banco Central do Brasil's internal research workshop.

1 Introduction

Practitioners often argue that market positioning – sometimes also referred to as the market's "technical position" – matters for asset price dynamics. According to this view, imbalances in how risk is distributed across market participants may influence how prices react to news, potentially generating movements that appear disproportionate to fundamentals. If that is indeed the case, and if associated asset price swings are material, market positioning should be of interest not only to practitioners (for both expected return and risk-management considerations), but also to regulators and policymakers concerned with proper market functioning and systemic risk.

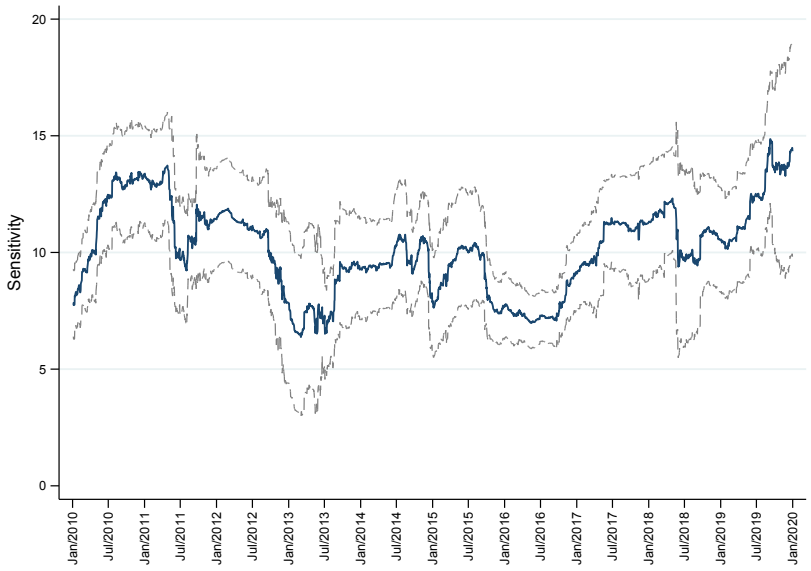
In this paper, we examine empirically whether market positioning helps explain the sensitivity of the Brazilian real (BRL) to domestic and global financial shocks. More specifically, we are interested in whether market positioning alters how the BRL's returns and volatility respond to shocks. Figure 1 shows the rolling-window coefficient of an ordinary least squares regression of the daily return of a long U.S. dollar versus Brazilian real (BRL) position on the daily change in the 5yr Brazilian credit default swap (CDS). The figure illustrates that the BRL's sensitivity to changes in sovereign risk varies substantially over time. We investigate whether patterns of this type can be related to the positioning of different participants in the BRL market.

To address our research question, we exploit the regulatory environment of the Brazilian FX market and confidential supervisory data from the Banco Central do Brasil (BCB), which gives us access to detailed information on the currency positions and exposures of virtually all participants in the BRL market, including positions held through derivatives. This enables us to construct several measures of "market positioning" and examine whether they help account for differences in exchange rate dynamics across states of the world.

We do so by estimating regressions of the BRL's return and volatility on measures of sovereign risk and global currency shocks, allowing the sensitivity of the BRL to vary with predetermined measures of market positioning.

Our results indicate that foreign investors' exposure to BRL is associated with changes in the sensitivity of the BRL to shocks. When foreign investors hold more BRL risk, BRL volatility tends to respond more strongly to movements in Brazilian CDS and in a global EM currency basket. The sensitivity of BRL returns to CDS shocks also appears larger when foreign investors are more exposed. These patterns hold for different measures of foreign investor exposure (e.g., direct investment, portfolio investment). We

Figure 1: Time-varying BRL sensitivity to 5yr Brazilian CDS



Notes: Figure plots the coefficient (and standard-error bands) of an OLS regression of the daily return of a long U.S. dollar position against the Brazilian real on the daily change of 5yr Brazilian CDS. Rolling windows with approximately 1yr of data in each window.

also examine whether the BRL's sensitivity to shocks varies with domestic banks' FX positions. Due to regulatory restrictions, banks generally avoid taking meaningful open FX positions and instead function mainly as liquidity providers across BRL markets (e.g., spot and derivatives). Consistent with this institutional role, we do not find evidence that banks' FX positions meaningfully influence the propagation of shocks.

There are several reasons why market positioning may matter for asset price dynamics. A given trade may become popular and attract too much capital relative to available liquidity – a so-called "crowded trade." In such circumstances, adverse news can induce players to "run for the exit" Pedersen (2009). The exit may prove narrow, and forced liquidations may further depress prices. Positioning may also matter due to the special role of certain market participants. He and Krishnamurthy (2013) develop an equilibrium asset-pricing model in which leveraged intermediaries are marginal investors; their riskbearing capacity influences how asset prices respond to shocks.[1] Empirical work by Adrian and Shin (2010) and Adrian and Shin (2014) and by He, Kelly, et al. (2017) shows that balance-sheet constraints of intermediaries shape asset price co-movements. Furthermore, investors with large positions relative to their risk limits may become vulnerable to "predatory trading" by others, who may strategically exploit their constraints Brunnermeier and Pedersen (2005).

[1] See also Garleanu and Pedersen (2011) for related mechanisms.

Section 2 describes the structure of Brazil's FX market and our data sources. Sections 3 and 4 present our empirical strategy and main results. The final section concludes and outlines directions for future work.

2 Structure of FX market in Brazil and data

This section presents relevant institutional background information as well as details on the data used in the empirical analysis.

2.1 Structure of FX market in Brazil

Despite important regulatory changes in the last decades,[2] the Brazilian real (BRL) is still a non-convertible currency and, with few exceptions, all FX transactions with delivery of a foreign currency must have a financial institution authorized by the BCB as one of the counterparts. Additionally, banks are not allowed to receive demand deposits in dollars and all operations in the FX deliverable market must comply with the FX regulation and be recorded in a system administered by BCB (henceforth "FX trade repository").[3] Brazil has also a deep and liquid FX derivatives market, which is subject to less regulation. Financial institutions regulated by the BCB, however, are subject to strict supervisory rules, capital requirements etc.

Transactions in the deliverable FX market can be classified along two dimensions: one according to the nature of transactions and the other related to the settlement period. Regarding the nature of transactions, the FX market is divided into two segments: the primary market and the secondary market. The primary market is where balance of payments transactions (imports, exports and financial operations) occur and each trade requires an authorized financial institution as intermediary. The secondary or interbank market provides liquidity for the primary market and allows banks to adjust their FX positions according to their risk management strategies. This secondary market is restricted to financial institutions whose participation need to be authorized by the BCB. The FX deliverable market can also be divided according to the settlement period, into: spot market and deliverable forward market. The spot market includes those transactions that settle at most two days after the trade, while the deliverable forward market comprises the remaining cases. Based on the spot market with two-day settlement, the BCB

[2] See, for example, the BCB's technical report Simplification Measures in the Foreign Exchange Area. More recently, a new law revamped FX regulations in Brazil. A version translated to English can be found here.

[3] The system is refered to as "*Sistema Câmbio*". For more information on FX regulation in Brazil, visit the web page Foreign Exchange Policy, and in particular CMN Resolution 3568 and BCB Circular 3691.

calculates and reports a reference FX rate – the PTAX rate – that is used to settle derivatives and price some BRL-denominated assets linked to FX.

In contrast to the broad regulatory environment on the deliverable FX market, there are no restrictions to participate in the FX derivatives (non-deliverable) market. Perhaps as a result of these differences in regulation, the FX derivatives market is more than twice as liquid as the FX interbank market (Central Bank of Brazil 2018). The main FX derivatives products are futures, non-deliverable forwards, swaps and options. Trades take place both in the Futures Exchange ("B3 Exchange") and in the over-the-counter (OTC) market. We point out that even the over-the-counter (OTC) trades must be informed to the FX trade repository.

According to Central Bank of Brazil (2018), "the Brazilian derivatives market is considered one of the most developed in the world". Moreover, empirical evidence (Ventura and Márcio Garcia (2012), Santos et al. (2015)) supports that the currency price discovery takes place in the derivatives market, *i.e.*, the BRL quotation is determined firstly at the derivatives market, more specifically at US dollar futures market, and then transmitted via no-arbitrage to the spot market.

Besides its key role in regulating and overseeing the FX Market, the BCB conducts foreign exchange intervention (FXI) in order to reduce excessive exchange rate volatility. FXI in both interbank and derivatives markets are usually carried out via auctions.[4] In the interbank market, the FXI may be conducted in the Spot market, through auctions to buy or sell a determined amount of UDS dollars to be settle in two days, or the Central Bank may opt for FX Repo operations, in which it offers to sell (or buy) some amount of US dollars at a certain price with the agreement to repurchase (or resell) the same amount of US dollar at a later date. Interbank FXI changes the amount of Reserves Assets and their impact on the monetary base were always automatically sterilized by the monetary policy operations.[5]

In order to intervene in the FX derivatives market, the BCB runs auctions to buy or sell Foreign Currency Swaps traded in the B3 Exchange. Despite the denomination of swap, this type of contract have all the properties of a futures derivatives: differences in settlement prices and margin requirements are settled daily in BRL and there are fixed expiration dates.[6] Different from the interventions carried out in the interbank market, FXI in derivatives do not impact BCB's stock of reserve assets.

[4]For the literature on FXI in Brazil, refer to Nedeljkovic and Saborowski (2019), Chamon, Márcio Garcia, et al. (2017), and Kohlscheen and Andrade (2014).

[5]Brazil adopted an inflation targeting regime in 1999 and employs interest rate as the main policy instrument to control inflation. When there is a change in the monetary base due to Spot FX interventions, there is an automatic adjustment in the volume of Repo operations conducted daily by the Central Bank in order to meet the policy interest rate.

[6]See the BCB's website.

2.2 Data

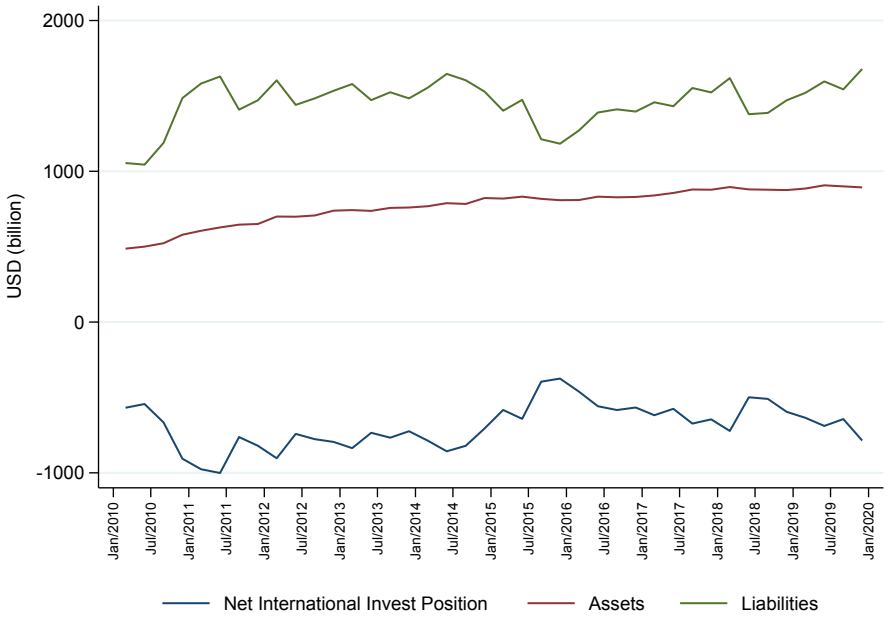
We combine data from many different sources. First, we gather daily market data[7] from Reuters and Bloomberg, such as Brazil 5 Years Sovereign CDS, emerging markets exchange rates against the dollar (including Brazil), 3-month at-the-money option implied volatility of Brazilian currency against dollar, dollar index (DXY), VIX index, among others. Based on those data, we constructed our main dependent variables: daily return of the dollar relative to the BRL (*i.e.*, the percentage change in the exchange rate quoted in units of BRL per dollar) and the daily change in Brazil's currency implied volatility. Additionally, we combined daily FX rates from South Africa (ZAR), Chile (CLP), Colombia (COP), India (INR), Indonesia (IDR), Malaysia (MYR), Mexico (MXN), Peru (PEN) and Russia (RUB) to compose our Emerging Market Dollar Index (EM DXY), employing the same methodology used for computing the U.S. Dollar Index (DXY) published by ICE (Intercontinental Exchange, Inc.).[8] For our shock measures we employ the daily change in Brazil 5 Years Sovereign Credit Default Swap (CDS), measured in basis points, and the daily return of EM DXY (daily percentage change) also measured in basis points. To facilitate analysis, all other percentage related variables, such as FX rate and volatility change are also gauge in basis points units.

Our second set of data comes from Brazil's external statistics compiled by BCB under the guidelines of International Monetary Fund. We rely basically on the International Investment Position, a quarterly statistical statement that reports external financial assets and external financial liabilities of residents of an specific economy. Figure 2 displays the evolution of Brazil's external assets and liabilities during our sample of analysis (from Dec/2009 to Dec/2019). During all period, our Net International Investment Position is negative and its main variation is due to changes in the external financial liabilities.

Figure 3 decomposes the main aggregates of both external financial assets and external financial liabilities. Among the external financial assets (Panel 3a), the most relevant aggregates are Reserve Assets and Direct Investments. Reserve Assets, *i.e.*, "those external assets that are readily available to and controlled by monetary authorities" according to definition in BPM6 manual,[9] displays a relevant growth in the beginning of the sample. This period is marked for the excess of liquidity around the world due to Quantitative Easing monetary policies put in place by developed economies as a response to recession threats triggered by the end Great Recession. Also, at the same time Brazil imposed a series of capital control measures to prevent from excessive appreciation of the BRL (Forbes et al. (2016),Chamon

[7] We collected end of the day quotation for each variable.
[8] The index is a weighted geometric mean of the dollar's value relative to the mentioned emerging market currencies.
[9] See Balance of Payments and International Investment Position Manual - Sixth Edition (BPM6).

Figure 2: Brazil's International Investment Position

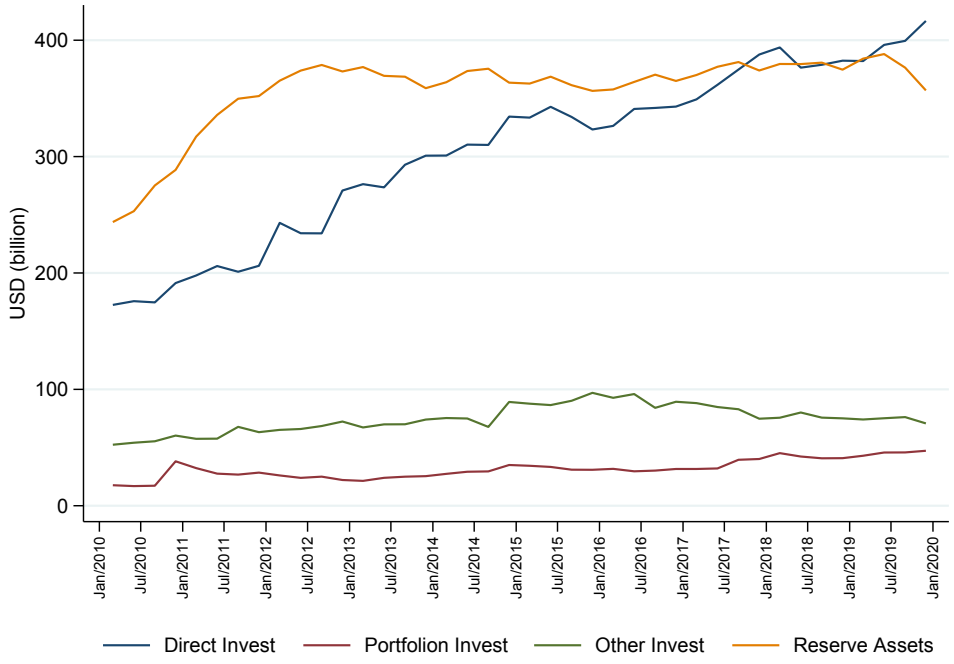


Notes: Figure plots the main aggregates of Brazil's International Investment Position. Data are compiled by BCB under IMF guidelines.

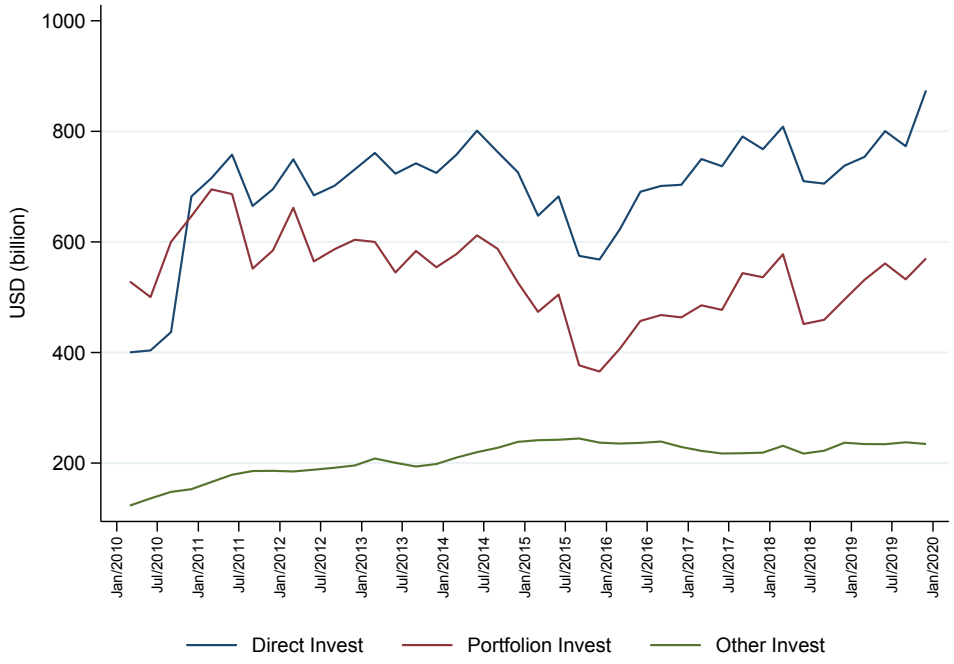
and Marcio Garcia (2016)) and other emerging market countries were also increasing their international reserves (Bianchi et al. (2018)). We also note a steady increase in the amount of Direct Investment abroad by Brazilian residents. That type of investment, according to BPM6 manual, "gives control or a significant degree of influence on the management of an enterprises".

Panel 3b describes Brazil's external liabilities. According to the data, Direct Investment and Portfolio investment accounts each for more than twice the Other Investment amount. Moreover, those two main aggregates are highly correlated ($\rho = 0.75$) and their market are more liquid than Other Investment's. While investors in Portfolio Investment accounts may withdraw their resources by selling their securities in the B3 Exchange or in well organized OTC markets, direct investment holders may repatriate part of their investment by receiving dividends, interest on their invested capital or by anticipating the repayment of loans. On the other hand, transactions that are registered as Other Investment are loans and trade credits whose terms are established during the signing of the contract and the decision to anticipate the repayment depends on the agreement of the Brazilian resident.

Our third main data set is the Daily Risk Report (DDR for the acronym in Portuguese), a BCB's proprietary database that comprises daily bank information concerning banks' exposures and capital



(a) External Financial Assets



(b) External Financial Liabilities

Figure 3: International Investment Position - Main Aggregate Accounts

limits.[10] These data are collected by BCB for the purpose of monitoring the fulfillment of minimum capital requirements in accordance with the guidelines of the Bank for International Settlements (BIS). We constructed our banks' market positioning measures based on the following primary information available in the DDR: i) banks' informed FX exposure (*i.e.*, their required net equity to cover the foreign exchange market risk); ii) banks' net FX exposure calculated as the total of FX long positioned assets and derivatives minus the total of FX short positioned assets and derivatives; iii) banks informed net investment held abroad; and iv) the excess of short position that banks' inform and maintain in order to compensate the fiscal impact due to holding assets abroad, which is known as *overhedge* in the Brazilian regulatory setting.[11]

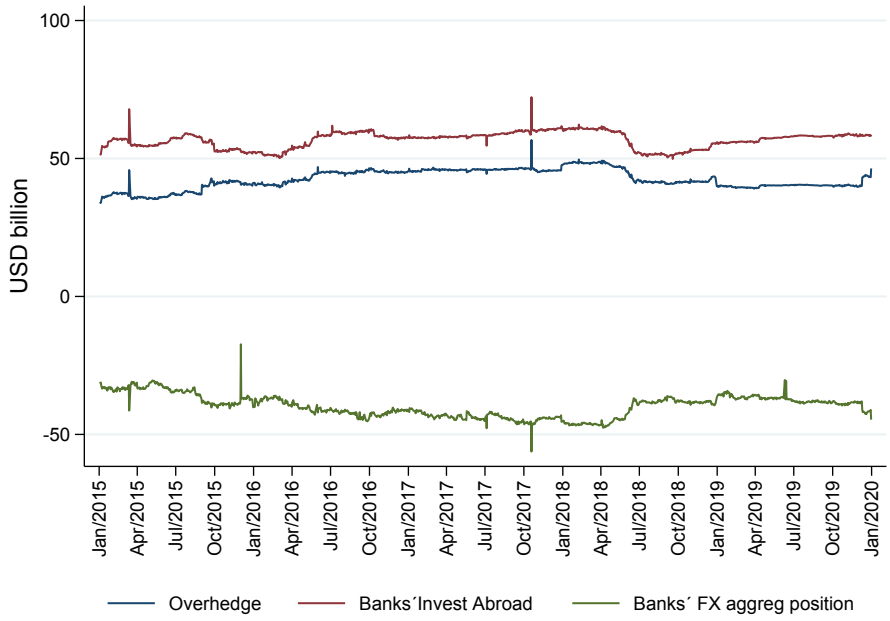
In order to maintain comparability along time, a change in the way banks consolidate their FX exposure imposes us to analyse the influence of banks' market positioning only in the sub-sample starting in Jan/2015. Until Dec/2014, banks's informed their FX positions and FX regulatory risk exposure consolidating their positions inside the Financial Conglomerate shell. In that setting, funds and insurances companies that belongs to a bank holding company were excluded from that consolidation criteria. Since Jan/2015, the consolidating criteria for a bank holding company has been the Prudential Conglomerate and all firms that may add some potential FX risk to the bank must be included in the DDR.

Figure 4 shows the evolution of banks's main aggregates along our sample. We observe a short aggregate position for banks, which is obtained by adding the net FX positions of each bank in a day, during all sample. Moreover, Banks' aggregate position mirrors the aggregate *overhedge* amount ($\rho = -0.97$) which is correlated with the aggregate of net investments of banks abroad ($\rho = 0.55$). As mentioned above, when banks opt for informing and maintain *overhedge* positions, their regulatory exposure is then computed based on their *overhedge* amount, (*i.e.*, their regulatory exposure must be calculated as the difference between the actual position and the informed value for *overhedge*. Additionally, as the capital requirements to counteract foreign exchange risk ranges between 40% to 100% of their regulatory exposures, banks refrain from maintaining FX exposures most of the time to save capital. That explains why the figures of *overhedge* amount and Banks' aggregate position are similar in absolute value and highly correlated over time.

[10] For more detailed information about Minimum Capital Requirements and other related regulation, consult the BCB web page.

[11] The *overhedge* amount is an excess of short position that banks holding investment abroad are allowed to maintain without incurring in FX capital burden. This imbalance is due to the fact that Brazil's Internal Revenue Service does not allow banks to net their gains/losses in assets held abroad with the losses/gain with derivatives used to hedge those positions. For more information on that issue, see the item 2.3 Investment abroad and *overhedge* in BCB's Financial Stability Report, October 2020.

Figure 4: Banks' Aggregated Daily Position



Notes: Figure plots the evolution of the main FX Banks' Aggregated Position. Data are informed by banks to BCB in the Daily Risk Report (DDR). *Overhedge* is the excess of FX short position that banks are allowed to hold to compensate differences in the accounting criteria of gain and losses regarding investment abroad and its corresponding domestic hedging according to Brazil's IRS authority regulations

We conclude this section summarizing the data. Table 1 presents summary statistics for the main variables employed in our analysis related to the Foreign Investors's market positioning influence on the FX rate and FX volatility. For this investigation, we employed data from 2010 to 2019. Along the sample, there are large variation in the levels of FX rate (minimum of 1.54 BRL/USD and maximum of 4.26 BRL/USD) and FX volatility (from 6.95% to 27.63%). The measure of sovereign risk, CDS, also presents large variation in our sample, ranging from 89 b.p. to 533 b.p. Daily changes in the CDS are also relevant. One standard-deviation in ΔCDS (5.83) is equivalent to 3.5% of the median (166.25) and to 6% of the standard deviation (86.3) in the CDS level. Our other shock measure, daily return of EM DXY index, also presents significant variation: its standard deviation (120.69) is greater then the standard deviation of Daily return of FX rate (95.96).

There are also large variation in the market positioning measures according to Table 1. In absolute value, the maximum value of the Net International Investment Position (USD -328 billions) is equivalent to one-third of its minimum record in the sample (USD -1017 billions). Foreign Investor's Position varies from USD 865 billions to USD 1,465 billions, while its more volatile component –Foreign Portfolio Investment – varies from USD 355 billions to USD 708 billions. Moreover, these market positioning

measures are highly correlated, according to Table 3. Its important to point out that External Financial Liabilities are more correlated to the Net International Investment Position ($\rho = -0.72$) than External Financial Assets ($\rho = 0.30$). Among the components of External Financial Liabilities, Foreign Portfolio Investment presents the larger correlation with the Net International Investment Position ($\rho = -0.96$).

We also present descriptive statistics for the sample used to assess the banks' market positioning measures, which goes from Jan/2015 to Dec/2019 (Table 2). Even in the reduced sample, Foreign Investors' position changes considerably from a minimum of USD 904 billion to a maximum of USD 1,407 billions. Moreover, our shock variables represents relevant changes: one standard-deviation in ΔCDS (6.79) is equivalent to 3% of the median (228.99) and to 7% of the standard deviation (93.4) in the CDS level. Additionally, most banks' market positioning measures presents variations in the same order of magnitude as foreign investors' ones. Banks' aggregate FX position goes from USD - 17 billion to USD -56 billions while Banks' FX exposure (the measure calculated based on regulatory requirements) varies from USD -3.66 billion to USD 24.55 billion. The exception are the banks' concentration measures, *i.e.*, the shares of the 5 largest short and 5 largest long positioned banks. The 5 largest short banks accounts for 95% of the total banks' daily short positions and this share varies from 92% to 97% over the sample. The 5 largest long positions banks displays a larger variation (from 75% to 99%) but it is still a highly concentrated market (average of 93%).

Banks' market positioning measures are also correlated with each other and with Foreign investors's measures according to Table 4. As mentioned above, because of capital requirements, Banks FX position is highly correlated with Banks' *Overhedge* ($\rho = -0.96$) and Banks' *Overhedge* follows closely Banks' Investment Abroad ($\rho = -0.59$). This last measure, on the other hand is highly correlated with Foreign Investors' position ($\rho = -0.61$). Therefore, when analysing the impact of banks's market positioning on the propagation of shocks through FX markets, one must control for the correlation between the bank and foreign investors measures.

Table 1: Summary Statistics - Overall Sample (2010-2019)

	Obs	Mean	Median	Std.Dev.	Min	Max
Implied volatility (3-month in %)	2512	14.45	13.77	3.48	6.95	27.63
FX rate (BRL/DOL - end of the day)	2512	2.75	2.64	0.84	1.54	4.26
FX rate (BRL/DOL - ptax)	2512	2.75	2.62	0.84	1.53	4.26
CDS (Brazil 5 Years Sovereign CDS)	2512	192.81	166.25	86.30	89.31	533.32
ΔVol (basis points)	2512	-0.28	-2.50	43.16	-284.90	569.50
ΔCDS (basis points)	2512	-0.01	-0.28	5.83	-38.94	59.65
Daily return of FX rate (basis points)	2512	3.79	2.41	95.96	-544.72	754.04
Daily return of EM DXY index (basis points)	2512	4.58	-1.74	120.69	-466.99	752.67
International Position - Assets (USD billion)	2512	762.65	806.22	119.43	472.42	906.96
International Position - Liabilities (USD billion)	2512	1453.13	1485.39	164.01	968.50	1705.55
Net International Invest Position (USD billion)	2512	-690.48	-685.70	154.05	-1016.67	-327.65
Foreign Investors' Position (USD billion)	2512	1237.75	1279.08	151.00	865.21	1465.28
Foreign Direct Investment (USD billion)	2512	696.30	725.87	106.93	373.03	830.79
Foreign Portfolio Investment (USD billion)	2512	541.45	540.37	76.06	355.32	708.07
Central Bank Net FX Position (USD billion)	2512	314.96	321.70	41.07	234.59	378.39

Table 2: Summary Statistics - Banks' Sample (2015-2019)

	Obs	Mean	Median	Std.Dev.	Min	Max
Implied volatility (3-month in %)	1253	15.65	14.77	3.41	10.06	25.64
FX rate (BRL/DOL - end of the day)	1253	3.52	3.48	0.38	2.57	4.26
FX rate (BRL/DOL - ptax)	1253	3.52	3.48	0.38	2.58	4.26
CDS (Brazil 5 Years Sovereign CDS)	1253	244.56	228.99	93.40	97.37	533.32
ΔVol (basis points)	1253	-0.36	-2.00	41.27	-284.90	569.50
ΔCDS (basis points)	1253	-0.09	-0.58	6.79	-38.94	59.65
Daily return of FX rate (basis points)	1253	3.87	0.00	104.73	-544.72	754.04
Daily return of EM DXY index (basis points)	1253	3.45	-2.29	129.95	-466.99	660.91
Banks FX aggregated position (USD billion)	1253	-39.72	-39.00	4.03	-56.21	-17.33
Banks' FX exposure (USD billion)	1253	2.61	2.73	1.43	-3.66	24.55
Banks' Investment Abroad (USD billion)	1253	56.76	57.57	2.90	49.83	72.23
Banks' Overhedge amount (USD billion)	1253	42.46	41.67	3.51	33.86	56.70
Share of 5 Largest Short Positions	1253	0.95	0.96	0.01	0.92	0.97
Share of 5 Largest Long Positions	1253	0.93	0.93	0.03	0.75	0.99
Net International Invest Position (USD billion)	1253	-591.77	-611.51	104.28	-753.70	-327.65
Foreign Investors' Position (USD billion)	1253	1207.17	1228.74	129.21	903.79	1407.22
Central Bank Net FX Position (USD billion)	1253	313.51	321.70	35.56	254.00	355.47

Table 3: Correlations among components of International Investment Position (2010-2019)

	Assets	Liabilities	Net IIP	Foreign Investors'	Direct Investment	Portfolio Investment	Central Bank Net FX
Assets	1						
Liabilities	0.445***	1					
Net IIP	0.302***	-0.720***	1				
Foreign Investors'	0.269***	0.972***	-0.827***	1			
Direct Investment	0.674***	0.945***	-0.484***	0.881***	1		
Portfolio Investment	-0.415***	0.601***	-0.961***	0.747***	0.343***	1	
Central Bank Net FX	0.257***	0.579***	-0.418***	0.633***	0.630***	0.371***	1

Notes: This table displays the correlation coefficients among the main aggregates of International Investment Position Statements employed as Marketing Positioning measures. The sample goes from Jan/2010 to Dec/2019. Direct Investment and Portfolio Investment refers to Foreign Investors' s position in those specific type of investment. *** p<0.01, ** p<0.05, * p<0.1

Table 4: Correlations among different measures of BRL positions (Sample 2010-2019)

	FX position	FX exposure	Invest Abroad	Overhedge	5 Largest Short	5 Largest Long	Net IIP	Foreign Investors'	Central Bank
Banks FX position	1								
Banks' FX exposure	0.480***	1							
Banks' Investment Abroad	-0.586***	-0.258***	1						
Banks' Overhedge	-0.957***	-0.247***	0.547***	1					
Share of 5 Largest Short	-0.553***	-0.226***	0.317***	0.545***	1				
Share of 5 Largest Long	-0.0167	0.298***	-0.0838**	0.129***	0.00528	1			
Net IIP	0.125***	0.147***	-0.622***	-0.0727*	-0.0845**	0.162***	1		
Foreign Investors'	-0.272***	-0.231***	0.611***	0.226***	0.239***	-0.114***	-0.940***	1	
Central Bank Net FX	-0.768***	-0.257***	0.604***	0.781***	0.595***	0.149***	-0.451***	0.652***	1

Notes: This table displays the correlation coefficients among the main Marketing Positioning measures for banks. The sample goes from Jan/2015 to Dec/2019. . *** p<0.01, ** p<0.05, * p<0.1

3 Empirical strategy

In order to assess whether market positioning matters for FX dynamics, we test if BRL's sensitivity to different types of shocks varies depending on the positions of the main types of market players. Specifically, we estimate the following regression:

$$FX_t = \alpha_0 + \alpha_1 Shock_t + \alpha_2 Shock_t * MktPosit_{t-1} + \epsilon_t, \tag{1}$$

where FX_t is either the daily return of the dollar relative to the BRL (*i.e.*, the percentage change in the exchange rate quoted in units of BRL per dollar) or the daily change in BRL's volatility, and $Shock_t$ refers to either the daily change of Brazil's 5yr CDS or to the daily return of the dollar against our index of Emerging Markets (EM) currencies excluding BRL (EM DXY), which is constructed so that an increase in the index indicates depreciation of the basket of EM currencies relative to the dollar. All these variables are measured in basis points. $MktPosit_{t-1}$ measures predetermined positioning of a given type of market participant when the shock occurs, as explained below.

We focus mainly on foreign investors' and banks' position. As described in Section 2.2, the measures for the two groups differ due to data restrictions. Foreign investors' positions are recorded at the monthly frequency and banks' position are available daily. We emphasize that foreign investors' positions are comprised of domestic financial assets owned by nonresidents and are registered based on balance of payments accounting standards[12] without risk exposure considerations, while banks' positions reflect their overall currency exposure and are marked to market. Although banks's measures are more appropriate for market positioning analysis, we claim that foreign investors's measures consists of a good proxy for Foreign Investors exposure, once the total notional of foreign investors' FX long position in the B3 Exchange represents less than 4% of foreign investors' positioned registered in the International Investment Position.

Our identification relies on the fact that our market positioning measures are predetermined relative to the daily shocks we consider. As a result, while we do not claim that variation in market positioning over time is exogenous, we can assess whether a change in the country's risk premium or an external shock that depreciates emerging market currencies affect the BRL differently depending on how foreign investors or banks were positioned prior to the shock.

[12]Refer to the IMF's manual on Balance of Payments and International Investment Position.

3.1 Foreign Investors

As presented in Section 2.2, foreign investors comprise the largest share of the Brazilian's liabilities in its International Investment Position during the period of analysis: the sum of Foreign Direct Investment and Foreign Portfolio Investment is around 6 times the amount registered in the Financial Assets Liabilities as Other Investments (Figure 3b). Additionally, as pointed out before, the correlation between external financial liabilities and net International Investment Position is more than twice as large as the correlation between external financial asses and the net International Investment Position. This correlation is even higher when we consider only the Portfolio investment position ($\rho = -0.96$). Those facts suggest that Foreign Investors' position may have an important influence on FX dynamics through its preponderance on the determination of Net International Investment Position.

Foreign investors' positions in a particular country may influence the propagation of an exogenous shock through both a passive or an active mechanism. For instance, risk management requisites or portfolio rebalancing among different countries triggered by an internal regulation may result in pension funds adjusting their investments in a specific country. Hence, any exogenous shock that changes the foreign exchange market volatility has a potential to propagate through these type of liquidity spiral, in which the investor reduces (increases) its amounted invested when market volatility increases (reduces) according to some kind of preestablished internal rules (Albertazzi et al. (2020)). Following this reasoning, we argue that the greater the amount of foreign investment in a particular country, the more intense is the shock transmission due to the described reinforcement effect.

On the other hand, the presence of foreign investors may also be associated with leveraged mechanisms (Adrian and Shin (2010) and Adrian and Shin (2014)) in which there is a shift in financial intermediaries' risk appetite in response to changes in market conditions. In that setting, investors like hedge funds increase (decrease) their leverage in response to an decrease (increase) in market volatility. Hence, the larger the presence of the such investors, the more intense is the effect of an exogenous negative (positive) shock in the economy due to a decrease (an increase) in market liquidity that would intensify (dampen) the market volatility or increase (decrease) the price level.

Therefore, the propagation of shock through the FX rate and the FX volatility should occur independent of the type of the investor (conservative or aggressive). Nevertheless, differences in the intensity of the shock propagation could be due to the purpose of the investment and the liquidity of the market. A fast response to shocks are expected where foreign investments are on securities traded in exchanges or in well established over-the-counter markets. Those kind of investments are registered in the International

Investment Position as Portfolio Investment. In contrast, for those investment in financial assets where foreign investors establish an intended long term duration relationship, changes in the short run market conditions may have little or no impact on the investor's decision to increase or decrease their level of investment. This is particularly relevant for investors who intend to have influence on the invested firm's management, which are recorded as Foreign Direct Investment in the International Investment Position. We explore this heterogeneity in Foreign Investment and test whether the impact on the shock propagation are more intense for Portfolio Investment vis-à-vis Direct Investment.

3.2 Banks

Although banks foreign assets and foreign liabilities are not at the same order of magnitude as foreign investors, banks play an important role in Brazilian FX market due to regulatory restrictions. As previously discussed in Section 2.1, non-financial firms and households are not allowed to maintain dollar (or any other foreign currency) denominated deposits in the Brazilian banking system. Moreover, the BCB authorizes financial institutions to operate in the FX spot markets and limit the maximum amount value traded between non-banking firms with their customers spot operations. Therefore, in the vast majority of FX spot market transactions, there are banks as at least one of the counterparts. On the other hand, banks are subjected to capital regulation that prevent them from holding large FX exposure most of the times.

The comprehensive data base that BCB maintains for regulatory purposes allows us to test whether banks' position in FX market impact the propagation of an exogenous shock to FX market variables. Our data provides a more precise measure of banks position, once we have access to banks' FX exposure at daily basis. Hence, we test whether banks' FX exposure in the previous day have an impact on a shock propagation through FX price level and volatility in a given day.

4 Results

In this section, we report the regression results of equation 1. We test separately the influence of the positioning of foreign investors and banks on the propagation of financial shocks, measured by daily change of the Brazil 5 Years Sovereign CDS and the return of Emerging Markets Dollar Index (EM DXY).

4.1 Foreign investors

We first analyse how the country's external financial conditions affect the transmission of a financial shock to the domestic FX market. In order to capture these shocks, we use daily changes of Brazil 5 Years Sovereign CDS. The results of this exercise are reported in Table 5. According to our estimates, Brazil's FX volatility is quite sensitive to changes in the sovereign risk measure. As displayed in column (1), a positive shock of one standard deviation (5.83 bp) corresponds to an increase of FX volatility of 21 basis points, which is equivalent to 49% of the standard deviation of the daily volatility change. Moreover, the relationship between CDS and FX volatility is even stronger once we consider financial external conditions heterogeneity (column (2)). When increase of one standard deviation in our net external liabilities, the sensitivity of FX volatility with respect to CDS rises by 25% (=1.066/4.254).

In columns (3)-(5), we focus our analyses on the Foreign Investors, which constitutes the largest share of Brazil's financial external liabilities. As shown in column (3), the foreign investors position effect is statistically significant and economically releva. An increase of one standard deviation in Foreign Investor Positions is associated to a rise of 25% on the shock propagation of CDS. Moreover, when we decompose Foreign Investor Positions in Foreign Direct Investment (column (4)) and Foreign Portfolio Investment (column (5)), although we observe a larger coefficient for Foreign Portfolio Investment, its impact is not statistically different from the Foreign Direct Investment.

We next analyse the impact of foreign investors'market positions on the FX rate. According to results presented in Table 6, our model has a better fit when we employ FX rate daily return as the dependent variable instead of daily volatility change (adjusted R-squared increases 9 pp). This fact is expected once the change in the sovereign risk entails an adjustment in the FX rate conforming the uncovered interest rate parity theory predicts. According to column (1), a positive shock of one standard deviation in the CDS (5.83 basis points) is associated with a devaluation of Brazilian FX rate of 65 basis points, which corresponds to 58% of the standard deviation of FX rate's daily return.

Columns (2) and (3) follow the same pattern observed for FX volatility. An increase of one standard deviation in the net foreign liabilities or in foreign investors' position is associated with an increase of 9% (=0.922/10.042) in the sensitivity of FX rate with respect the CDS. Nevertheless, when we decompose our foreign investors' position, we note that the result is driven by foreign portfolio investment (column (5)), as one standard deviation increase in this measure are related to a rise of 11% in the sensitivity coefficient. The estimated coefficient for foreign direct investment is lower in magnitude and not statistically different from zero (column (4)).

Table 5: Foreign investors' positioning and sensitivity of BRL volatility to Brazilian CDS

Dependent variable:	Daily changes in BRL volatility				
	(1)	(2)	(3)	(4)	(5)
ΔCDS	3.641***	4.254***	4.235***	3.920***	4.376***
	(0.342)	(0.359)	(0.377)	(0.361)	(0.365)
ΔCDS * Net International Invest Position		-1.066***			
		(0.234)			
ΔCDS * Foreign Investors' Position			1.045***		
			(0.246)		
ΔCDS * Foreign Direct Investment				0.926***	
				(0.329)	
ΔCDS * Foreign Portfolio Investment					1.044***
					(0.219)
Constant	-0.231	-0.508	-0.426	-0.329	-0.464
	(0.751)	(0.727)	(0.729)	(0.738)	(0.729)
Observations	2,512	2,512	2,512	2,512	2,512
Adjusted R-squared	0.242	0.269	0.265	0.254	0.268

Notes: These regressions show how the sensitivity of FX volatility with respect to the Brazil 5 Years Sovereign CDS depends on the market positioning of foreign investors. Dependent variable is measured as daily changes of dollar implied volatility for a 3-month dollar option traded in B3 - Brazilian Stock and Futures Exchange. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 6: Foreign investors' positioning and sensitivity of BRL to Brazilian CDS

Dependent variable:	BRL return				
	(1)	(2)	(3)	(4)	(5)
ΔCDS	9.511***	10.042***	10.027***	9.690***	10.276***
	(0.402)	(0.414)	(0.419)	(0.406)	(0.425)
ΔCDS * Net International Invest Position		-0.922***			
		(0.306)			
ΔCDS * Foreign Investors' Position			0.907***		
			(0.335)		
ΔCDS * Foreign Direct Investment				0.592	
				(0.426)	
ΔCDS * Foreign Portfolio Investment					1.085***
					(0.301)
Constant	3.914**	3.675**	3.745**	3.852**	3.672**
	(1.563)	(1.557)	(1.556)	(1.559)	(1.555)
Observations	2,512	2,512	2,512	2,512	2,512
Adjusted R-squared	0.334	0.338	0.337	0.335	0.339

Notes: These regressions show how the sensitivity of FX rate with respect to the Brazil 5 Years Sovereign CDS depends on the market positioning of foreign investors. Dependent variable is measured as daily returns of FX rate,*i.e.*, the percentage change in the exchange rate quoted in Brazilian reais per dollar. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

In Table 7, our shock measure is the return of EM DXY index. According to our estimates in column (1), Brazil's FX volatility response with respect to other emerging market economies is both economic and statistically significant. For a depreciation equivalent to one standard deviation of the other emerging markets currencies (121 b.p.), BRL volatility increases on average 18 basis points, which corresponds to 42% of the standard deviation of the daily volatility change. In addition, the country's external condition is relevant for this shock transmission. As shown in column (2), this relationship is statistically significant at 1% and a standard deviation decrease in the Net International Investment Position (which could be driven by an increase in Brazil's external financial liabilities) corresponds to an expansion on the average impact of EM DXY of more than 30% (=0.049/0.16).

In columns (3)-(5), we test whether the relationship between Brazil's external financial condition is due to the foreign investors positions. According to column (2) the overall foreign investor's position is associated to an increment on the shock transmission of 21%. Our results suggest that is the position of foreign investor in portfolio that drives the observed results (column (5)). Although the impact of an increase in foreign direct investment on the shock transmission coefficient is not statistically different from zero, an increase of a standard deviation of Foreign Portfolio Investment raises the shock propagation in 28% (=0.046/0.162).

We then show the results describing how the foreign investors' position affect the sensitivity of the FX rate with respect to the Emerging Market DXY index (EM DXY). As we are regressing a FX rate return on an FX rate index return, we obtain a better fit than when using FX volatility as dependent variable. As displayed in column (1) of table 8, a positive shock of one standard deviation in the EM DXY (121 basis points) is associated with a depreciation of Brazilian FX rate of 54 basis points, which corresponds to 56% of the standard deviation of the FX rate's daily return. Nevertheless, there is no statistically significant impact of the interaction between EM DXY and the Net International Investment Position or with Foreign Investors' Position (columns (2) and (3)). If anything, column (4) reports a negative coefficient for the interaction between foreign direct investment and the daily return of the FX rate.

4.2 Banks

We explore in this subsection another source of market positioning variation that might have an effect on the FX market. We focus on banks who detain monopoly power in the Brazilian FX spot market due to the regulatory environment. Nevertheless, as pointed out before, there are other kind of regulation -

Table 7: Foreign investors' positioning and sensitivity of BRL volatility to EM DXY

Dependent variable:	Daily changes in BRL volatility				
	(1)	(2)	(3)	(4)	(5)
EM DXY	0.151***	0.160***	0.156***	0.152***	0.162***
	(0.011)	(0.010)	(0.011)	(0.011)	(0.011)
EM DXY * Net International Invest Position		-0.049***			
		(0.011)			
EM DXY * Foreign Investors' Position			0.033***		
			(0.011)		
EM DXY * Foreign Direct Investment				0.010	
				(0.010)	
EM DXY * Foreign Portfolio Investment					0.046***
					(0.010)
Constant	-0.968	-1.225	-1.130	-1.008	-1.156
	(0.770)	(0.756)	(0.761)	(0.764)	(0.758)
Observations	2,512	2,512	2,512	2,512	2,512
Adjusted R-squared	0.178	0.203	0.187	0.178	0.199

Notes: These regressions show how the sensitivity of FX volatility with respect to the Emerging Market DXY Index depends on the market positioning of foreign investors. Dependent variable is measured as daily changes of dollar implied volatility for a 3-month dollar option traded in B3 - Brazilian Stock and Futures Exchange. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 8: Foreign investors' positioning and sensitivity of BRL to EM DXY

Dependent variable:	BRL return				
	(1)	(2)	(3)	(4)	(5)
EM DXY	0.446***	0.450***	0.445***	0.443***	0.451***
	(0.017)	(0.016)	(0.016)	(0.017)	(0.016)
EM DXY * Net International Invest Position		-0.023			
		(0.014)			
EM DXY * Foreign Investors' Position			-0.009		
			(0.016)		
EM DXY * Foreign Direct Investment				-0.038**	
				(0.017)	
EM DXY * Foreign Portfolio Investment					0.020
					(0.014)
Constant	1.750	1.633	1.795	1.905	1.669
	(1.578)	(1.582)	(1.580)	(1.575)	(1.582)
Observations	2,512	2,512	2,512	2,512	2,512
Adjusted R-squared	0.315	0.315	0.315	0.316	0.315

Notes: These regressions show how the sensitivity of FX rate with respect to the Emerging Market DXY Index depends on the market positioning of foreign investors. Dependent variable is measured as daily returns of FX rate,*i.e.*,the percentage change in the exchange rate quoted in Brazilian reais per dollar. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

specially capital regulation on FX exposure - which hinders the market positioning of Banks.

There is another relevant difference from the previous subsection. We have access to a far more comprehensive proprietary data set that allows us to improve our investigation in two main dimensions: i) our primary source of data consists of data individualized by bank in an specific day, instead of data aggregated by quarter and institutional sector as in the International Investment Position; ii) we have all sources of bank's FX exposure, which allows us to net positions in assets with derivatives as well as make use of the informed FX exposure calculated by each banks according to Central Bank's criteria.

We present in Table 9 our first set of results regarding to the impact of banks's market positioning measures on the sensitivity of FX volatility with respect to CDS. Even columns show the results for each banks' market positioning measure, when we run the same regression as we did for foreign investors' measures. When computing each daily aggregated measure, we attributed positive values for banks's FX long position and negative values for short positions. In column (2) we analyse the impact of Banks's aggregate FX position, which we obtained by summing up all banks net FX position in a given day. In column (4) we aggregate banks' FX exposure, which was calculated also by adding the value that each bank computed and informed to BCB in a given day. In column (6) we restricted our measure to only the amount of assets held abroad by banks. That measure, according to Brazilian regulation during the sample period, would allow banks to hold an excess of short positions in order to meet Fiscal imbalance regulations, which is known as *overhedge*. Columns (8) and (10) report concentration measures by type of position (long x short). We computed the share for the 5 largest banks long (or short) positioned a given day in relation to the overall long (or short) position of all banks in that day.

Overall, the results do not support the claim that banks' market positioning affect the sensitivity of FX Volatility with respect to CDS. All our estimates, but the interaction with Banks's Investment Abroad (column (6)) which is statistically significant at 10%, are not statistically significant at conventional levels. Moreover, when we control for Foreign investors' Position, even the weak impact of Banks's FX exposure vanishes.

We repeat the same exercise to assess the influence of banks' marketing positioning measures on the sensitivity of FX rate with respect to CDS (Table 10) and the results are basically the same. The only difference is that the impact of Banks's investment abroad(column (6) is now the statistically significant at 1% instead of 10%, and the Share of 5 Largest Long Positions are also statistically significant at 1%. Those estimates, though, are not robust to the control of Foreign Investors' Position (columns (7) and (11) respectively).

We also run similar regressions to assess how the sensitivities of FX volatility and FX rate with respect to Emerging Market DXY index change under the interaction with Banks' market positioning measures. Results presented in Table 11 and Table 12 show no evidence for banks' market positioning influence on the FX market variables.

Table 9: Banks' positioning and sensitivity of BRL volatility to Brazilian CDS

Dependent variable:	Daily changes in BRL volatility										
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
ΔCDS	4.045***	3.159***	3.994***	2.993***	3.971***	3.444***	4.050***	3.121***	4.063***	3.101***	4.044***
	(0.656)	(0.462)	(0.554)	(0.363)	(0.490)	(0.575)	(0.649)	(0.507)	(0.669)	(0.479)	(0.649)
ΔCDS * Foreign Investors' Position	1.121***		1.009***		1.141***		1.168***		1.112***		1.118***
	(0.392)		(0.279)		(0.345)		(0.352)		(0.381)		(0.385)
ΔCDS * Banks' FX aggregated position		-0.860	-0.484								
		(0.689)	(0.556)								
ΔCDS * Banks' FX exposure				-0.647	-0.687						
				(0.661)	(0.514)						
ΔCDS * Banks' Investment Abroad						0.744*	-0.074				
						(0.434)	(0.367)				
ΔCDS * Share of 5 Largest Short Positions								0.219	0.137		
								(0.283)	(0.245)		
ΔCDS * Share of 5 Largest Long Positions										0.329	0.014
										(0.333)	(0.266)
Constant	-0.197	-0.090	-0.187	-0.179	-0.294	-0.315	-0.179	-0.061	-0.179	-0.009	-0.194
	(0.975)	(1.002)	(0.976)	(0.983)	(0.955)	(0.959)	(0.949)	(1.024)	(0.982)	(1.027)	(0.978)
Observations	1,253	1,253	1,253	1,253	1,253	1,253	1,253	1,253	1,253	1,253	1,253
Adjusted R-squared	0.293	0.269	0.297	0.266	0.305	0.271	0.293	0.257	0.293	0.258	0.293

Notes: These regressions show how the sensitivity of FX volatility with respect to the Brazil 5 Years Sovereign CDS depends on the market positioning of banks. Dependent variable is measured as daily changes of dollar implied volatility for a 3-month dollar option traded in B3 - Brazilian Stock and Futures Exchange. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 10: Banks' positioning and sensitivity of BRL to Brazilian CDS

Dependent variable:	BRL return										
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
ΔCDS	10.899***	9.199***	10.982***	9.285***	10.963***	9.844***	10.907***	9.117***	10.824***	9.267***	10.842***
	(0.614)	(0.537)	(0.633)	(0.524)	(0.645)	(0.561)	(0.614)	(0.539)	(0.626)	(0.494)	(0.612)
ΔCDS * Foreign Investors' Position	1.976***		2.156***		1.959***		2.048***		2.013***		1.866***
	(0.452)		(0.470)		(0.460)		(0.579)		(0.460)		(0.455)
ΔCDS * Banks' FX aggregated position		-0.020	0.783								
		(0.657)	(0.625)								
ΔCDS * Banks' FX exposure				0.655	0.587						
				(0.695)	(0.483)						
ΔCDS * Banks' Investment Abroad						1.322***	-0.112				
						(0.439)	(0.565)				
ΔCDS * Share of 5 Largest Short Positions								-0.433	-0.581		
								(0.532)	(0.564)		
ΔCDS * Share of 5 Largest Long Positions										1.103**	0.576
										(0.511)	(0.500)
Constant	4.489*	4.679**	4.473*	4.770**	4.572*	4.278*	4.516*	4.623*	4.410*	4.947**	4.640**
	(2.342)	(2.381)	(2.340)	(2.382)	(2.345)	(2.355)	(2.347)	(2.381)	(2.339)	(2.384)	(2.344)
Observations	1,253	1,253	1,253	1,253	1,253	1,253	1,253	1,253	1,253	1,253	1,253
Adjusted R-squared	0.373	0.355	0.374	0.356	0.374	0.362	0.372	0.356	0.374	0.359	0.373

Notes: These regressions show how the sensitivity of FX rate with respect to the Brazil 5 Years Sovereign CDS depends on the market positioning of banks. Dependent variable is measured as daily returns of FX rate,*i.e.*, the percentage change in the exchange rate quoted in Brazilian reais per dollar. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 11: Banks' positioning and sensitivity of BRL volatility to EM DXY

Dependent variable:	Daily changes in BRL volatility										
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
EM DXY	0.108***	0.103***	0.108***	0.104***	0.109***	0.104***	0.108***	0.102***	0.108***	0.104***	0.109***
	(0.011)	(0.011)	(0.011)	(0.012)	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)
EM DXY * Foreign Investors' Position	0.016*		0.016*		0.015		0.020*		0.019*		0.016*
	(0.009)		(0.009)		(0.010)		(0.010)		(0.010)		(0.009)
EM DXY * Banks' FX aggregated position		-0.004	0.001								
		(0.012)	(0.012)								
EM DXY * Banks' FX exposure				-0.015	-0.012						
				(0.016)	(0.017)						
EM DXY * Banks' Investment Abroad						0.005	-0.006				
						(0.010)	(0.011)				
EM DXY * Share of 5 Largest Short Positions								-0.006	-0.010		
								(0.008)	(0.009)		
EM DXY * Share of 5 Largest Long Positions										-0.009	-0.009
										(0.010)	(0.010)
Constant	-0.734	-0.702	-0.738	-0.757	-0.767	-0.709	-0.745	-0.709	-0.727	-0.741	-0.762
	(1.093)	(1.109)	(1.105)	(1.084)	(1.082)	(1.099)	(1.096)	(1.095)	(1.092)	(1.099)	(1.096)
Observations	1,253	1,253	1,253	1,253	1,253	1,253	1,253	1,253	1,253	1,253	1,253
Adjusted R-squared	0.107	0.104	0.106	0.105	0.107	0.104	0.106	0.104	0.107	0.104	0.106

Notes: These regressions show how the sensitivity of FX volatility with respect to the Emerging Market DXY Index depends on the market positioning of banks. Dependent variable is measured as daily changes of dollar implied volatility for a 3-month dollar option traded in B3 - Brazilian Stock and Futures Exchange. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 12: Banks' positioning and sensitivity of BRL to EM DXY

Dependent variable:	BRL return										
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
EM DXY	0.412***	0.412***	0.414***	0.414***	0.414***	0.417***	0.413***	0.410***	0.412***	0.415***	0.416***
	(0.023)	(0.023)	(0.023)	(0.023)	(0.023)	(0.023)	(0.023)	(0.023)	(0.023)	(0.024)	(0.023)
EM DXY * Foreign Investors' Position	0.001		0.006		-0.002		-0.019		0.006		0.001
	(0.021)		(0.022)		(0.021)		(0.026)		(0.022)		(0.021)
EM DXY * Banks' FX aggregated position		0.019	0.021								
		(0.026)	(0.027)								
EM DXY * Banks' FX exposure				-0.022	-0.023						
				(0.030)	(0.031)						
EM DXY * Banks' Investment Abroad						0.024	0.035				
						(0.020)	(0.025)				
EM DXY * Share of 5 Largest Short Positions								-0.020	-0.022		
								(0.023)	(0.024)		
EM DXY * Share of 5 Largest Long Positions										-0.028	-0.028
										(0.026)	(0.026)
Constant	2.450	2.389	2.377	2.387	2.389	2.476	2.511	2.471	2.465	2.364	2.363
	(2.532)	(2.537)	(2.538)	(2.527)	(2.527)	(2.532)	(2.532)	(2.532)	(2.532)	(2.533)	(2.533)
Observations	1,253	1,253	1,253	1,253	1,253	1,253	1,253	1,253	1,253	1,253	1,253
Adjusted R-squared	0.260	0.261	0.260	0.261	0.260	0.261	0.261	0.261	0.260	0.261	0.261

Notes: These regressions show how the sensitivity of FX rate with respect to the Emerging Market DXY Index depends on the market positioning of banks. Dependent variable is measured as daily returns of FX rate,*i.e.*, the percentage change in the exchange rate quoted in Brazilian reais per dollar. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

4.3 Shock asymmetry and market positioning

Once have documented that foreign investors' market positioning have a significant impact on a shock propagation through FX volatility and FX rate, we next investigate the channel for which the foreign investors' position should change the sensitivity of FX variables with respect to our shock measures. Firstly, we distinguish positive shocks, ΔCDS+ and EM DXY+, from the negative ones (respectively ΔCDS− and EM DXY−). Positive shocks are associated with an increase in the country's sovereign risk (ΔCDS+) and with the appreciation of the dollar against emerging markets' currencies. Therefore, as discussed in Section 3.1, one would expect that a response of Foreign Investors to changes in the domestic economy environment (CDS) or variations in the relative value of dollar against other currencies (EM DXY) would be more pronounced for positive shocks. In those circumstances, foreign investors may reduce more their positions for some kind of passive adjustments (portfolio rebalancing due to risk management criteria) or even for deleveraging according to Adrian and Shin (2010) theory, when we compare to their reaction increasing their portfolio when facing favorable shocks (negative ones) in the domestic economy.

We then run a specification similar to Equation (1) in which we differentiate the impacts of positive from negative shocks. To facilitate the analysis, in this exercise, shocks are measured in absolute value. Table 13 displays the results for the relationship between FX volatility and CDS shocks. Column (1) shows that the sensitivity of FX volatility are 86% larger for positive shocks. A positive standard deviation in the CDS (6.79) corresponds to an increase of 31 basis points in FX volatility, which explains ¾ of the standard deviation in FX volatility daily change. In contrast, a decrease of one standard deviation in the CDS is associated with a reduction of 17 basis points in the daily volatility (or 40% of the standard deviation in FX volatility daily change).

When we add our market positioning measures, this asymmetry becomes even more pronounced. An one standard deviation increase in the net external liabilities (column (2)) or in the foreign investors' position (column (3)) is associated with a 25% larger sensitivity of positive shocks (column (2)), while the decrease of daily volatility is smaller for negative shocks (the sensitivity coefficient increases in absolute value of 22% in response to an increase of one standard deviation in the Net International Investment Position and 18% for the same increase in Foreign Investors' position). When we decompose Foreign Investors's Positions, it becomes evident that the effect is mainly driven by Foreign Portfolio Investment (column (5)). The interaction between Foreign Direct Investment and the negative CDS shock is not even statistically significant at standard levels.

We conduct the same analysis for the FX rate as dependent variable (Table 14). Different from the

Table 13: Foreign investors' positioning and sensitivity of BRL volatility to positive and negative changes in Brazilian CDS

Dependent variable:	Daily changes in BRL volatility				
	(1)	(2)	(3)	(4)	(5)
ΔCDS+	4.573***	5.301***	5.257***	4.847***	5.514***
	(0.622)	(0.652)	(0.648)	(0.602)	(0.672)
ΔCDS−	-2.451***	-2.798***	-2.768***	-2.611***	-2.812***
	(0.420)	(0.414)	(0.429)	(0.412)	(0.432)
ΔCDS+ * Net International Invest Position		-1.345***			
		(0.344)			
ΔCDS− * Net International Invest Position		0.623**			
		(0.291)			
ΔCDS+ * Foreign Investors' Position			1.327***		
			(0.352)		
ΔCDS− * Foreign Investors' Position			-0.549*		
			(0.294)		
ΔCDS+ * Foreign Direct Investment				1.168**	
				(0.459)	
ΔCDS− * Foreign Direct Investment				-0.427	
				(0.339)	
ΔCDS+ * Foreign Portfolio Investment					1.352***
					(0.325)
ΔCDS− * Foreign Portfolio Investment					-0.584**
					(0.280)
Constant	-4.192***	-4.777***	-4.635***	-4.271***	-4.990***
	(1.516)	(1.504)	(1.484)	(1.426)	(1.535)
Observations	2,512	2,512	2,512	2,512	2,512
Adjusted R-squared	0.253	0.281	0.277	0.265	0.281

Notes: These regressions show how the sensitivity of FX volatility with respect to the Brazil 5 Years Sovereign CDS depends on the market positioning of foreign investors. Dependent variable is measured as daily changes of dollar implied volatility for a 3-month dollar option traded in B3 - Brazilian Stock and Futures Exchange. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

FX volatility, the FX rate sensibility with respect to CDS does not depend on the direction of the shock (column (1)). Additionally, market positioning measures have larger influence for positive shocks in the CDS. While the sensitivity of FX rate increases about 11.5% for a standard deviation rise in Net External Liabilities and 10.6% for an increase of same magnitude in Foreign Investors's Position, its impact is not statistically significant at conventional levels for the interaction with negative CDS shocks. Moreover, according to column (4) Foreign Direct Investment changes do not have an impact in neither positive nor negative shock sensitivities.

Next, we repeat the previous exercise considering the asymmetry on the Emerging Market DXY shocks. Table 15 reports the results for the sensitivity of FX volatility with respect to EM DXY shocks. As shown it column (1) the sensitivity of positive shocks is more than twice the sensitivity of the negative shocks. The Net International Investment Position interaction is associated with significant increase of the sensitivities coefficients for both shocks (27% increase for positive shocks and 35% increase for negative shocks). When it comes to Foreign Investors' Position, the effect in only statistically significant for positive shocks in EM DXY, which represents an increase of 20% in the sensitivity of FX volatility to positive shocks in EM DXY. Columns (4) and (5) shows that the observed impact for Foreign Investors is driven by Foreign Portfolio Investment.

Finally, Table 16 displays the results for the sensitivity of FX rate with respect to asymmetric shocks in the Emerging Market DXY index. The sensitivity of FX rate with respect to EM DXY does not seem to differ between positive and negative shocks (column (1)). Additionally, although an increase of Net External Liabilities and Foreign Portfolio Investment are associated with an increase in the positive shock sensitivity, this result is not robust to the choice of market positioning measures (for instance, column (3) shows no evidence of Foreign Investors's position influence on the magnitude of the sensitivity of FX rate with respect to EM DXY index).

4.4 Central Bank's net FX position

In this section, we add the Central Bank's Net Position, which is comprised of the amount of reserve assets net of Central Bank's FX derivatives, to our regression model. We point out that this measure changes with the FXI and, hence, is endogenously determined with the FX volatility and FX rate variables. Additionally, as seen in Table 3, Central Bank's Net Position in positively correlated with Foreign Investor's position. One could rationalize that as Central Bank buying reserve assets during capital inflows and reducing its net FX position during capital outflows. Because of this endogeneity, we kept Central Bank's

Table 14: Foreign investors' positioning and sensitivity of BRL to positive and negative changes in Brazilian CDS

Dependent variable:	BRL return				
	(1)	(2)	(3)	(4)	(5)
ΔCDS+	9.527***	10.152***	10.046***	9.691***	10.359***
	(0.673)	(0.695)	(0.697)	(0.669)	(0.720)
ΔCDS−	-9.492***	-9.854***	-9.972***	-9.661***	-10.147***
	(0.677)	(0.697)	(0.706)	(0.671)	(0.726)
ΔCDS+ * Net International Invest Position		-1.169***			
		(0.416)			
ΔCDS− * Net International Invest Position		0.618			
		(0.466)			
ΔCDS+ * Foreign Investors' Position			1.066**		
			(0.458)		
ΔCDS− * Foreign Investors' Position			-0.719		
			(0.506)		
ΔCDS+ * Foreign Direct Investment				0.742	
				(0.589)	
ΔCDS− * Foreign Direct Investment				-0.413	
				(0.607)	
ΔCDS+ * Foreign Portfolio Investment					1.255***
					(0.413)
ΔCDS− * Foreign Portfolio Investment					-0.882*
					(0.464)
Constant	3.849*	3.419	3.796*	3.894*	3.522
	(2.257)	(2.255)	(2.252)	(2.227)	(2.285)
Observations	2,512	2,512	2,512	2,512	2,512
Adjusted R-squared	0.333	0.338	0.337	0.334	0.339

Notes: These regressions show how the sensitivity of FX rate with respect to the Brazil 5 Years Sovereign CDS depends on the market positioning of banks. Dependent variable is measured as daily returns of FX rate,*i.e.*, the percentage change in the exchange rate quoted in Brazilian reais per dollar. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 15: Foreign investors' positioning and sensitivity of BRL volatility to positive and negative changes in EM DXY

Dependent variable:	Daily changes in BRL volatility				
	(1)	(2)	(3)	(4)	(5)
EM DXY+	0.208***	0.214***	0.215***	0.210***	0.219***
	(0.022)	(0.019)	(0.021)	(0.022)	(0.021)
EM DXY−	-0.080***	-0.089***	-0.081***	-0.078***	-0.087***
	(0.017)	(0.016)	(0.017)	(0.017)	(0.016)
EM DXY+ * Net International Invest Position		-0.057***			
		(0.014)			
EM DXY− * Net International Invest Position		0.031***			
		(0.012)			
EM DXY+ * Foreign Investors' Position			0.044***		
			(0.015)		
EM DXY− * Foreign Investors' Position			-0.013		
			(0.012)		
EM DXY+ * Foreign Direct Investment				0.020	
				(0.015)	
EM DXY− * Foreign Direct Investment				0.005	
				(0.012)	
EM DXY+ * Foreign Portfolio Investment					0.055***
					(0.014)
EM DXY− * Foreign Portfolio Investment					-0.027**
					(0.011)
Constant	-6.866***	-6.831***	-7.100***	-6.981***	-7.020***
	(1.512)	(1.349)	(1.463)	(1.512)	(1.414)
Observations	2,512	2,512	2,512	2,512	2,512
Adjusted R-squared	0.190	0.215	0.200	0.191	0.212

Notes: These regressions show how the sensitivity of FX volatility with respect to the Emerging Market DXY Index depends on the market positioning of foreign investors. Dependent variable is measured as daily changes of dollar implied volatility for a 3-month dollar option traded in B3 - Brazilian Stock and Futures Exchange. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 16: Foreign investors' positioning and sensitivity of BRL to positive and negative changes in EM DXY

Dependent variable:	BRL return				
	(1)	(2)	(3)	(4)	(5)
EM DXY+	0.440***	0.449***	0.449***	0.443***	0.453***
	(0.031)	(0.028)	(0.030)	(0.031)	(0.029)
EM DXY−	-0.454***	-0.443***	-0.433***	-0.441***	-0.442***
	(0.030)	(0.031)	(0.030)	(0.030)	(0.031)
EM DXY+ * Net International Invest Position		-0.053***			
		(0.018)			
EM DXY− * Net International Invest Position		-0.022			
		(0.022)			
EM DXY+ * Foreign Investors' Position			0.030		
			(0.021)		
EM DXY− * Foreign Investors' Position			0.060**		
			(0.023)		
EM DXY+ * Foreign Direct Investment				0.000	
				(0.024)	
EM DXY− * Foreign Direct Investment				0.081***	
				(0.022)	
EM DXY+ * Foreign Portfolio Investment					0.048**
					(0.019)
EM DXY− * Foreign Portfolio Investment					0.020
					(0.022)
Constant	2.372	1.759	1.454	1.967	1.578
	(2.512)	(2.470)	(2.503)	(2.513)	(2.495)
Observations	2,512	2,512	2,512	2,512	2,512
Adjusted R-squared	0.314	0.318	0.317	0.318	0.317

Notes: These regressions show how the sensitivity of FX rate with respect to the Emerging Market DXY Index depends on the market positioning of foreign investors. Dependent variable is measured as daily returns of FX rate,*i.e.*, the percentage change in the exchange rate quoted in Brazilian reais per dollar. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Net Position out of our main specification.

Tables 17 to 20 show estimates for the influence of Foreign Investors' market positioning when we control for the Central Bank's Net Position. Although we observe a lower magnitude effect, Foreign Portfolio Investment remain statistically significant at 5% in all specifications. The effect remains significant economically too. An increase of one standard deviation in Foreign Portfolio investment is associated with an increase of 14% (=0.641/4.418) in the sensitivity of FX volatility and with an increase of 9% (=.929/10.292) of the sensitivity of FX rate, both with respect to CDS. When it comes to EM DXY shocks, the sensitivity of FX volatility and FX rates rises even more, respectively, by 29% (=0.047/0.162) and 13% (=0.059/0.462)

4.5 Robustness

In this section, we change our main specification to include the other type of daily shock in the tested model. Tables 21 and 22 assess the effect of foreign investors' market positioning on FX volatility and FX rate sensitivity to CDS shocks while controlling for EM DXY shocks. We note small changes in FX volatility sensitivity coefficients, which remain statistically significant. Nevertheless, the sensitivity of FX rate with respect to CDS loses its significance with the inclusion of EM DXY shock variable.

In the same way, Tables 23 and 24 show how the FX volatility and FX rate sensitivities with respect to EM DXY changes when we control for CDS shocks. The inclusion of CDS yields a model with a better fit (Adjusted R^2 increases by 50%, from around 0.20 to 0.30) and the FX volatility sensitivity remains unaltered. We also point out that the FX rate sensitivity to EM DXY shocks is larger and statistically significant for Foreign Portfolio Investment when we control for CDS shocks.

Finally, we run a model combining both shocks and their market positioning interactions. Results are shown in Tables 25 and 26. We note that the influence of market positioning measures on the sensitivities of FX volatility and FX rate to EM DXY is robust to the inclusion of the CDS shock and its interaction with the market positioning variables. On the other hand, the effect of market positioning on FX rate sensitivity to CDS shocks vanishes when we add EM DXY shock and its interaction with market positioning variables in the same regression (Table 26).

5 Conclusion

Table 17: Central Bank net FX position and the sensitivity of BRL volatility to Brazilian CDS

	(1)	(2)	(3)	(4)	(5)
ΔCDS	3.641***	4.334***	4.253***	4.126***	4.418***
	(0.342)	(0.356)	(0.348)	(0.357)	(0.348)
ΔCDS * Central Bank Net FX Position		0.791*	0.873**	1.281***	0.813*
		(0.429)	(0.404)	(0.340)	(0.420)
ΔCDS * Net International Invest Position		-0.655**			
		(0.304)			
ΔCDS * Foreign Investors' Position			0.462*		
			(0.265)		
ΔCDS * Foreign Direct Investment				-0.092	
				(0.248)	
ΔCDS * Foreign Portfolio Investment					0.641**
					(0.281)
Constant	-0.231	-0.364	-0.277	-0.162	-0.336
	(0.751)	(0.738)	(0.738)	(0.740)	(0.738)
Observations	2512	2512	2512	2512	2512
Adjusted R^2	0.242	0.277	0.272	0.270	0.277

Notes: These regressions show how the sensitivity of FX volatility with respect to the Brazil 5 Years Sovereign CDS depends on the market positioning of foreign investors. Dependent variable is measured as daily changes of dollar implied volatility for a 3-month dollar option traded in B3 - Brazilian Stock and Futures Exchange. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 18: Central Bank net FX position and the sensitivity of BRL to Brazilian CDS

	(1)	(2)	(3)	(4)	(5)
ΔCDS	9.511***	10.088***	10.037***	9.862***	10.292***
	(0.402)	(0.407)	(0.408)	(0.388)	(0.420)
ΔCDS * Central Bank Net FX Position		0.459	0.449	1.070**	0.315
		(0.467)	(0.520)	(0.483)	(0.463)
ΔCDS * Net International Invest Position		-0.683*			
		(0.383)			
ΔCDS * Foreign Investors' Position			0.607		
			(0.468)		
ΔCDS * Foreign Direct Investment				-0.258	
				(0.538)	
ΔCDS * Foreign Portfolio Investment					0.929**
					(0.373)
Constant	3.914**	3.758**	3.822**	3.991**	3.722**
	(1.563)	(1.560)	(1.557)	(1.557)	(1.558)
Observations	2512	2512	2512	2512	2512
Adjusted R^2	0.334	0.338	0.337	0.337	0.339

Notes: These regressions show how the sensitivity of FX rate with respect to the Brazil 5 Years Sovereign CDS depends on the market positioning of banks. Dependent variable is measured as daily returns of FX rate,*i.e.*, the percentage change in the exchange rate quoted in Brazilian reais per dollar. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 19: Central Bank net FX position and the sensitivity of BRL volatility to EM DXY

	(1)	(2)	(3)	(4)	(5)
EM DXY	0.151***	0.161***	0.156***	0.149***	0.162***
	(0.011)	(0.010)	(0.011)	(0.010)	(0.011)
EM DXY * Central Bank Net FX Position		-0.008	0.002	0.038***	-0.002
		(0.010)	(0.012)	(0.013)	(0.010)
EM DXY * Net International Invest Position		-0.053***			
		(0.012)			
EM DXY * Foreign Investors' Position			0.031**		
			(0.012)		
EM DXY * Foreign Direct Investment				-0.018*	
				(0.011)	
EM DXY * Foreign Portfolio Investment					0.047***
					(0.011)
Constant	-0.968	-1.243	-1.123	-0.909	-1.158
	(0.770)	(0.759)	(0.766)	(0.769)	(0.760)
Observations	2512	2512	2512	2512	2512
Adjusted R^2	0.178	0.203	0.186	0.183	0.199

Notes: These regressions show how the sensitivity of FX volatility with respect to the Emerging Market DXY Index depends on the market positioning of foreign investors. Dependent variable is measured as daily changes of dollar implied volatility for a 3-month dollar option traded in B3 - Brazilian Stock and Futures Exchange. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 20: Central Bank net FX position and the sensitivity of BRL to EM DXY

	(1)	(2)	(3)	(4)	(5)
EM DXY	0.446***	0.461***	0.458***	0.448***	0.462***
	(0.017)	(0.016)	(0.017)	(0.017)	(0.016)
EM DXY * Central Bank Net FX Position		-0.098***	-0.095***	-0.056**	-0.089***
		(0.021)	(0.025)	(0.024)	(0.020)
EM DXY * Net International Invest Position		-0.069***			
		(0.017)			
EM DXY * Foreign Investors' Position			0.055**		
			(0.022)		
EM DXY * Foreign Direct Investment				0.004	
				(0.023)	
EM DXY * Foreign Portfolio Investment					0.059***
					(0.017)
Constant	1.750	1.429	1.516	1.756	1.544
	(1.578)	(1.574)	(1.577)	(1.573)	(1.573)
Observations	2512	2512	2512	2512	2512
Adjusted R^2	0.315	0.326	0.321	0.319	0.324

Notes: These regressions show how the sensitivity of FX rate with respect to the Emerging Market DXY Index depends on the market positioning of foreign investors. Dependent variable is measured as daily returns of FX rate,*i.e.*,the percentage change in the exchange rate quoted in Brazilian reais per dollar. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 21: Foreign investors' positioning and sensitivity of BRL volatility to Brazilian CDS, controlling for EM DXY

	(1)	(2)	(3)	(4)	(5)
ΔCDS	2.761***	3.380***	3.349***	3.042***	3.476***
	(0.416)	(0.431)	(0.464)	(0.445)	(0.435)
ΔCDS * Net International Invest Position		-0.895***			
		(0.222)			
ΔCDS * Foreign Investors' Position			0.899***		
			(0.247)		
ΔCDS * Foreign Direct Investment				0.851**	
				(0.339)	
ΔCDS * Foreign Portfolio Investment					0.857***
					(0.208)
EM DXY	0.080***	0.071***	0.073***	0.078***	0.070***
	(0.012)	(0.011)	(0.012)	(0.012)	(0.011)
Constant	-0.610	-0.798	-0.745	-0.689	-0.753
	(0.732)	(0.717)	(0.716)	(0.719)	(0.719)
Observations	2512	2512	2512	2512	2512
Adjusted R^2	0.277	0.296	0.295	0.288	0.295

Notes: These regressions show how the sensitivity of FX volatility with respect to the Brazil 5 Years Sovereign CDS depends on the market positioning of foreign investors. Dependent variable is measured as daily changes of dollar implied volatility for a 3-month dollar option traded in B3 - Brazilian Stock and Futures Exchange. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 22: Foreign investors' positioning and sensitivity of BRL to Brazilian CDS, controlling for EM DXY

	(1)	(2)	(3)	(4)	(5)
ΔCDS	6.422***	6.591***	6.652***	6.528***	6.709***
	(0.464)	(0.487)	(0.521)	(0.504)	(0.497)
ΔCDS * Net International Invest Position		-0.246			
		(0.267)			
ΔCDS * Foreign Investors' Position			0.352		
			(0.305)		
ΔCDS * Foreign Direct Investment				0.323	
				(0.398)	
ΔCDS * Foreign Portfolio Investment					0.344
					(0.265)
EM DXY	0.282***	0.279***	0.279***	0.281***	0.278***
	(0.018)	(0.018)	(0.018)	(0.018)	(0.018)
Constant	2.584*	2.532*	2.531*	2.554*	2.526*
	(1.454)	(1.455)	(1.452)	(1.451)	(1.455)
Observations	2512	2512	2512	2512	2512
Adjusted R^2	0.424	0.424	0.424	0.424	0.424

Notes: These regressions show how the sensitivity of FX rate with respect to the Brazil 5 Years Sovereign CDS depends on the market positioning of banks. Dependent variable is measured as daily returns of FX rate,*i.e.*, the percentage change in the exchange rate quoted in Brazilian reais per dollar. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 23: Foreign investors' positioning and sensitivity of BRL volatility to EM DXY, controlling for Brazilian CDS

	(1)	(2)	(3)	(4)	(5)
EM DXY	0.080***	0.088***	0.085***	0.081***	0.090***
	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)
EM DXY * Net International Invest Position		-0.054***			
		(0.010)			
EM DXY * Foreign Investors' Position			0.044***		
			(0.011)		
EM DXY * Foreign Direct Investment				0.022**	
				(0.010)	
EM DXY * Foreign Portfolio Investment					0.053***
					(0.010)
ΔCDS	2.761***	2.840***	2.879***	2.813***	2.870***
	(0.416)	(0.408)	(0.409)	(0.416)	(0.408)
Constant	-0.610	-0.883	-0.813	-0.695	-0.813
	(0.732)	(0.713)	(0.718)	(0.725)	(0.714)
Observations	2512	2512	2512	2512	2512
Adjusted R^2	0.277	0.308	0.294	0.281	0.306

Notes: These regressions show how the sensitivity of FX volatility with respect to the Emerging Market DXY Index depends on the market positioning of foreign investors. Dependent variable is measured as daily changes of dollar implied volatility for a 3-month dollar option traded in B3 - Brazilian Stock and Futures Exchange. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 24: Foreign investors' positioning and sensitivity of BRL to EM DXY, controlling for Brazilian CDS

	(1)	(2)	(3)	(4)	(5)
EM DXY	0.282***	0.287***	0.284***	0.282***	0.289***
	(0.018)	(0.017)	(0.018)	(0.018)	(0.017)
EM DXY * Net International Invest Position		-0.034***			
		(0.013)			
EM DXY * Foreign Investors' Position			0.017		
			(0.014)		
EM DXY * Foreign Direct Investment				-0.009	
				(0.015)	
EM DXY * Foreign Portfolio Investment					0.037***
					(0.013)
ΔCDS	6.422***	6.471***	6.467***	6.401***	6.496***
	(0.464)	(0.462)	(0.466)	(0.471)	(0.462)
Constant	2.584*	2.411*	2.505*	2.618*	2.444*
	(1.454)	(1.454)	(1.454)	(1.452)	(1.453)
Observations	2512	2512	2512	2512	2512
Adjusted R^2	0.424	0.426	0.424	0.424	0.427

Notes: These regressions show how the sensitivity of FX rate with respect to the Emerging Market DXY Index depends on the market positioning of foreign investors. Dependent variable is measured as daily returns of FX rate,*i.e.*,the percentage change in the exchange rate quoted in Brazilian reais per dollar. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 25: Foreign investors' positioning and sensitivity of BRL volatility to both Brazilian CDS and EM DXY

	(1)	(2)	(3)	(4)	(5)
EM DXY	0.080***	0.083***	0.079***	0.078***	0.084***
	(0.012)	(0.012)	(0.013)	(0.012)	(0.012)
EM DXY * Net International Invest Position		-0.045***			
		(0.011)			
EM DXY * Foreign Investors' Position			0.028**		
			(0.011)		
EM DXY * Foreign Direct Investment				-0.002	
				(0.012)	
EM DXY * Foreign Portfolio Investment					0.044***
					(0.010)
ΔCDS	2.761***	3.065***	3.220***	3.045***	3.142***
	(0.416)	(0.428)	(0.477)	(0.453)	(0.428)
ΔCDS * Net International Invest Position		-0.345			
		(0.212)			
ΔCDS * Foreign Investors' Position			0.588**		
			(0.268)		
ΔCDS * Foreign Direct Investment				0.876**	
				(0.406)	
ΔCDS * Foreign Portfolio Investment					0.350*
					(0.199)
Constant	-0.610	-0.907	-0.826	-0.684	-0.836
	(0.732)	(0.711)	(0.714)	(0.722)	(0.713)
Observations	2512	2512	2512	2512	2512
Adjusted R^2	0.277	0.310	0.299	0.288	0.308

Notes: These regressions show how the sensitivity of FX volatility with respect to the Emerging Market DXY Index depends on the market positioning of foreign investors. Dependent variable is measured as daily changes of dollar implied volatility for a 3-month dollar option traded in B3 - Brazilian Stock and Futures Exchange. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 26: Foreign investors' positioning and sensitivity of BRL to both Brazilian CDS and EM DXY

	(1)	(2)	(3)	(4)	(5)
EM DXY	0.282***	0.291***	0.281***	0.280***	0.291***
	(0.018)	(0.018)	(0.018)	(0.018)	(0.018)
EM DXY * Net International Invest Position		-0.042***			
		(0.016)			
EM DXY * Foreign Investors' Position			0.011		
			(0.018)		
EM DXY * Foreign Direct Investment				-0.027	
				(0.019)	
EM DXY * Foreign Portfolio Investment					0.040**
					(0.016)
ΔCDS	6.422***	6.296***	6.603***	6.577***	6.405***
	(0.464)	(0.494)	(0.531)	(0.502)	(0.502)
ΔCDS * Net International Invest Position		0.269			
		(0.334)			
ΔCDS * Foreign Investors' Position			0.234		
			(0.372)		
ΔCDS * Foreign Direct Investment				0.666	
				(0.482)	
ΔCDS * Foreign Portfolio Investment					-0.117
					(0.324)
Constant	2.584*	2.430*	2.500*	2.626*	2.451*
	(1.454)	(1.454)	(1.454)	(1.452)	(1.453)
Observations	2512	2512	2512	2512	2512
Adjusted R^2	0.424	0.426	0.424	0.425	0.426

Notes: These regressions show how the sensitivity of FX rate with respect to the Emerging Market DXY Index depends on the market positioning of foreign investors. Dependent variable is measured as daily returns of FX rate,*i.e.*,the percentage change in the exchange rate quoted in Brazilian reais per dollar. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

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A Additional results

A.1 XXX