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Capital controls in Brazil: effective?

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CAPITAL CONTROLS IN BRAZIL: EFFECTIVE?

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Abstract

In the aftermath of the 2008 crisis, capital poured in emerging markets, enticing many different responses. No emerging market experimented as actively with capital controls as Brazil did during that period. We analyze the impact of the capital controls that Brazil adopted since late 2009. These policies had some success in segmenting the Brazilian from global financial markets, as measured by the spread between onshore and offshore dollar interest rates, as well as ADR premia relative to the underlying local stocks. The measures adopted from late 2009 to mid-2011 did not translate into significant changes in the exchange rate, suggesting limited success in mitigating exchange rate appreciation. However, the exchange rate strongly depreciates after a tax on the notional amount of derivatives is adopted in mid-2011. The last of the three restrictions studied may have depreciated the Brazilian real by as much 10 percent. That strong response may have been driven by complementarities with the previous measures.

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I. INTRODUCTION

Emerging markets have experienced a strong recovery in capital inflows in the aftermath of the systemic sudden stop in late 2008-early 2009. Flows reached levels comparable to their pre-crisis peak, driven by a combination of relatively favorable fundamentals in emerging markets and a "search for yield" in the context of low interest rates in advanced economies. These flows should, in principle, bring numerous benefits, helping finance investment opportunities that may be otherwise missed, smoothing shocks to consumption and facilitating technology transfers in the case of FDI. But they can also bring risks. One concern is that massive inflows can lead to a strong appreciation of the exchange rate and loss of competitiveness of the tradable sector. Given large adjustment costs, a strong but temporary appreciation may cause lasting damage to industries which may not recover even after the flows abate and the exchange rate returns to its equilibrium level. Large inflows can also complicate macroeconomic management by further stimulating an already overheating economy, particularly if efforts to control inflation through higher interest rates attract more inflows. On the prudential side, there are concerns that flows may be associated with risky external liability structures, and more generally that the flows may not be directed to productive uses, and end-up fueling consumption booms and asset price bubbles instead.

Emerging markets have been aware of these risks from previous surge episodes, but the Global Financial Crisis has heightened these concerns. Recent papers have shown capital controls may play a useful role in managing the macroeconomic and prudential risks associated with flows (e.g. Ostry et al 2010, 2012, Korinek 2011, Rey 2013 and Engel 2013). There has been a marked change in the conventional wisdom among policy makers, with the IMF recognizing capital controls as a valid component of the policy toolkit under appropriate circumstances (IMF 2012).

Brazil has been one of the leading countries in this effort to manage inflows, and one of the most vocal against the loose monetary policy in advanced economy policies that are pushing capital towards emerging markets (the Brazilian finance minister, Guido Mantega, coined the term "currency wars"). It sought to limit inflows in the aftermath of the crisis, adopting taxes on portfolio inflows in October 2009. Over the following two years, Brazil adopted a series of other measures to discourage inflows, starting gradually to dismantle them in 2012.

In this paper, we document that these efforts had some success in segmenting Brazil's domestic financial market from the global one, and analyze the impact of these measures on the exchange rate. The controls on capital inflows further segmented the Brazilian from global financial markets, as measured by wedges between onshore and offshore prices of similar fixed and variable income assets. The response of the exchange rate is more nuanced. There is little effect in the aftermath of the first several measures. While the exchange rate seems to revert from an appreciation trend following some measures, we do not find significantly strong effects on

specifications that consider longer time windows for the first measures. But the exchange rate seems to respond strongly to the last restrictions adopted, beginning with a tax on the notional amount of derivatives. Our estimates point to a response of 10 percent or more, even after controlling for other variables that affect the exchange rate. This strong response may be the result of a cumulative effect of the several restrictions. That is, the response may have been large because the last measures finally closed the main remaining channels to bypass the inflow taxes. That result may also have been supported by the beginning of a monetary policy easing cycle.

Our results are much stronger than those typically found in the capital controls literature, which may be largely driven by the broad and extensive nature of the measures adopted in Brazil. There is a vast literature on the effect of capital controls on the exchange rate. Magud, Reinhart and Rogoff (2011) provide an excellent survey and meta-analysis of that literature. The evidence on the effectiveness of controls on reducing the volume of flows, and hence exchange rate pressures, is mixed. The evidence tends to be stronger for an effect on the composition of flows (e.g. controls on portfolio flows leading to a shift towards FDI or longer maturities for which the control is less burdensome). Part of this shift may just reflect a relabeling of flows. Controls can also have an effect on financial stability (e.g. Ostry et al 2012). Klein (2012) distinguishes between permanent and transitory controls ("walls and gates"), concluding that the latter are not very effective in affecting macroeconomic variables.

Several studies have focused on specific country experiences with controls. Some noteworthy capital controls on inflows in Latin America include the Chilean Unremunerated Reserve Requirement (URR) adopted in 1991-98, and the Colombian URR adopted in 1993-98 and 2007-08. De Gregorio, Edwards and Valdes (2000) who show that the Chilean URR had a very small effect on the real exchange rate, but was more successful in tilting the composition of flows towards longer maturities. Edwards and Rigobon (2009) find a stronger (but still modest) effect of the controls on the exchange rate. Forbes (2007) analyzes the potential costs of the Chilean controls, finding that they increased financing costs, particularly for small and medium enterprises.[2] Cardenas and Barrera (1997) show that the Colombian URR in the 1990s did not affect the volume of flows, but had some success in shifting foreign liabilities towards longer-term maturities. Clements and Kamil (2009) find that the 2007-08 Colombian URR did not have a significant impact on the volume of non-FDI flows, and did not moderate exchange rate pressures.

In the Brazilian context, Cardoso and Goldfajn (1997) show the capital controls were only effective in restricting financial inflows to Brazil in the 1990s for two to six months. Carvalho

[2] Korinek (2011) argues that a successful and welfare increasing prudential regulation, which deters over borrowing, should precisely increase debt costs. But while risky external liability structures can lead to crises, they can also lead to higher growth in tranquil times (Ranciere, Tornell, and Vamvakidis 2010).

and Garcia (2008) present strong evidence that the controls had been bypassed during the first years after the end of hyperinflation (1994), when a combination of controlled exchange rate with extremely high interest rates attracted much carry-trade. Benelli, Segura-Ubiergo and Walker (2011) describe some of the recent measures adopted by Brazil to manage capital inflows, discussing the evolution of flows, domestic financial market developments and the exchange rate. Jinjarak et al (2013) use a synthetic cohort approach to study some of the recent Brazilian controls, and find that the restrictions did not affect flows or the exchange rate. While their approach allows for a counter-factual exchange rate to be constructed based on the evolution of the exchange rate in other countries, it does not allow for other explanatory variables (including Brazil-specific variables) that could affect the exchange rate to be considered.[3] In a contemporaneous paper, Baumann and Gallagher (2012) find that the Brazilian controls had a significant but small effect on the exchange rate. One reason why we find a stronger result than other papers on Brazil is because we take into account the delay in the implementation of the tax on derivatives (whose implementation had a much larger impact on the exchange rate than its announcement).

The recent Brazilian experience provides an ideal context to study the effect of capital controls and restrictions. No other country with a similar level of integration with global financial markets has ever experimented as actively with market-based capital controls, placing Brazil on a category of its own. Our study adds value to the literature on controls for a number of reasons. It provides the most detailed and in depth discussion of the policies adopted and their effect on domestic financial markets. Brazil has very sophisticated capital markets (arguably the most sophisticated among emerging markets), with deep and liquid instruments which we use to document the effectiveness of capital controls in segmenting the domestic and global markets. The measures adopted were transparent and market-based. The inflow tax increases were announced when the market was closed and became effective on the following day, with one exception. This makes these policies particularly suitable for daily-frequency analysis. We use daily data and control for a host of variables that can also affect the exchange rate, including daily sterilized intervention data (not only through spot interventions but also through futures and swaps), and also test the effect of controls over longer horizons.

The remainder of the paper is organized as follows. Section II describes the history of capital controls in Brazil. Section III analyzes the effectiveness of these controls in Brazil, since 2009. It shows how the controls create wedges between prices onshore and offshore, both on the fixed income, and on the variable income markets. Then, it analyzes whether or not the controls were

[3]It is also difficult to recover an intuition for the results, since as pointed out in their paper, the country weights on the synthetic cohort have no economic significance or otherwise interpretable meaning.

able to mitigate the nominal appreciation of the real. Finally, Section IV presents the conclusions and the policy implications of our findings.

II. CAPITAL CONTROLS IN BRAZIL

Controls on capital outflows have a long history in Brazil, since financial repression was the norm until the early 1990s. In 1991, real interest rates were significantly raised to avoid capital flight and help to accumulate foreign reserves. With the low rates prevailing in the US, capital started flowing in the country. So much so, that, starting in 1993, controls on capital inflows were enacted. Unlike the Chilean or Colombian capital controls, which took the form of unremunerated reserve requirements, the capital controls in Brazil took the form of a tax on the exchange rate transaction when capital first entered Brazil. This tax was a particular stance of the IOF tax, which taxes most financial transactions in Brazil with different tax rates (IOF is the Portuguese acronym for Tax on Financial Transactions). Most countries tend to use unremunerated reserve requirements instead of taxes to discourage inflows because the latter typically requires congressional approval. Brazil's case is unique because a general tax on financial transactions (the IOF) already existed, and the Executive was able to extend its coverage to certain foreign exchange transactions, as well as to change its rate, by decree (including setting the tax rate to zero) without congressional approval.

During the nineties, the top IOF tax rate on capital inflows applied to fixed income (carry-trade) was 9%.[4] With the capital flight caused by the Russian crisis and the LTCM debacle, in 1998, the IOF tax rate on capital inflows was set to zero. In 2008, it was again raised to 1.5% for a brief period as a way (albeit imperfect) to equalize the tax treatment of foreigners (who were not subject to the income tax imposed on domestic investors). This IOF was removed when the capital flight associated with the Lehman crisis began. With the resumption of massive capital inflows, as early as February 2009, capital inflows were again deployed.

Table 1 lists the measures that have been adopted in Brazil since October 2009, which are the subject of the current paper. All the IOF tax increases and restrictions listed in that table were announced when the Brazilian market was closed and became effective at the time of their publication (next business day), except for the tax on the notional amount of derivatives.[5] On October 19th, 2009, a tax of 2 percent was imposed on portfolio flows, covering both equities and fixed income. In the past, equity flows were often excluded from such taxes. Unlike the opportunistic and volatile carry-trade, equity flows are typically perceived to be a fairly safe type of flow. Nevertheless, Brazilian equity markets attracted so much capital in the aftermath of the recovery from the Global Financial Crisis that the government, concerned with the exchange rate

[4] Carvalho and Garcia (2008) describe several ways through which the IOF tax was avoided at the time. Cardoso and Goldfajn (1998) also measure the effectiveness of those taxes.

[5] The only other restriction in that table that did not become effective on the following business day was the URR on the Bank's Gross FX Position announced on January 6, 2011, which only became effective on April 4, 2011. In contrast, the tightening of that URR announced on July 8, 2011 became effective on the following business day.

appreciation, decided to include stocks in the controls. Also, the use of stocks as a vehicle to bring funds in the country aiming to replicate fixed income returns, as had happened in the previous Brazilian experience with controls on capital inflows, in the 1990s (discussed in Carvalho and Garcia 2008), may have played a role.

One obvious channel, which allowed investors to bypass the controls in the case of equity flows, was the conversion of Depositary Receipts (DRs). DRs are securities issued by a custodian bank, which receives the underlying stock in Brazil, and issues a corresponding receipt that is traded in foreign markets (e.g. ADRs in the case of U.S. markets). On November 18, 2009 a 1.5 percent tax was imposed on the issuance of DRs to discourage their use as a way to buy Brazilian equities without incurring the inflow tax. When a foreign investor buys a DR, it has the right to convert that DR into the underlying stock in the Brazilian market. This provided a mechanism to enter the Brazilian financial market without incurring the 2 percent tax on capital inflows. Eventually a tax of 2 percent was imposed on those conversions (December 30, 2010). There were no other changes targeting equity inflows, and taxes on equity flows were eventually removed (set to zero) on December 2011, although the 1.5% IOF tax on DR issuance still remains.

The fixed income arena has seen much more regulatory action, as a series of measures tightened restrictions on fixed income flows. The tax on fixed income flows, initially set at 2%, was raised to 4%, on October 4th 2010, and shortly afterwards to 6%,on October 18th, 2010.

The controls discriminate against only a subset of capital inflows (portfolio flows), leaving others untaxed. If a transfer between a financial institution abroad and its domestic counterpart could fall in the non-taxed subset it would not incur the IOF tax. Therefore, foreign investors wanting to do carry trade could buy Non-Deliverable Forward Brazilian reals in offshore markets (where they are beyond the reach of the inflow tax), and the banks could take an offsetting position in Brazil. The end result would be banks selling dollars to the Brazilian Central Bank for reals in order to offset the position (which causes the same pressure on the exchange rate as if the foreigners had come directly). It is difficult to gauge how much such strategies have been used during the last episode of capital controls.

On January 6th, 2011 the central bank announced an unremunerated reserve requirement on banks' gross FX liabilities beyond US$ 3 billion (on the spot market only),[6] which limited the

[6] In Brazil, only banks with a special charter granted by the central bank may trade in the spot exchange rate market. This hindrance has historically stimulated the use of exchange rate derivatives, as discussed in Ventura and Garcia (2011). Also, banks' assets and liabilities in foreign currency have always been closely monitored by the Brazilian Central Bank, and very often controlled. In times of massive capital inflows, restrictions on banks' liabilities are usually deployed, as exemplified by this unremunerated reserve requirement. On the other extreme, i.e., in times of capital flight, limits to FX assets were typically imposed (to avoid further drain on foreign reserves). This is because

(continued)

extent to which the strategy described above could be used to bypass the controls. This requirement became effective on April 4th, 2011. On March 28th, 2011, Brazilian firms borrowing abroad became subject to a 6 percent tax on those flows if their maturity was less than 1 year (extended to two years shortly afterwards). Related measures were adopted to prevent firms from borrowing abroad long-term without paying the tax and then converting the loan to a shorter maturity. Foreign investors could use derivatives to leverage their currency exposure, with the inflow tax only being applied to the money they brought to Brazil to meet their margin requirements. Such strategies were somewhat constrained by the earlier measure restricting banks' gross spot FX positions (which was further tightened on July 8th, 2011). And on July 26th, 2011 a tax on the notional amounts of currency derivatives was announced. The initial tax rate being set at 1 percent, and the maximum rate being set at 25% (although the rate was never actually raised). This tax is levied whenever a currency derivative that shorts foreign currencies is purchased, sold, or at its expiration date (and therefore investors are exposed to the risk that the tax rate increases while they are holding the derivative). This measure became effective on September 16, 2011.

On February and March 2012, additional restrictions were put in place (limiting payments to exporters before actual delivery of goods or services, akin to export credit, and extending the tax on foreign borrowing to loans with maturities up to 3 years, and then up to 5 years). During 2012, capital flows waned. Inflationary concerns, especially after the large reduction of the policy interest rate by the Brazilian Central Bank (from 12.50%, on July 20, 2011 to 7.25%, on October 10, 2012), made further depreciation of the real less desirable. By the end of 2012, a movement to withdraw some of the capital controls started, aimed at attracting capital inflows. The Brazilian central bank started providing U.S. dollars through repo operations (which has a similar effect to sterilized sales of foreign exchange), so as to manage the exchange rate (which hovered around a relatively narrow band above 2 BRL/USD from May/2012 to May/2013, with relatively small volatility). The tax on foreign borrowing was limited to loans with maturities up to two years on June 2012, and eventually limited to loans with maturities up to one year in December 2012. On June 4, 2013, amid concerns about excessive weakening of the Brazilian real, the tax on fixed income flows was eliminated (set to zero). Eight days later, the IOF tax on the notional amount of currency derivatives was also eliminated (set to zero). As of the time of writing, the only remaining restrictions are the 6% tax on short term external loans (eventually limited to loans below 6 months), and the 1.5% tax on issuances of DRs.

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increases in banks' FX liabilities bring liquidity, while increases in banks' FX assets drain liquidity from the domestic FX market.

III. EFFECTIVENESS OF MEASURES

Figure 1 reports the gross capital inflows to Brazil broken down by different types of flows (monthly data). We observe sizable inflows in the period prior to the Global Financial Crisis, with a sharp reversal in late 2008/early 2009 (with the exception of FDI flows which remained positive even at the height of the crisis). But inflows recover rapidly following the crisis, and by mid-2009 inflows are comparable to their pre-crisis levels. The first vertical line indicates the imposition of the 2 percent tax on portfolio flows. Both portfolio equity and debt flows remain strong after the imposition of that tax. The second vertical line indicates the month when the tax on portfolio debt inflows was raised to 4 and then to 6 percent. While portfolio debt flows decline following the increase in the tax, they continue to trickle. Perhaps the most striking pattern in Figure 1 is the sizable increase in FDI flows during this period. While there was indeed much FDI during this period, this shift could partly reflect a relabeling of flows as FDI so as to avoid the inflow tax. One often hears the argument that intra-company loans are classified as foreign direct investment, thereby avoiding the IOF tax. We checked with the Brazilian Central Bank whether this was the case. According to the explanation given to us, the classification of intra-company loans as FDI is solely for statistical purposes. Intra-company loans were taxed at the same rate as regular (non-intra-company) loan with the same characteristics. According to this explanation, it is very hard to avoid the taxes by relabeling flows.[7] Nevertheless, financial institutions that operate both in Brazil and abroad seem to have more room to avoid the IOF, offering offshore products that mimic the Brazilian interest rate, e.g., a total return swap or a cross currency swap. These financial institutions use their operations in Brazil to hedge the offshore operations with Brazilian real products.

It is difficult to assess the effectiveness of controls from the volume of flows, since that would involve making assumptions about the counterfactual volumes in the absence of controls. Also, as previously mentioned, the literature generally fails to find effects of the controls on the total volumes of capital inflows. The main concern is that flows are relabeled in order to bypass the controls, since controls typically exempt some types of flows, notably FDI. One alternative is to focus on differences between onshore and offshore prices of similar assets. If the measures were successful in discouraging capital flows to Brazil, we should have observed the emergence of wedges in local fixed and variable income markets that would have normally been arbitraged away, but could no longer be under the controls on capital inflows (these wedges will emerge to some degree even if the controls are porous and have a limited effect on the volume of flows).

[7] One viable strategy involves a firm bringing in as FDI more money than it actually plans to invest in its business, investing the additional funds in fixed income markets. The gains from this strategy seems limited (unless it is done in a very large scale, e.g. with the firm using offshore derivatives to fund their domestic carry trade). Furthermore, as a local firm, it has to pay income tax.

When it comes to estimating the impact on the exchange rate, we need to estimate a model in order to analyze the impact of the controls (since otherwise we cannot assess what the exchange rate behavior would have been in their absence). Effectiveness is harder to assess along other dimensions. For example, controls on capital inflows can serve a macroprudential role, helping to avoid excessive capital inflows that could inflate bubbles and lead to financial instability. But much of the motivation for the controls was to promote the depreciation of the real. The Brazilian authorities were quite candid about competitiveness concerns. For example, on October 21, 2009 (two days after the first control was announced), Finance Minister Mantega stated that "*We want to prevent an excessive appreciation of the real. When the real appreciates, it makes our exports more expensive and our imports cheaper, and we already have an expressive increase in imports while the exports are not growing as they should*"[8] Therefore, we will focus on the exchange rate as the main metric for effectiveness.

A. Local Fixed Income Markets

The extent to which controls succeed in segmenting fixed income markets can be gauged by the spread between the world interest rate and Brazil's onshore dollar rate. It is illegal to settle contracts in Brazil in any currency other than the Brazilian real (legislation originated in the aftermath of the Great Depression). As previously mentioned, banks, in Brazil, are not allowed to offer deposit accounts in any other currency but the Brazilian real. Nevertheless, there are liquid markets for currency derivatives (currency derivatives did not exist in Brazil when the restrictive FX legislation was created, and were much later used to bypass it). Until 2002, it was common for the government to issue bonds indexed to the exchange rate (while the value of the payment was determined in dollars, it was settled in Brazilian reals at the prevailing exchange rate). But these bonds have been mostly retired. The main liquid instrument with which to obtain a benchmark onshore dollar rate for Brazil is the *cupom cambial*, which is the US dollar (USD) interest rate implied by currency futures. That is, based on the forward exchange rate, the spot exchange rate, and the local currency interest rate, one can easily recover, through Covered Interest Parity, the implied onshore dollar interest rate:

$$1 + Cupom\,Cambial_t = (1 + i_t) * \frac{Spot\,Exchange\,Rate_t}{Forward\,Exchange\,Rate_t}$$

If the onshore dollar interest rate is higher than the world interest rate, gains can be made by arbitrating that difference, without incurring currency risk. But if there are limits to that

[8] Translated from http://www.bbc.co.uk/portuguese/noticias/2009/10/091021_mantega_cambio_dt.shtml.

arbitrage, a persistent wedge between the onshore and offshore dollar rates would arise.[9]The evolution of the onshore dollar rate also has major implications for pressures on the exchange rate, since it measures the local cost of funding carry trades (shorting dollars in the onshore market to long the real).[10] It is possible to profit from the appreciation of the real and the positive interest rate differential via the onshore derivatives traded at BM&FBovespa.[11] The most common trades are to short the US dollar futures contract, to short the contracts on the onshore dollar rate, or to short the onshore dollar rate combined with going long on the domestic interest rate futures (DI x Pre).

Since Brazil emerged from its 2002 crisis, the spread between onshore and offshore dollar rates has been relatively small. For example, in the period between 2005M1 and 2007M6 (during which international financial markets remained tranquil), the spread between the 90 day cupom cambial and the 90-day t-bill averaged less than 50 bps (part of which could be in principle explained by small credit and convertibility risks).

Figure 2A plots the evolution of the cupom cambial with 90 and 360-day maturities. The vertical bars indicate the days in which different measures were announced (with the announced tax being effective on the following business day). That spread hovered around 1 percent in the months prior to the adoption of the different controls. There wasn't much variation in the world interest rate during this period or in Brazil's credit risk. But for the sake of completeness, Figure 2B illustrates the spread between the 360-day cupom cambial, the one-year LIBOR and Brazil's one-year CDS spread, which confirms the overall pattern from Figure 2A (while the 90-day cupom cambial is more liquid than its 360-counterpart, there are no liquid markets for CDS at a

[9] In the past, when country risk was a major concern, large deviations to covered interest parity were observed, due to credit risk (Didier and Garcia, 2003). However, nowadays, for short term transactions among large banks, this is much less of a concern in Brazil.

[10] While a higher onshore dollar rate could in principle make Brazil a more attractive destination to foreign capital, one must bear in mind two things. First, capital inflow taxes are contributing to the higher onshore dollar rate ,i.e., the spread reflects the very effect of the capital controls, because investors are precluded from arbitraging it away. Second, and more importantly, most foreign fixed income flows sought local currency exposure (so if anything, the higher onshore dollar rate is discouraging carry trades by increasing its local funding costs). Banks authorized to do business in Brazil may profit from the higher onshore dollar rate, arbitraging funds borrowed abroad. Since this arbitrage depends on the capacity to borrow abroad with low risk spreads, only major banks undertake it. However, they must obey the limits set by the Central Bank regulation alluded before, as well as their own currency risk limits.

[11] According to its website, "…BM&FBOVESPA is a Brazilian company, created in 2008, through the integration between the São Paulo Stock Exchange (Bolsa de Valores de São Paulo) and the Brazilian Mercantile & Futures Exchange (Bolsa de Mercadorias e Futuros).It is the most important Brazilian institution to intermediate equity market transactions and the only securities, commodities and futures exchange in Brazil. BM&FBOVESPA further acts as a driver for the Brazilian capital markets." (http://www.bmfbovespa.com.br/en-us/intros/intro-about-us.aspx?idioma=en-us)

90-day horizon that would allow a comparison based on the 90-day cupom cambial). On balance, there was not much of an impact on onshore dollar rates following the initial controls. There is more suggestive evidence of an effect following the October 2010 round of controls targeting fixed income. The spread actually declines immediately after restrictions were placed on bank's gross FX positions in January 2011, although it starts to gradually increase soon afterwards, most likely because there was a delay for that measure to squeeze liquidity in the domestic dollar market.[12] The spread spikes shortly after the March-April 2011 taxes on foreign loans. The chart suggests that those measures were more successful in creating a large wedge between external and internal dollar liquidity, with the more liquid 90-day cupom cambial peaking at over 8 percent. Brazilian banks were borrowing abroad short-term to provide dollar liquidity in the local market. The tax on short-term loans temporarily disrupted that flow. But with the resulting large onshore dollar rates, banks switched to long-term borrowing abroad to restore liquidity in the local market. Indeed, after that spike, the onshore dollar rate gradually declines towards more normal levels (which, while non-negligible, are nowhere near the 6 percent tax rate on fixed income flows). This is consistent with the view that controls tend to become more porous over time (in this particular case, the high onshore dollar rate lead banks to tap costlier long-term external funding that was exempt from the tax). But we cannot attribute all fluctuations in the onshore dollar rate to the controls becoming more or less effective over time, since these fluctuations can also be driven by the demand and supply of dollar liquidity in the local market. For example, consider the limiting case where controls create a no arbitrage band within which the onshore dollar rate will be determined by the local supply and demand conditions (a measure may have a different effect depending on whether or not there is excess demand or supply of liquidity in the local market at the time of its adoption).

We now analyze the econometric results linking the behavior of the onshore dollar rate, the *cupom cambial*, to the capital control measures. Table 2 presents the results of a regression of the change in the 90-day cupom cambial on its lagged level, and dummies for the different capital control and restrictions adopted:

$$\Delta cc_t = c + \sum_i \beta_i DControl_{i,t} + \delta cc_{t-1} + \varepsilon_t$$

where *cc* is the 90-day cupom cambial, and $Control_i$ is a singleton dummy that takes the value of one on the day a measure takes effect and zero on all other days. Again, measures were announced after the market was closed on *t-1*, and only two measures had a delayed

[12]A possible explanation for the initial counterintuitive fall of the onshore dollar rate is that the IOF tax was applied to increases in the short position of foreign currency derivatives, i.e., the idea was to tax positions long in BRL akin to the simple carry trade (borrow in USD and go long in BRL interest rate). Therefore, there could have been an initial movement to increase the short position that would serve as the base for the tax, thereby avoiding it, at least partially. In order not to increase the desired risk exposure, an investor could hedge the increase in the short position with an equivalent long position, not taxed, under a different tax ID.

implementation (we include dummies for both the announcement and implementation of the tax on the notional amount of derivatives). Column 1 reports the results of that regression. As expected, there is a tendency for the cupom cambial to decline when its level is large (given by the negative coefficient on the lagged level). The only dummies which have a positive and significant effect are the ones for the taxation of foreign borrowing with less than 2 years, and for the tightening of the URR on Bank's Gross FX Position, with point estimates of 0.8 and 1.1, respectively. This is consistent with the discussion above. Note that the taxation of the notional amount of derivatives has a negative and statistically significant effect on the cupom cambial. This is consistent with that restriction discouraging onshore carry trades (and hence pressure on the cupom cambial). At the bottom of the table we report the average effect of the 13 dummies associated with restrictions on capital flows. The statistic reported corresponds to the sum of the coefficient on those twelve dummies divided by thirteen. The point estimate is very small, and not statistically significant. Columns 2 and 3 consider longer windows for the estimation. Column 2 reports the results of a regression where the dependent variable is the two-day change in the cupom cambial: from *t-1* to *t+1*, where *t* is the first day in which the meausure impacted the dependent variable. This window gives one extra day for the effects of a given measure to impact the cupom cambial. The results are similar, but the magnitude of the effects becomes stronger (a 0.9 and 1.4 percent increase and a 2.1 percent decrease for the three measures that were significant in column 1). The removal of the tax on equity inflows is also associated with a statistically significant decline of 1 percent in the cupom cambial. Finally, column 3 reports the results for a five-day change from *t-2* to *t+2* (where the lagged level is the one at *t-2* and the dummies indicate a measure at time *t*). A longer window adds more time for the effect of a measure to impact the cupom cambial. And by using a longer lag as the starting point, it also addresses potential fears that measures were anticipated (although we were unable to collect anecdotal evidence to that effect). But as the length of the window considered increases, the standard errors become wider. Only the taxation on foreign borrowing up to 2 years and the taxation of derivatives remain significant (point estimates of 1.3 and -1.2, respectively).

Figure 3 plots the evolution of the foreign investors' net position (open interest) in the Brazilian onshore derivative market for fixed income (where positions are centrally cleared at the Brazilian Mercantile and Future Exchange, BM&FBovespa). There is a marked reduction in the foreigners' aggregate net position (open interest) shortly after the tax on the notional amount of derivatives, and beginning of an interest rate easing cycle. The historical peak for that series was 24.6 billion in early July 2011. On the eve of the surprise rate cut (August 31, 2011), that position was 17 billion. By the time the tax on the notional amount of derivatives became effective (September 16, 2011) that position had declined to 11.2 billion and by the end of September 2011 it declined to 1.1 billion. This suggests the tax on derivatives (perhaps in combination with a lower interest rate environment) eliminated onshore carry trades by foreigners via the derivatives market.

There were a number of measures related to the taxation of external borrowing. While that is not directly related to the domestic fixed income market, the evolution of the maturity profile of that borrowing illustrates how the markets can adapt to those measures. Figure 4 plots the external borrowing flows by maturity during 2011 and 2012. Initially, debt with less than one year maturity accounted for half of the flows (and debt with maturity below two years accounted for ¾ of flows). But once the 6% tax is imposed on debt with maturities below one year, those flows disappear almost entirely. Shortly afterwards that tax was extended to maturities up to two years, and virtually all new debt (97%) shifts to maturities above that horizon. Eventually the incidence of the tax is extended to debt with maturity below five years. Flows remain concentrated in the longer-term maturities even after the incidence of the tax is restricted to maturities above 2 years.

The low dollar interest rates made shifting towards longer-term maturities a cheap way to avoid the capital controls. The overall volume of flows is volatile, and on average smaller after the imposition of the tax on short-term loans (although there are cases in the post-tax period where it reaches levels comparable to those prior to the tax).

B. Local Stock Market

The different measures adopted to restrict capital flows have also led to the emergence of premia/discount in variable income markets that could not be arbitraged away. The issuance of DRs involves a small transaction cost, but provides foreigners the ability to buy and sell the DR among themselves without incurring the inflow tax multiple times. Historically, DR prices fluctuated very close to that of the underlying stock. But the imposition of the capital control has created a wider band over which those fluctuations cannot be arbitraged away. For example, even if the ADR traded at a premium close to 2%, it was still “cheaper” for a foreign investor than paying the 2 percent inflow tax to purchase the stock locally. If a sizable premium were to persist, the custodian bank could create more DRs to increase their supply (although that also involves some transaction costs). On the flipside, if the DR were to trade at a discount, it would be worthwhile to convert it into the local underlying stock. Within that limited-arbitrage band, the premium of the DR can fluctuate, depending on whether or not there is excess demand by foreigners for Brazilian stocks. For example, during times when that excess demand is present, the premium should move towards the upper range of that band. During times when that excess demand is weaker the premium will decline.

We focus on the stocks for Petrobras (the state controlled oil company) and Vale (a large mining company), which are the largest companies in the Brazilian market (jointly, they account for about a quarter of the Brazilian equity market capitalization), and by far the most liquid stocks. São Paulo is 1-3 hours ahead of New York (2 hours ahead plus or minus one hour depending on whether it is daylight saving time, in the U.S. or Brazil). We compute the premium by measuring the price of the ADR and the underlying stock as of 12pm EST, a time when both exchanges are open simultaneously, and drop days when either stock exchange is closed.

Figure 5 plots the evolution of the ADR premium for Petrobras. That premium used to fluctuate very close to zero before the controls. It immediately rose following the initial control, and spiked to a level close to 2% following the second control (taxing the conversion of ADRs). That premium declines beginning in the first quarter of 2010, presumably as rising global risk aversion around that time limited the excess demand for Brazilian equities. But the premium rises beginning in late 2010[13] and remains high until the tax on equity inflows is eliminated in December 2011 (at which point the premium starts to converge to zero). In principle, only the first two controls should affect the ADR premium, since all the other measures targeted only fixed income flows. It was common for ADRs to be issued and cancelled during that period (as was also the case prior to the controls), but, as expected, issuances tended to occur when the premium was high, whereas cancellations tended to occur when the premium was low. While foreigners could use the cancellation of DRs as a gateway to the Brazilian local markets, foreign accounts for fixed income and stocks are separately maintained and regulated, and it would take some financial engineering to construct a fixed income position from positions in the stock market. However, the other controls could still have affected the ADR premium through other channels. For example, the increasingly tight fixed income controls signaled that the government was serious about trying to restrict foreign access to local markets, and some investors may have feared tighter restrictions were being contemplated for equity flows.[14]

Table 3 reports the results from regressions analogous to those in Table 2, except that instead of using the cupom cambial we use the ADR premium for Petrobras and Vale. As before, we consider the change from *t-1* to *t*; *t-1* to *t+1*, and *t-2* to *t+2* and dummies indicate a measure at *t*. Columns 1-3 report the results for Petrobras, whereas Columns 5-6 report the results for Vale. As expected, the tax on DR issuance is the measure with the most robust impact, increasing the premium for Petrobras by about 0.5 percent, and the premium for Vale by 0.6-0.9 percent depending on the horizon considered. The increase in the tax on fixed income flows is also associated with an increase in the premium of about 0.5 percent for both stocks (but the effect is not significant for the longer windows in the case of Vale). There are a few other measures that have a statistically significant impact, but the results tend to be mixed. For example, the increase in the tax on fixed income inflows to 6 percent has a positive effect for Petrobras but a negative effect for Vale (and in both cases only of the three event windows). The taxation of foreign borrowing with less than two years maturity has a negative and statistically significant effect on

[13] In September 2010, Petrobras conducted the largest share sale in history, when US$72.8 billion worth of shares in the company were sold. Upon the sale, Petrobras immediately became the fourth-largest company in the world measured by market capitalisation.(http://en.wikipedia.org/wiki/Petroleo_Brasileiro_SA)

[14]Forbes et al. (2012), analyzing the Brazilian experience with capital controls from the point of view of foreign investors, conclude that an increase in Brazil's tax on foreign investment in bonds caused investors to significantly decrease their portfolio allocations to Brazil in both bonds and equities.

some specifications, and the tax on derivatives has a positive effect for one specification for Vale. The removal of the tax on equity inflows lowers the premium for Petrobras by 0.5 percent in the *t-2* to *t+2* window, but does not have a significant effect anywhere else. At the bottom of the table we report the average effect for the twelve dummies associated with restrictions. That average effect is significant for both Petrobras and Vale, with points estimates of 0.10 and 0.12, respectively for the change from *t-1* to *t*, but is not significant for longer horizons. Thus, we do find that different measures have on average been associated with an increase in the ADR premium for those two companies, but the estimates are fairly noisy.

On balance, these results suggest that the controls were reasonably effective in creating at least some segmentation between local and offshore markets. They seem to have been more effective—in the sense of creating spreads commensurate with the inflow tax rate—in the case of equity flows than in the case of fixed income flows. Two factors may have contributed to this pattern. First, the tax on equity flows was kept at 2 percent, which may have limited the incentives to circumvent the controls vis-à-vis fixed income flows. After all, equity investors usually invest for longer terms. Forbes et al. (2012) survey foreign investors, and equity investors stated that most of the recent capital controls in emerging markets were so small that they did not materially affect their portfolio allocations. Second, many of the equity flows are related to institutional investors such as pension funds and mutual funds, which may face regulatory constraints on their ability to trade derivatives and jump through a series of hoops in order to avoid the tax (unlike, say, a hedge fund trying to do carry trade). Reports from the Ministry of Finance confirm that the inflow taxes generated a significant amount of revenues. In 2008 and 2009, the IOF revenues related to currency transactions on inflows was only R$735 million and R$ 1,368 billion, respectively. Those figures rose to R$5,392 and R$4,797 billion in 2010 and 2011 respectively, and declined to R$2,327 in 2012 (the year when the restrictions began to be removed). Figure A1 plots the evolution of these revenues. These figures include a few other currency transactions (data are not available at a finer level of disaggregation), but the vast majority of this volume corresponds to IOF tax on currency transactions related to the capital controls (as indicated by the sizable changes from 2008/09 to 2010/11, and decline afterwards).

C. Effect of controls on the exchange rate

Figure 6 plots the evolution of the Brazilian real-US dollar nominal exchange rate during this period. We follow the convention in Brazil, reporting the exchange rate in terms of *reals* per dollar, so an increase denotes a depreciation of the real. While appreciation trends seem to halt after some of the initial capital controls adopted, the plots do not suggest sizable discrete responses. In contrast, there seems to be sharp movements in the days following the surprise cut and the last restrictions adopted: the implementation of the tax on the notional amount of derivatives, and the tightening of the restrictions on external borrowing. The dots in the figure indicate the volume of the central bank's interventions in the FX market (right axis). Green (red)

dots correspond to interventions where the central bank buys (sells) dollars. There were sizable interventions through most of 2009-11, which the plot suggests failed to stop the appreciation pressures on the real.

In principle, the exchange rate is a forward-looking variable that should jump to reflect any changes in expectation as a result of the different measures adopted. But in practice, it may take some time for the market to digest the implications of the different policies, and the extent to which they succeed in discouraging flows. In order to more formally assess the effect of the capital controls and related measures on the exchange rate, we must control for other factors that could have influenced the latter. The first specification we consider is:

$$\Delta \log(e_t) = c + \sum_i \beta_i DControl_{i,t} + \gamma_1 \Delta\left(CDI_t - LIBOR_t\right) + \gamma_2 \Delta Onshore\ Dollar\ Rate_t +$$
$$\gamma_3 \Delta \log\left(Ibovespa_t\right) + \gamma_4 \Delta \log\left(VIX_t\right) + \gamma_5 \Delta \log\left(Commodities_t\right) + \gamma_6 \Delta \log\left(Dollar\ Index_t\right) +$$
$$\gamma_7 FX\ Purchases_t + \gamma_8 FX\ Sales_t + \grave{o}_t$$

Where *e* is the dollar-real bilateral exchange rate (an increase in *e* denotes a depreciation of the real), $DControl_{i,t}$ is a singleton dummy equal to one on the day of a capital control or other measure, and zero elsewhere. We have thirteen dummies associated with the imposition of capital controls/restrictions, one dummy associated with the easing of a restriction, and one dummy for a surprise cut in the policy rate. The dummies are coded as one on the first day of trading after the announcement of the measure (after the close of market on the previous day). All measures took effect immediately after their announcement, except for a restriction on bank's gross FX positions and the tax on the notional amount of derivatives. For that reason, we also include a dummy for the day in which the tax on the notional amount of derivatives took effect.[15] Additional explanatory variables include the change in the spread between the one-month CDI (Brazil's interbank rate) and the one-month LIBOR, the change in the onshore dollar rate (90-day cupom cambial), the change in log of the Ibovespa stock index (Brazil's most used equity index), the change in the log of the VIX, the change in the log of the CRB commodity price index, the change in the log of an index constructed by the Federal Reserve for the value of the dollar relative to major currencies of advanced economies weighted by U.S. trade shares, and FX interventions by the Central Bank of Brazil, broken down between purchases and sales. We will also consider specifications where the lagged level of the exchange rate, as well as the variables that enter in changes in the specification above, are included (which provides an error correction feature to the dynamics):

[15] We did not include a dummy for the delayed implementation of URR on banks' gross FX position for the sake of conciseness (since it was not as disruptive on implementation as the tax on derivatives). If we include that dummy, it is not significant in any of the specifications considered.

$$\Delta \log(e_t) = c + \sum_i \beta_i DControl_{i,t} + \gamma_1 \Delta\left(CDI_t - LIBOR_t\right) + \gamma_2 \Delta Onshore\ Dollar\ Rate_t +$$
$$\gamma_3 \Delta \log\left(Ibovespa_t\right) + \gamma_4 \Delta \log\left(VIX_t\right) + \gamma_5 \Delta \log\left(Commodities_t\right) + \gamma_6 \Delta \log\left(Dollar\ Index_t\right) +$$
$$\gamma_7 FX\ Purchases_t + \gamma_8 FX\ Sales_t +$$
$$\delta_1 \log(e_{t-1}) + \delta_2\left(CDI_{t-1} - LIBOR_{t-1}\right) + \delta_3 Onshore\ Dollar\ Rate_{t-1} + \delta_4 \log\left(Ibovespa_{t-1}\right) +$$
$$\delta_5 \log\left(VIX_{t-1}\right) + \delta_6 \log\left(Commodities_{t-1}\right) + \delta_7 \log\left(Dollar\ Index_{t-1}\right) + \grave{o}_t$$

The Central Bank of Brazil publishes data on foreign exchange interventions at a daily frequency. We include central bank interventions (measured in billions of dollars) as an additional control in some specifications. This variable is clearly endogenous, as presumably the interventions are at least partly motivated by developments in the exchange rate market. We instrument FX interventions with the first two lags, as well as with the lagged option-implied 3-month volatility of the exchange rate. The use of lagged interventions as instruments is justified by the fact that once the Brazilian Central Bank decided to intervene, it did so for a long time, irrespective of the short term behavior of the exchange rate (as documented in Vervloet, 2010).

The exchange rate data is based on the PTAX rate published by the Brazilian Central Bank. That rate is based on an average of quotes from foreign exchange dealers in Brazil, and is the reference exchange rate typically used for future contracts (including offshore Non-Deliverable Forwards). Using that reference exchange rate also ensures that each daily data does not reflect capital control announcements made on that day (since the announcement of restrictions took place after the closing of Brazilian markets). We use Bloomberg as the source for the remaining variables.

Our sample focuses on the period where Brazil was receiving sizable capital inflows and taking measures to discourage these flows. Our estimation sample begins in June 1, 2009 and ends in March 15, 2012 (when the controls/restrictions began to be gradually loosened). For ease of interpretation of the coefficients, we multiply the variables that enter as log changes by 100, and measure the interest rate differential in percentage points.

Table 4 reports the results from this regression. The first column excludes the intervention variable. The coefficient on the interest rate differential is not significant (which may strike as surprising, but is in line with previous studies on Brazil, e.g. Vervloet, 2010 and Kohlscheen, 2011). The coefficient on the onshore dollar rate is not significant either, which may seem puzzling, but is consistent with the fact that periods where the onshore dollar rate was higher (for example, when controls temporarily succeeded in squeezing liquidity) were not accompanied by

reduced appreciation pressures.[16] The point estimates suggest that a 1 percent increase in the local stock market or in commodity prices is associated with a 0.07 and 0.22 percent appreciation of the real, respectively. A one percent increase in the value of the dollar against advanced economy currencies are associated with a 0.70 depreciation of the real. The coefficient on the VIX is not statistically significant (but would become significant if the dollar currency index was dropped, which may be capturing changes in global risk aversion that would otherwise be explained by the VIX, and is significant in some of the other specifications on the table). The magnitudes are plausible and in line with previous estimates, and the coefficients in these variables remain comparable across all specifications in Table 1. Turning to the main variables of interest, the capital control/measures with a positive and significant result include the initial control, the tax on the notional amount of derivatives, and the taxation of external borrowing with less than 5 years, with point estimates of 1.2, 1.4, and 2.3 percent, respectively. The coefficient on the tax on foreign borrowing up to two years is significant but negative (-1.1 percent). At the bottom of the table we report the average effect for the thirteen dummies associated with the controls/restrictions adopted. That statistic has a point estimate of 0.34 percent, and is statistically significant. Taking this result at face value, and treating all the changes as permanent would point to a cumulative effect of the twelve measures (that average multiplied by thirteen) of 4.5 percent on the exchange rate.

In Column 2 we add the central bank's intervention as an additional variable. The estimates suggest that interventions had no effect on the exchange rate, neither when the central bank purchased dollars nor when it sold. In principle, the capital controls could have increased the traction of FX interventions (since they further segment the domestic and foreign financial markets, strengthening portfolio effects). But lack of an effect is consistent with the fact that the real steadily appreciated despite frequent and sizable interventions (Figure 6). There were only 6 instances where the central bank intervened by selling dollars in our sample, which makes it difficult to identify an effect. Sterilized sales became much more common after March 2012 (as shown in Figure 6).

One possible explanation for why the central bank buying dollars does not affect the exchange rate involves the onshore dollar rate market. As explained before, and documented by Figure 2, the onshore dollar rate in Brazil runs above the equivalent rate in the US. When the Brazilian Central Bank conducts sterilized purchases of foreign exchange, the onshore dollar rate increases and large banks start bringing short term funds borrowed abroad to profit from the higher interest rate differential, without incurring in currency risk. The increase in the supply of foreign exchange provided by this dollar-interest-rate arbitrage tends to mitigate the effect of the

[16]The point estimates are compatible with the interpretation that increased onshore dollar rate attracts more funds, thereby appreciating the currency. This result was also true before the controls (Vervloet 2010).

sterilized purchases on the exchange rate. However, the reverse effect does not occur. When the Central Bank conducts sterilized sales of foreign exchange, thereby lowering the onshore dollar rate, this does not entice banks to borrow dollars in Brazil and invest them abroad, since the onshore dollar rate is still superior to its counterpart abroad.

Columns 4-6 are analogous to Columns 1-3 but also include the lagged level of the log of the exchange rate, interest rate spread, onshore dollar rate, VIX, commodity prices and dollar index as controls. This specification allows the exchange rate to revert to a long-run level that will depend on the levels of these other explanatory variables (an error correction model). The results are fairly comparable to those in Columns 1-3. The coefficient on the interest rate differential becomes significant, but its magnitude remains very small (a 1 percent increase would appreciate the real by only 0.15 percent on impact). The coefficients on the lagged levels of the independent variables are not reported for the sake of conciseness. The coefficient on the lagged level of the log exchange rate is -0.04 and -0.05 in columns 4 and 5 (suggesting that in any given day, a one percent deviation from the long-run level is associated with a 0.04 and 0.05 percent correction towards that level, respectively). That coefficient is not statistically significant in column 6. The results on the capital control dummies are fairly comparable across all specifications in the table. The average effect for the 13 dummies related to capital controls/restrictions ranges from 0.29 to 0.36, which would imply a combined effect, if changes were treated as permanent, of 4-4.5 percent, and is significant in all but one of the specifications (column 3).

In order to test for an effect of the controls at different horizons, we ran similar regressions to the ones in Table 4 but spanning longer time windows. Table 5 reports the results when the dependent variable is the change in the exchange rate from *t-1* to *t+1* and the dummies still take the value of one at *t* and zero elsewhere. For the sake of conciseness, we only report the coefficients for the variables of interest. Each column reports the result from a regression analogous to the one from the same column of Table 4 (except for the longer time window for the change in the dependent variable).The dummies for the initial 2 percent tax on portfolio inflows and the dummy for the tax on foreign borrowing with less than 5 year maturity remain statistically significant with a positive sign, with point estimates of about 1.6 and 2.5 percent, respectively. The dummy for the implementation of the tax on the notional amount of derivatives is now significant, with a point estimate of 3.2 percent (the highest point estimate of all the dummies). The dummy on the surprise rate cut is also and has a point estimate ranging from 1.9-2.4 percent. The dummy on the taxation of foreign debt up to two years continues to point to a negative and statistically significant effect (with a point estimate of about -1.9 percent). At the bottom of the table we report the average effect of the 13 dummies related to capital controls/restrictions. The average point estimate is about 0.56, and is statistically significant across all specifications. However, the effect is being driven by the last controls/restrictions, with the average effect associated with the first 9 measures being close to zero (ranging from -.05 to 0.01).

Table 6 is analogous to Table 5, but reports the results for the change in the exchange rate from *t-2* to *t+2* with dummies that take the value of one at *t*. This specification provides one extra trading day for the measures to impact the exchange rate. And the base for comparison is the exchange rate at *t-2*, which can also address concerns that the announcement of some measures may have been anticipated at *t-1*. But as discussed previously, the standard errors increase with the horizon considered, which makes it more difficult for a one-off change of a given size to be statistically significant. Among the capital controls and restrictions, only the dummies for the implementation of the tax on derivatives, and for the taxation of foreign borrowing with less than 5 year maturity remain significant, with point estimates of about 3.3 and 2.5, which are comparable to the ones in the previous table. The dummy on the surprise rate cut remains significant in all specifications, with a point estimate ranging from 2.3 to 3.2. When we compute the average effect for the 13 dummies related to capital controls/restrictions, the point estimate ranges from 0.70 to 0.85. If we take this point estimate at face-value and multiply it by thirteen (treating all the changes as permanent), the combined effect is about 10 percent. But again, much of the effect is coming from the very last measures, with the average effect from the first 9 restrictions ranging from 0.21 to 0.41 (so less than half of the average when we include the last 3 dummies), and is not statistically significant.

In Table 7 we repeat the same exercise, but consider the change in the exchange rate from *t-2* to *t+5*. The only dummies related to capital control/restrictions that remain significant are the ones associated with the last 3 restrictions: the implementation of the tax on derivatives, and the taxes on external borrowing with less than 3 and less than 5 years. The last two measures have point estimates of about 3 percent, but the implementation of the tax on derivatives has point estimates that range from 4.9 to 7.0 percent. The surprise rate cut is also statistically significant in all specifications, with a point estimate ranging from 2.9 to 4.1 percent. When we compute the average effect for the twelve dummies related to capital controls/restrictions, the point estimate ranges from 1.02 to 1.36. Taking these results at face-value, the combined effect of adding all thirteen dummies is about 15 percent. But again, the effect is driven mainly by the last three restrictions. When we estimate the average effect of the first nine restrictions, the point estimate becomes smaller (ranging from 0.41 to 0.58) and is no longer statistically significant.

Finally, in Table 8 we repeat the exercise considering the change in the exchange rate from *t-2* to *t+10*. The results are similar to the ones in Table 7, with the last 3 capital controls/restrictions remaining significant (with the exception of one specification for two of the measures). The dummy for the tax on external borrowing with less than 3 years has the largest point estimates, ranging from 3.5 to 5.5. The point estimates for the implementation of the tax on derivatives ranges from -0.3 to 4.4, while the one for the tax on external borrowing with less than 5 years ranges from 2.6 to 3.5. The dummy for the surprise rate cut is significant across all specifications, with a point estimate that ranges from 7.4 to 9.7 percent. The average effect for

the twelve dummies related to capital controls/restrictions is about 1 percent and statistically significant in columns 1-3, but only about 0.5 percent and no longer statistically significant in columns 4-6.

To summarize, the results above do suggest that on average the controls had some success in depreciating the real. But the effect seems to be driven mainly by the last three measures adopted. It is difficult to disentangle whether those measures were particularly effective, or whether it was the accumulation of those measures with the previous ones that made them particularly effective (for example, if they succeeded in closing the remaining avenues with which to bypass the controls).

The regressions above consider the behavior of the exchange rate over relatively short windows. It is difficult to ascertain how much of those changes are temporary and how much proved persistent. Some of our regressions treated the effect of the controls as permanent, while others allowed the exchange rate to revert back to its mean (or more precisely, to the level implied by the levels of the other explanatory variables). But one should be careful when using such features of the specifications to ascertain dynamic behavior, since the models are fitted to explain the relatively short-term changes in the exchange rate. As an alternative approach, Figure 7 plots the actual exchange rate as well as the fitted exchange rate implied by a regression of the log of the exchange rate on the log of the explanatory variables (excluding capital control/measure dummies and sterilized interventions). This regression is equivalent to the co-integration relationship estimated in an error-correction model, and is estimated in different sub-samples, so we can compare the out-of-sample results with the actual exchange rate. There is a vast literature beginning with Meese and Rogoff (1981), recently reviewed in Engel (2013) that shows how difficult it is to forecast exchange rates. But the goal of this exercise is not to forecast exchange rates. Instead it is just to gauge whether the sustained depreciation of the real in 2012 can potentially be explained by the evolution of these explanatory variables. As expected, the fitted values closely track the exchange rate in-sample, but diverge from actual values out-of-sample. We present results when the estimation sample ends in December 30, 2010 (last tightening of controls on portfolio flows), in July 26, 2011 (tax on the notional amount of derivatives), and March 15, 2012 (beginning of easing of restrictions). In all cases, the fitted values are only systematically below the actual exchange rate beginning around the time of the surprise interest rate cut and start of the monetary policy easing cycle. This divergence becomes more pronounced in the period after March 2012, when the easing of restrictions begins, with the fitted values hovering at a level 5 to 10 percent more appreciated than the actual exchange rate.

A comparison of the Brazilian real with other emerging market and commodity currencies also suggests a break towards the end of 2011, which becomes even more pronounced in 2012. Figure 8 plots the evolution of the Australian dollar, Chilean and Colombian pesos, South African rand, and Turkish lira during 2009-12. The real seems to closely track the South African

rand and the Chilean and Colombian pesos during much of this period. But beginning in July 2011 (around the time of the tax on derivatives), the real tends to depreciate substantially vis-à-vis the Chilean and Colombian pesos. It eventually stabilizes at a much more depreciated level, along with the South African rand and Turkish lira (whose depreciation trends started earlier, around mid-2011 and late-2010, respectively).

The different strands of evidence seem to point to an effect of controls on the order of 5-10 percent, but concentrated towards the last restrictions adopted. Cuts to the policy rate also contributed to a weaker currency, and the effect may have been boosted by previous controls. For example, it is possible that a 6 percent tax failed to deter inflows in an environment where the policy rate was 12.5 percent, but that same tax proved more of a deterrent in a lower interest rate environment (the policy rate was cut by 525bps over the easing cycle that begin with the October 2011 surprise cut). When estimating the effect of a given measure on the exchange rate, our dummy variable captured a snapshot at that particular time. But it is possible that the very same measure may complement follow-up measures down the road. For example, expanding the restrictions on borrowing abroad may have had a more limited impact in the absence of taxes on portfolio inflows. And the effect of measures may have been boosted in an environment with a lower policy rate.[17]

Another institutional detail that must be borne in mind is that price discovery in Brazilian FX markets occur in the futures market, at the first-to-mature contract (Garcia, Medeiros and Santos, 2014). I.e., the exchange rate is formed in the trades of the first-to-mature futures dollar contract at the BM&FBovespa. Those markets are also fairly segmented from world markets because the Brazilian real is a non-convertible currency, meaning that it cannot be traded outside Brazil, unlike, say, the Mexican Peso. This may have contributed to the effectiveness of the derivative tax in depreciating the exchange rate.

The focus of our analysis has been the effect of the controls/restrictions on the exchange rate. But they also had an effect through prudential considerations. For example, there has been a dramatic reduction in short-term external borrowing following the imposition of the 6 percent tax (as shown in Figure 4). In March 2011 short-term (less than one year) external borrowing amounted to US$ 6.5 billion. In April 2011, following the tax on short-term borrowing, that flow drops to only US$26 million. This maturity lengthening may have improved the country's resilience against external shocks.

[17] We test for breaks in the coefficients on the interest rate differential and FX intervention following different capital controls/restrictions, but do not find evidence of a significant break.

A full fledged assessment of the welfare implications of the controls would have to include the costs associated with them. The controls did imply an increase in the cost of funding for Brazilian firms. The amount they were able to raise through equity financing was affected by the 2 percent tax foreigners had to pay to buy that equity. In the case of debt financing, the taxes could be avoided by borrowing abroad long-term. Given how flat the (dollar) yield curve was, borrowing long-term may have been a relatively small cost (which may well pay-off if the crisis were to deepen and global credit markets to dry). Small firms could not tap foreign markets directly, and their cost of funding may have been more affected by the controls. The taxes on derivative trades were fine-tuned so as to avoid incidence in the case of bona fide hedging by exporters (although taxing "speculators" can still hurt those firms by affecting the liquidity of those markets, as it seems to have happened since liquidity fell substantially). Some market analysts have attributed Brazil's weak growth performance to a self-inflicted "sudden stop" (Volpon 2013) originating from the combination of economic policy deterioration and capital controls.

IV. CONCLUSION

Controls on capital inflows have gained renewed interest in the last years. Brazil provided the most cited example, both because of its size among emerging markets, and because of its active experimentation with many different forms of controls on capital inflows. Our results indicate that the controls were effective in making the domestic assets more expensive, partially segmenting the Brazilian financial market from the international market. The first several measures (from late 2009 to mid-2011) had very limited success in containing the appreciation of the real. But the exchange rate seems to respond strongly in the aftermath of the last restrictions adopted, with several different specifications pointing to an effect 10 percent or more. It is unlikely that those last measures would have been so effective if taken in isolation. Instead, this strong response may reflect a combined effect, whereby these measures complemented previous ones, closing the main remaining channels to bypass the initial tax on inflows. The response of the exchange rate was also supported by the beginning of a monetary policy easing cycle.

Given the weak state of the global economy together with the diminished interest that foreign investors have been devoting to Brazil recently, capital inflows have waned and most of the controls have been undone. Controls may have helped Brazil to avoid a bubble and perhaps worse.[18] However, given the very low domestic saving rate of the Brazilian economy (16%), constraining access to foreign financing may have contributed to the low investment and growth performance during that period. Overall, the results suggest capital controls can be effective, but

[18]Even with the controls, the private credit to GDP ratio rose from 44 to 54% from end-2009 to end-2012.

only if they are very comprehensive.[19] This may also explain why the estimated effect is much stronger than the results typically found in the capital control literature. While more comprehensive controls can be more effective, they may also increase the associated costs, which is an interesting subject for further research.

[19] The configuration of the Brazilian FX markets may have helped: the Brazilian real is a non-convertible currency and the (exchange rate) price discovery occurs at the futures market.

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Table 1. Major Capital Control and Related Measures Adopted in Brazil Since November 2009.

Date	Tighten or Loosen Restrictions?	Measure
10/19/2009	Tighten	Tax of 2 percent on portoflio equity and fixed income inflows
11/18/2009	Tighten	Tax of 1.5% on the Issuance of DRs into local equities
10/4/2010	Tighten	Tax rate raised to 4 percent for fixed income inflows
10/18/2010	Tighten	Tax rate raised to 6 percent for fixed income inflows
12/30/2010	Tigthen	Tax of 2% on the cancellation of DRs into local equities
1/6/2011	Tighten	Unremunrated reserve requirement of 60 percent on bank's gross FX positions beyond US$3 billions
3/28/2011	Tighten	Tax of 6 percent on borrowing abroad with maturity below one year
4/6/2011	Tighten	Tax of 6 percent on borrowing abroad extended to maturity below two years
7/8/2011	Tighten	Unremunrated reserve requirement of 60 percent on bank's gross FX positions beyond US$1 billion
7/26/2011	Tighten	Tax on notional amount of currency derivatives
9/16/2011	Tigthen	Tax on notional amount of derivatives takes effect
12/1/2011	Loosen	Tax on portfolio equity inflows eliminated
2/29/2012	Tighten	Tax of 6 percent on borrowing abroad extended to maturity below three years
3/1/2012	Tighten	Restricts anticipation of payments to exporters to one year horizon
3/9/2012	Tighten	Tax of 6 percent on borrowing abroad extended to maturity below five years
3/15/2012	Loosen	Tax on derivatives set to zero for hedging by exporters (up to 1.2 times exports in previous year)
6/14/2012	Loosen	Tax on 6 percent on borrowing abroad restricted to maturities below two years
6/28/2012	Loosen	Anticipation of payments to exporters can be done by financial instittutions
12/4/2012	Loosen	Anticipation of payments to exporters allowed for horizon above one year but below five years
12/5/2012	Loosen	Tax on 6 percent on borrowing abroad restricted to maturities below one year
12/18/2012	Loosen	Unremunerated reserve requirement on bank's gross FX position applies only after US$3 billion
6/4/2013	Loosen	Tax on fixed income flows eliminated
6/12/2013	Loosen	Tax on notional amount of derivatives eliminated

All tightening restrictions were announced when the market was closed, and became effective on the following business day (the only exceptions were the January 6, 2011 URR on Banks' Gross FX Positions which only became effective on April 4, and the tax on the notional amount of derivatives which was announced on July 26, 2011 and became effective on September 16 of that year.

Table 2. Regression Results for the Change in the 90-day Onshore Dollar Rate (Cupom Cambial).

Variables	1	2	3
	t-1 to t	t-1 to t+1	t-2 to t+2
Lagged Level of Cupom Cambial	-0.087***	-0.109***	-0.142**
	[0.025]	[0.040]	[0.062]
Constant	0.183***	0.237***	0.311***
	[0.050]	[0.077]	[0.119]
Dummy for:			
2% Tax on Portfolio Flows	0.425	0.039	-0.576
	[0.388]	[0.440]	[0.497]
Tax on DR Issuance	-0.049	-0.077	0.303
4% Tax on Fixed Income	0.005	-0.581	0.023
6% Tax on Fixed Income	0.074	0.073	-0.77
Tax on DR Cancellation	0.093	0.491	0.541
URR on Bank's Gross FX Position	-0.482	-0.504	-0.675
Tax on Foreign Borrowing up to 1 Year	0.135	-0.368	0.149
Tax on Foreign Borrowing up to 2 Years	0.786**	0.934**	1.355***
Tightening of URR on Bank's Gross FX Position	1.133***	1.385***	-0.314
Tax on Notional Amount of Derivatives	-1.125***	-2.122***	-1.238**
Implementation of Tax on Notional Amt. Deriv.	0.187	0.46	-0.052
Tax on Foreign Borrowing up to 3 Years	0.111	0.533	0.512
Tax on Foreign Borrowing up to 5 Years	-0.022	-0.405	-0.124
Removal of Tax on Equity Inflows	-0.199	-0.961**	-0.611
Surprise Rate Cut	-0.081	-0.663	-0.744
Avg. Effect of 13 Dummies for Capital Controls/Restrictions	-0.067	-0.011	0.098
	[0.139]	[0.123]	[0.109]
R-squared	0.077	0.126	0.109
Observations	680	649	620

Notes: Standard errors in brackets (Newey-West HAC standard errors, except for singleton dummies). Since the standard errors for the singleton dummies are similar, we only report them for the first dummy (2% Tax on Portfolio Flows). In the regression for the change from *t-1* to *t+1*, and from *t-2* to *t+2*, we exclude the observations that include a change in one of the measures captured by the dummies within that event window unless that measure took place at *t*. *, **, and *** denote statistical significance at the 10, 5 and 1 percent level, respectively.

Table 3. Regression Results for the ADR Premium for Petrobras and Vale.

	PETROBRAS			VALE		
	1	2	3	4	5	6
Variable	t-1 to t	t-1 to t+1	t-2 to t+2	t-1 to t	t-1 to t+1	t-2 to t+2
Lagged Level of Premium	-0.037***	-0.050***	-0.077***	-0.046***	-0.065***	-0.092***
	[0.010]	[0.017]	[0.023]	[0.011]	[0.018]	[0.021]
Constant	0.026**	0.036**	0.049**	0.019***	0.032***	0.042***
	[0.010]	[0.015]	[0.022]	[0.006]	[0.010]	[0.012]
Dummy for:						
2% Tax on Portfolio Flows	0.288	0.173	0.008	0.281	-0.03	0.041
	[0.196]	[0.236]	[0.283]	[0.183]	[0.223]	[0.245]
Tax on DR Issuance	0.447**	0.488**	0.413	0.595***	0.893***	0.572**
4% Tax on Fixed Income	0.605***	0.530**	0.473*	0.487***	0.313	0.119
6% Tax on Fixed Income	0.05	0.231	0.476*	-0.138	-0.389*	-0.187
Tax on DR Cancellation	0.004	-0.015	-0.199	-0.074	0.046	0.126
URR on Bank's Gross FX Position	-0.007	-0.052	-0.04	-0.027	-0.184	-0.175
Tax on Foreign Borrowing up to 1 Year	0.083	0.084	0.122	0.171	0.011	0.063
Tax on Foreign Borrowing up to 2 Years	-0.18	-0.400*	-0.039	-0.261	-0.386*	-0.496**
Tightening of URR on Bank's Gross FX Position	0.024	0.029	-0.232	0.154	-0.068	0.064
Tax on Notional Amount of Derivatives	0.208	-0.138	-0.096	0.341*	0.135	-0.252
Implementation of Tax on Notional Amt. Deriv.	-0.1	-0.045	0.116	-0.112	-0.133	-0.404*
Tax on Foreign Borrowing up to 3 Years	-0.017	-0.285	0.005	0.046	-0.131	-0.114
Tax on Foreign Borrowing up to 5 Years	-0.103	0.042	0.151	0.032	0.167	0.003
Removal of Tax on Equity Inflows	-0.136	-0.083	-0.505*	-0.123	-0.101	-0.145
Surprise Rate Cut	0.332*	-0.204	0.267	0.226	0.173	-0.194
Avg. Effect of 13 Dummies for	0.100*	0.049	0.089	.115**	0.019	-0.049
Capital Controls/Restrictions	[0.055]	[0.066]	[.079]	[0.051]	[0.062]	[.069]
R-squared	0.051	0.05	0.061	0.065	0.073	0.077
Observations	663	634	607	663	632	603

Notes: Standard errors in brackets (Newey-West HAC standard errors, except for singleton dummies). Since the standard errors for the singleton dummies are similar, we only report them for the first dummy (2% Tax on Portfolio Flows). In the regression for the change from *t-1* to *t+1*, and from *t-2* to *t+2*, we exclude the observations that include a change in one of the measures captured by the dummies within that event window unless that measure took place at *t*. *, **, and *** denote statistical significance at the 10, 5 and 1 percent level, respectively.

Table 4. Regression Results for the Change in the Log of the Exchange Rate.

Variables	1	2	3	4	5	6
	OLS	OLS	IV	OLS	OLS	IV
Δ Spread CDI - LIBOR	-0.047	-0.049	-0.036	-0.151*	-0.154*	-0.139*
	[0.075]	[0.075]	[0.077]	[0.080]	[0.080]	[0.083]
Δ Onshore Dollar Rate (90d)	-0.038	-0.055	0.039	-0.016	-0.043	0.051
	[0.084]	[0.076]	[0.167]	[0.087]	[0.077]	[0.166]
ΔLog(Ibovespa)	-0.071***	-0.067***	-0.092***	-0.071***	-0.065***	-0.084***
	[0.024]	[0.024]	[0.031]	[0.024]	[0.024]	[0.031]
ΔLog(Vix)	0.008	0.009*	0.004	0.009*	0.010*	0.008
	[0.005]	[0.006]	[0.007]	[0.006]	[0.006]	[0.006]
ΔLog(CRB Commodity Index)	-0.217***	-0.211***	-0.229***	-0.192***	-0.191***	-0.190***
	[0.043]	[0.042]	[0.048]	[0.041]	[0.040]	[0.043]
ΔLog(Dollar Currency Index)	0.700***	0.688***	0.744***	0.710***	0.695***	0.743***
	[0.064]	[0.062]	[0.086]	[0.063]	[0.061]	[0.086]
Lagged Level of Log(Exchange Rate)				-0.041***	-0.046***	-0.03
				[0.015]	[0.015]	[0.022]
Lagged Levels of Exp. Variables Above				YES	YES	YES
Intervention (Purchase, Billion USD)		-0.043	-0.071		-0.059	0.014
		[0.043]	[0.195]		[0.042]	[0.158]
Intervention (Sale, Billion USD)		0.281	-1.39		0.352	-0.935
		[0.231]	[1.094]		[0.237]	[1.103]
Dummies for:						
Initial Tax on Inflows	1.239**	1.264**	1.071	1.256**	1.267**	1.206*
	[0.624]	[0.624]	[0.667]	[0.608]	[0.606]	[0.637]
Tax on DR Issuance	0.614	0.622	0.578	0.509	0.505	0.52
4% Tax on Fixed Income	0.462	0.453	0.492	0.412	0.401	0.431
6% Tax on Fixed Income	-0.047	-0.023	-0.16	0.003	0.024	-0.065
Tax on DR Cancellation	-0.147	-0.135	-0.199	-0.241	-0.25	-0.239
URR on Bank's Gross FX Position	-0.185	-0.178	-0.196	-0.174	-0.182	-0.161
Tax on Foreign Borrowing up to 1 Year	-0.447	-0.435	-0.5	-0.43	-0.415	-0.483
Tax on Foreign Borrowing up to 2 Years	-1.094*	-1.081*	-1.160*	-1.166*	-1.153*	-1.224*
Tightening of URR on Bank's Gross FX Position	0.126	0.16	0.002	0.115	0.12	0.09
Tax on Notional Amount of Derivatives	1.373**	1.392**	1.515**	1.221**	1.227**	1.303**
Implement. of Tax on Notional Amt. Deriv.	0.092	0.089	0.057	0.019	0.038	-0.047
Tax on Foreign Borrowing up to 3 Years	0.207	0.231	0.198	0.184	0.193	0.193
Tax on Foreign Borrowing up to 5 Years	2.272***	2.278***	2.186***	2.311***	2.305***	2.291***
Removal of Tax on Equity Inflows	-0.828	-0.83	-0.865	-0.807	-0.773	-0.903
Surprise Rate Cut	0.895	0.881	0.926	0.609	0.591	0.627
Avg. Effect of 13 Dummies for	0.343**	0.357**	0.299	0.309*	0.314*	0.294*
Capital Controls/Restrictions	[0.174]	[0.174]	[0.185]	[0.169]	[0.169]	[0.177]
R-squared	0.434	0.437	0.347	0.454	0.458	0.408
Observations	680	680	679	680	680	679

Notes: Standard errors in brackets (Newey-West HAC standard errors, except for singleton dummies). Sterilized Interventions instrumented with its first two lags, and the lagged 3-month option-implied volatility of the exchange rate in columns 3 and 6. *, **, and *** denote statistical significance at the 10, 5 and 1 percent level, respectively.

Table 5. Regression Results for the Change in the Log of the Exchange Rate From 1 day Before to 1 Day After Capital Control/Restriction Measure.

Dummy for:	1	2	3	4	5	6
	OLS	OLS	IV	OLS	OLS	IV
Initial Tax on Inflows	1.554*	1.546*	1.589*	1.564*	1.535*	1.614*
	[0.850]	[0.850]	[0.846]	[0.843]	[0.841]	[0.948]
Tax on DR Issuance	0.935	0.937	0.944	0.689	0.672	0.644
4% Tax on Fixed Income	0.424	0.412	0.433	0.466	0.436	0.373
6% Tax on Fixed Income	-0.338	-0.32	-0.352	-0.335	-0.327	-0.208
Tax on DR Cancellation	0.83	0.85	0.814	0.73	0.721	0.75
URR on Bank's Gross FX Position	0.33	0.327	0.338	0.344	0.315	0.273
Tax on Foreign Borrowing up to 1 Year	-1.335	-1.329	-1.343	-1.283	-1.292	-1.214
Tax on Foreign Borrowing up to 2 Years	-1.919**	-1.915**	-1.911**	-1.979**	-1.973**	-1.755*
Tightening of URR on Bank's Gross FX Position	-0.45	-0.426	-0.456	-0.482	-0.498	-0.362
Tax on Notional Amount of Derivatives	1.354	1.376	1.25	1.092	1.074	0.391
Implementation of Tax on Notional Amt. Deriv.	3.209***	3.215***	3.220***	3.119***	3.167***	3.570***
Tax on Foreign Borrowing up to 3 Years	0.529	0.557	0.491	0.42	0.438	0.444
Tax on Foreign Borrowing up to 5 Years	2.548***	2.536***	2.575***	2.569***	2.521***	2.506***
Removal of Tax on Equity Inflows	-0.364	-0.39	-0.329	-0.263	-0.251	-0.075
Surprise Rate Cut	2.374***	2.362***	2.392***	1.913**	1.898**	1.925**
Avg. Effect of 13 Dummies for	0.59**	0.597**	0.584**	0.532**	0.522**	0.54**
Capital Controls/Restrictions	[0.238]	[0.238]	[0.236]	[0.235]	[0.235]	[0.265]
Avg. Effect of First 9 Capital Controls/Restrictions	0.003	0.009	0.006	-0.032	-0.046	0.013
	[0.285]	[0.285]	[0.284]	[0.282]	[0.281]	[0.319]

Notes: For conciseness, table reports only the coefficients on the dummy variables. Each column corresponds to the analogous regression from Table 4. The dependent variable is the two-day change in the exchange rate. Dummies equal to one on the day after measure announced (measures announced after market close on previous day). Coefficient on dummy corresponds to change in the exchange rate from *t-1* to *t+1* that can be attributed to measure at time *t*. Observations where the four-day window includes a capital control/restriction are dropped from the estimation unless that measure takes place at *t* . Intervention variables computed over corresponding two-day periods. Bottom row reports the results for the average of the coefficients of the twelve measures associated with capital controls and restrictions. Standard errors in brackets. *, **, and *** denote statistical significance at the 10, 5 and 1 percent level, respectively.

Table 6. Regression Results for the Change in the Log of the Exchange Rate From 2 days Before to 2 Days After Capital Control/Restriction Measure.

Dummy for:	1	2	3	4	5	6
	OLS	OLS	IV	OLS	OLS	IV
Initial Tax on Inflows	1.681	1.666	1.85	1.364	1.339	1.238
	[1.116]	[1.116]	[1.165]	[1.090]	[1.091]	[1.260]
Tax on DR Issuance	0.959	0.935	1.094	0.522	0.506	0.496
4% Tax on Fixed Income	0.455	0.446	0.482	0.311	0.3	0.346
6% Tax on Fixed Income	0.903	0.874	0.975	0.943	0.927	1.073
Tax on DR Cancellation	1.123	1.14	0.912	0.892	0.911	0.602
URR on Bank's Gross FX Position	1.041	1.034	1.062	1.013	0.995	0.975
Tax on Foreign Borrowing up to 1 Year	-1.371	-1.318	-1.931	-1.211	-1.132	-1.426
Tax on Foreign Borrowing up to 2 Years	-1.609	-1.64	-1.49	-1.557	-1.589	-1.276
Tightening of URR on Bank's Gross FX Position	0.522	0.535	0.398	0.258	0.262	-0.111
Tax on Notional Amount of Derivatives	0.364	0.413	-0.029	-0.105	-0.044	-0.608
Implementation of Tax on Notional Amt. Deriv.	3.124***	3.081***	3.338***	3.127***	3.103***	3.906***
Tax on Foreign Borrowing up to 3 Years	1.357	1.349	1.283	1.119	1.12	1.1
Tax on Foreign Borrowing up to 5 Years	2.535**	2.511**	2.606**	2.531**	2.501**	2.713**
Removal of Tax on Equity Inflows	-0.396	-0.4	-0.294	-0.052	-0.074	0.411
Surprise Rate Cut	3.186***	3.186***	3.169***	2.288**	2.284**	2.355*
Avg. Effect of 13 Dummies for	0.853***	0.848***	0.811**	0.708**	0.708**	0.694**
Capital Controls/Restrictions	[0.312]	[0.312]	[0.326]	[0.305]	[0.305]	[0.352]
Avg. Effect of First 9 Capital Controls/Restrictions	0.412	0.408	0.372	0.282	0.28	0.213
	[0.374]	[0.374]	[0.391]	[0.365]	[0.366]	[0.422]

Notes: For conciseness, table reports only the coefficients on the dummy variables. Each column corresponds to the analogous regression from Table 4. The dependent variable is the four-day change in the exchange rate. Dummies equal to one on the day after measure announced (measures announced after market close on previous day). Coefficient on dummy corresponds to change in the exchange rate from *t-2* to *t+2* that can be attributed to measure at time *t*. Observations where the four-day window includes a capital control/restriction are dropped from the estimation unless that measure takes place at *t.* Intervention variables computed over the corresponding four day period, and fourth lagged of levels of dependent explanatory variables used as controls in Columns 4-6. Bottom rows reports the results for the average of the coefficients of the twelve and first ten measures associated with capital controls and restrictions. Standard errors in brackets. *, **, and *** denote statistical significance at the 10, 5 and 1 percent level, respectively.

Table 7. Regression Results for the Change in the Log of the Exchange Rate From 2 days Before to 5 Days After Capital Control/Restriction Measure.

Dummy for:	1	2	3	4	5	6
	OLS	OLS	IV	OLS	OLS	IV
Initial Tax on Inflows	0.287	0.308	0.25	-0.438	-0.386	-0.516
	[1.331]	[1.293]	[1.269]	[1.271]	[1.255]	[1.243]
Tax on DR Issuance	2.269*	2.394*	2.372*	1.666	1.749	1.674
4% Tax on Fixed Income	0.553	0.471	0.474	0.188	0.19	0.296
6% Tax on Fixed Income	2.013	1.93	1.867	1.733	1.743	1.673
Tax on DR Cancellation	1.962	2.071	2.067	1.828	1.981	1.84
URR on Bank's Gross FX Position	1.825	1.693	1.681	1.526	1.564	1.533
Tax on Foreign Borrowing up to 1 Year	-1.876	-1.744	-1.678	-1.289	-1.259	-0.944
Tax on Foreign Borrowing up to 2 Years	-1.986	-2.168*	-2.179*	-1.767	-1.884	-1.866
Tightening of URR on Bank's Gross FX Position	0.135	0.134	0.159	-0.13	-0.037	-0.191
Tax on Notional Amount of Derivatives	-0.108	-0.299	-0.269	-0.951	-0.969	-0.776
Implementation of Tax on Notional Amt. Deriv.	4.893***	6.838***	6.969***	5.181***	6.343***	5.495***
Tax on Foreign Borrowing up to 3 Years	3.460***	3.340***	3.269***	2.817**	2.921**	2.796**
Tax on Foreign Borrowing up to 5 Years	2.757**	2.664**	2.609**	2.850**	2.802**	2.710**
Removal of Tax on Equity Inflows	0.384	0.195	0.169	0.928	0.609	0.773
Surprise Rate Cut	4.138***	4.091***	3.993***	2.894**	2.887**	2.905**
Avg. Effect of 13 Dummies for	1.245***	1.356***	1.353***	1.017***	1.135***	1.056***
Capital Controls/Restrictions	[0.373]	[0.362]	[0.36]	[0.356]	[0.353]	[0.359]
Avg. Effect of First 9 Capital Controls/Restrictions	0.576	0.565	0.557	0.369	0.407	0.389
	[0.447]	[0.434]	[0.426]	[0.427]	[0.421]	[0.418]

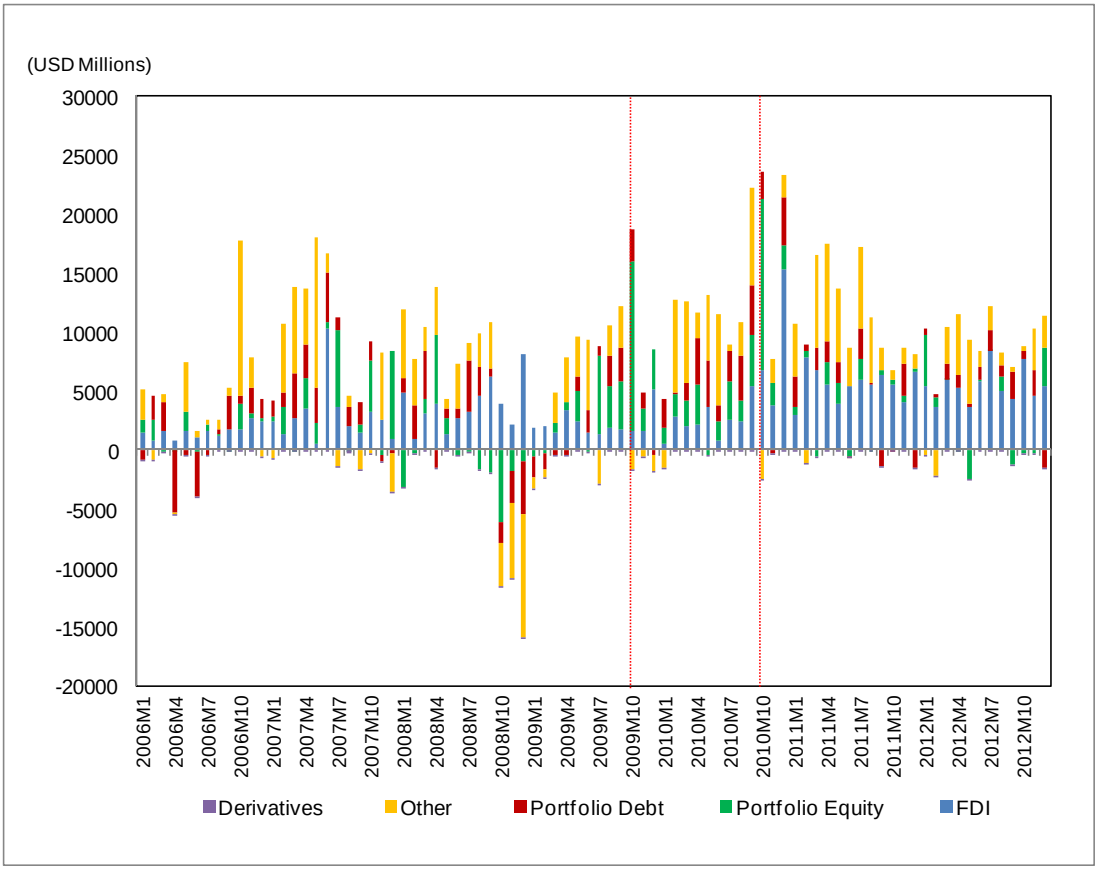
Notes: For conciseness, table reports only the coefficients on the dummy variables. Each column corresponds to the analogous regression from Table 4. The dependent variable is the seven-day change in the exchange rate. Dummies equal to one on the day after measure announced (measures announced after market close on previous day). Coefficient on dummy corresponds to change in the exchange rate from *t-2* to *t+5* that can be attributed to measure at time *t*. Observations where the seven-day window includes a capital control/restriction are dropped from the estimation unless that measure takes place at *t.* Intervention variables computed over the corresponding seven day period, and seventh lag of levels of dependent and explanatory variables used as controls in Columns 4-6. Bottom rows reports the results for the average of the coefficients of the twelve and first ten measures associated with capital controls and restrictions. Standard errors in brackets. *, **, and *** denote statistical significance at the 10, 5 and 1 percent level, respectively.

Table 8. Regression Results for the Change in the Log of the Exchange Rate From 2 days Before to 10 Days After Capital Control/Restriction Measure.

Dummy for Event	1	2	3	4	5	6
	OLS	OLS	IV	OLS	OLS	IV
Initial Tax on Inflows	0.656	0.91	1.053	-0.267	-0.226	0.05
	[1.663]	[1.625]	[1.619]	[1.512]	[1.504]	[2.005]
Tax on DR Issuance	0.511	0.528	0.505	-0.791	-0.735	-1.099
4% Tax on Fixed Income	1.365	1.127	1.055	0.861	0.757	1.046
6% Tax on Fixed Income	2.284	2.143	2.125	1.791	1.807	1.849
Tax on DR Cancellation	2.207	2.289	2.254	1.683	1.799	1.302
URR on Bank's Gross FX Position	1.655	1.54	1.372	1.26	1.193	1.085
Tax on Foreign Borrowing up to 1 Year	-3.870**	-3.908**	-4.102**	-2.817*	-2.947**	-2.536
Tax on Foreign Borrowing up to 2 Years	-2.513	-2.720*	-2.685*	-2.079	-2.091	-1.528
Tightening of URR on Bank's Gross FX Position	-1.128	-1.135	-1.152	-1.624	-1.483	-2.378
Tax on Notional Amount of Derivatives	0.169	0.023	0.115	-1.041	-1.31	0.554
Implementation of Tax on Notional Amt. Deriv.	2.967*	4.446***	4.086**	3.255**	3.837**	-0.346
Tax on Foreign Borrowing up to 3 Years	5.539***	5.286***	5.219***	4.224***	4.371***	3.467*
Tax on Foreign Borrowing up to 5 Years	2.845*	2.597	2.639*	2.842*	2.808*	3.498*
Removal of Tax on Equity Inflows	0.407	0.039	0.07	1.346	1.016	2.928
Surprise Rate Cut	9.731***	9.488***	9.448***	7.341***	7.314***	7.399***
Avg. Effect of 13 Dummies for	0.976**	1.01**	0.96**	0.561	0.598	0.382
Capital Controls/Restrictions	[0.468]	[0.457]	[0.458]	[0.426]	[0.424]	[0.572]
Avg. Effect of First 9 Capital Controls/Restrictions	0.13	0.086	0.047	-0.22	-0.214	-0.246
	[0.561]	[0.548]	[0.544]	[0.51]	[0.507]	[0.662]

Notes: For conciseness, table reports only the coefficients on the dummy variables. Each column corresponds to the analogous regression from Table 4. The dependent variable is the seven-day change in the exchange rate. Dummies equal to one on the day after measure announced (measures announced after market close on previous day). Coefficient on dummy corresponds to change in the exchange rate from *t-2* to *t+10* that can be attributed to measure at time *t*. Observations where the twelve-day window includes a capital control/restriction are dropped from the estimation unless that measure takes place at *t*. Intervention variables computed over the corresponding twelve day period, and twelfth lag of levels of dependent and explanatory variables used as controls in Columns 4-6. Bottom rows reports the results for the average of the coefficients of the twelve measures associated with capital controls and restrictions. Standard errors in brackets. *, **, and *** denote statistical significance at the 10, 5 and 1 percent level, respectively.

Figure 1. Gross Capital Inflows to Brazil.



Notes: Data from the Central Bank of Brazil. Data corresponds to liabilities to foreigners in the capital and financial account. First vertical line indicates the month where the 2 percent tax on portfolio inflows was imposed. Second vertical line indicates the month where the tax on fixed income flows was raised to 4 then to 6 percent.

Figure 2A. Evolution of the 90- and 360-Day Cupom Cambial (Onshore Dollar Rate).

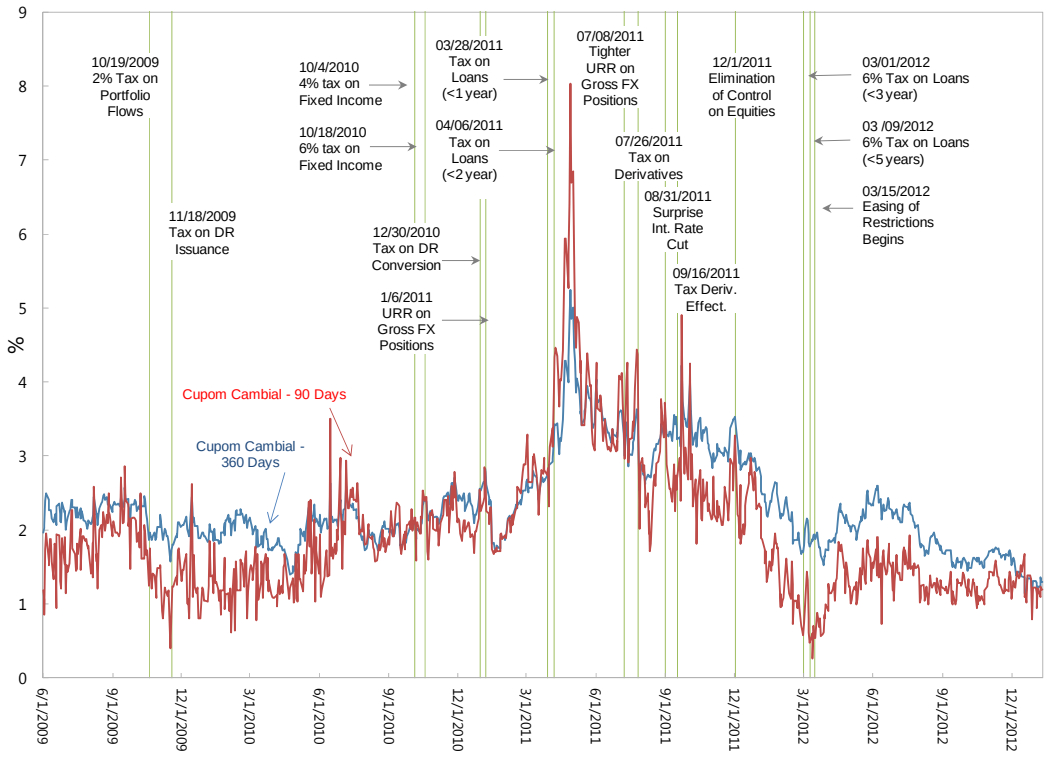
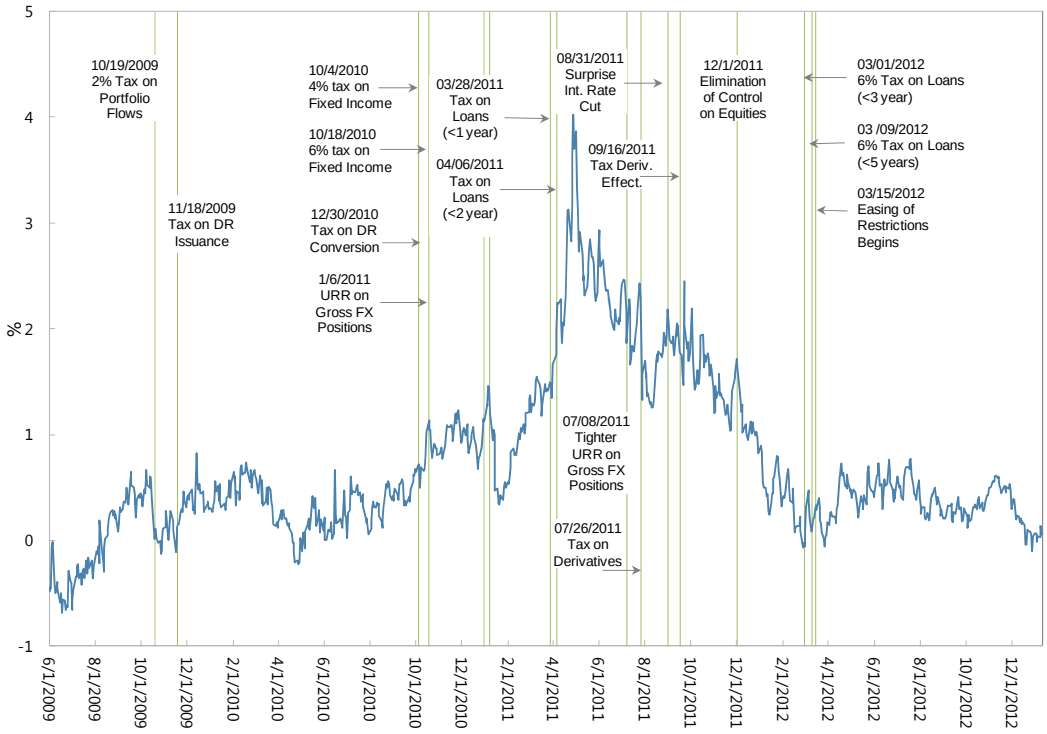
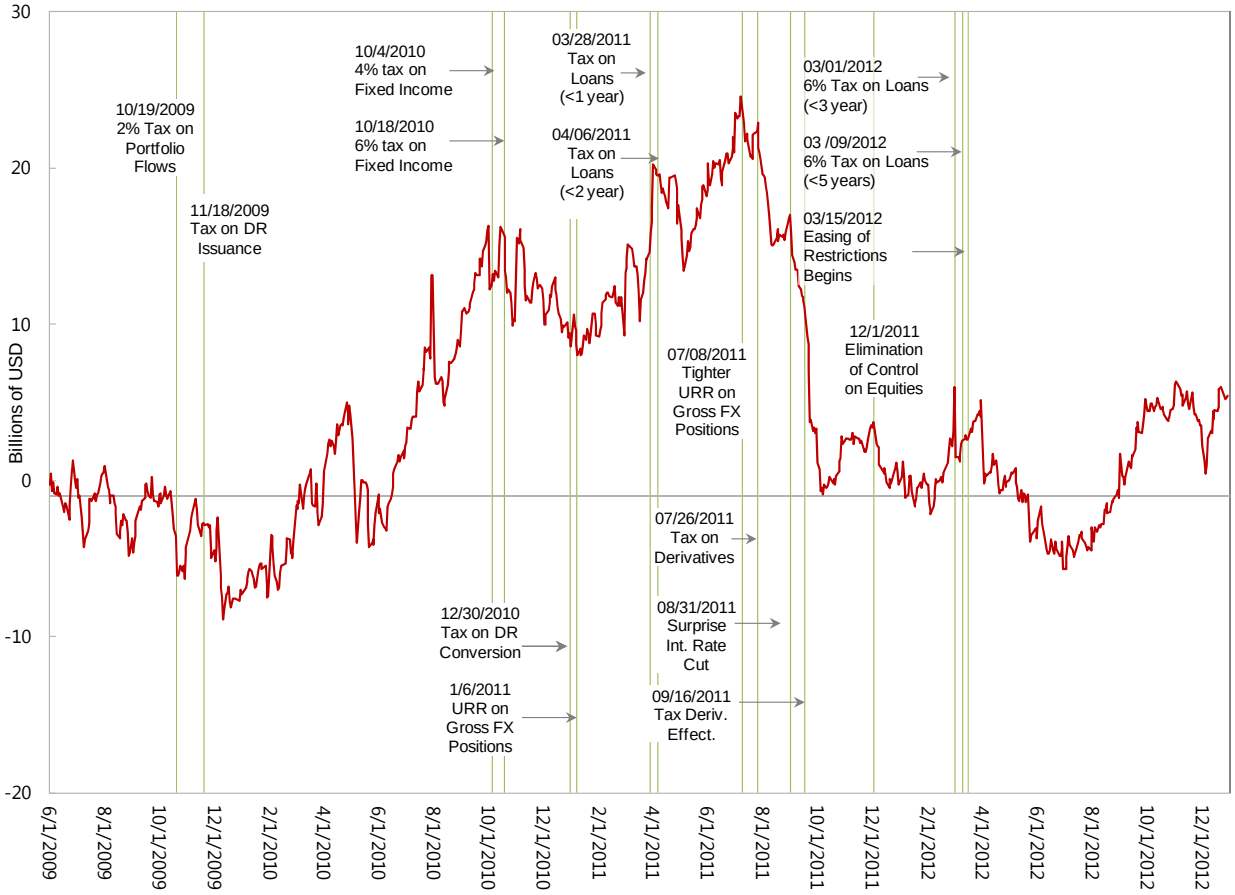


Figure 2B. Evolution of the Spread Between the 360-Day Cupom Cambial, the One-Year LIBOR, and Brazil's One-Year CDS spread.



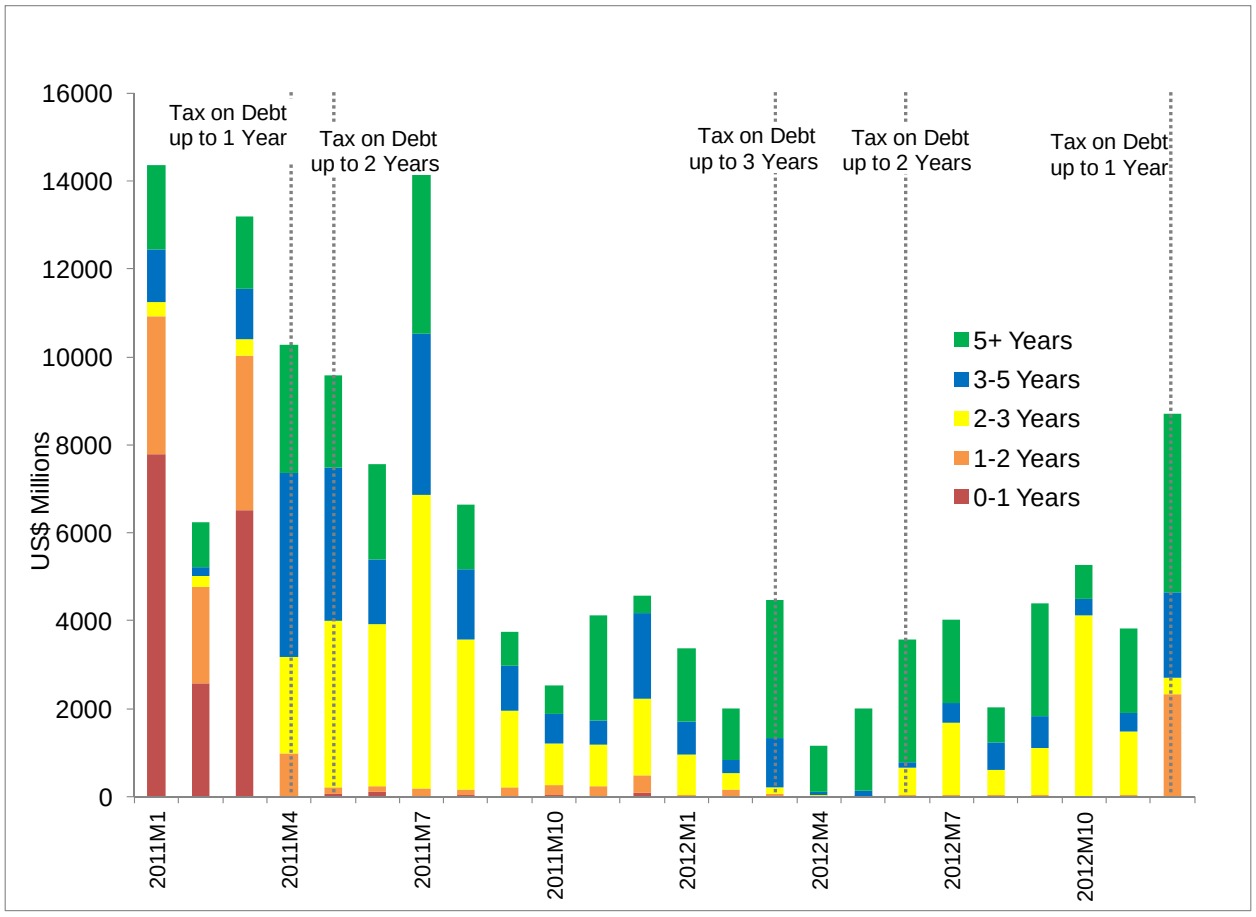
Source: Bloomberg.

Figure 3. Net Foreign Investor Position in Fixed Income Derivatives at the BMF Exchange.



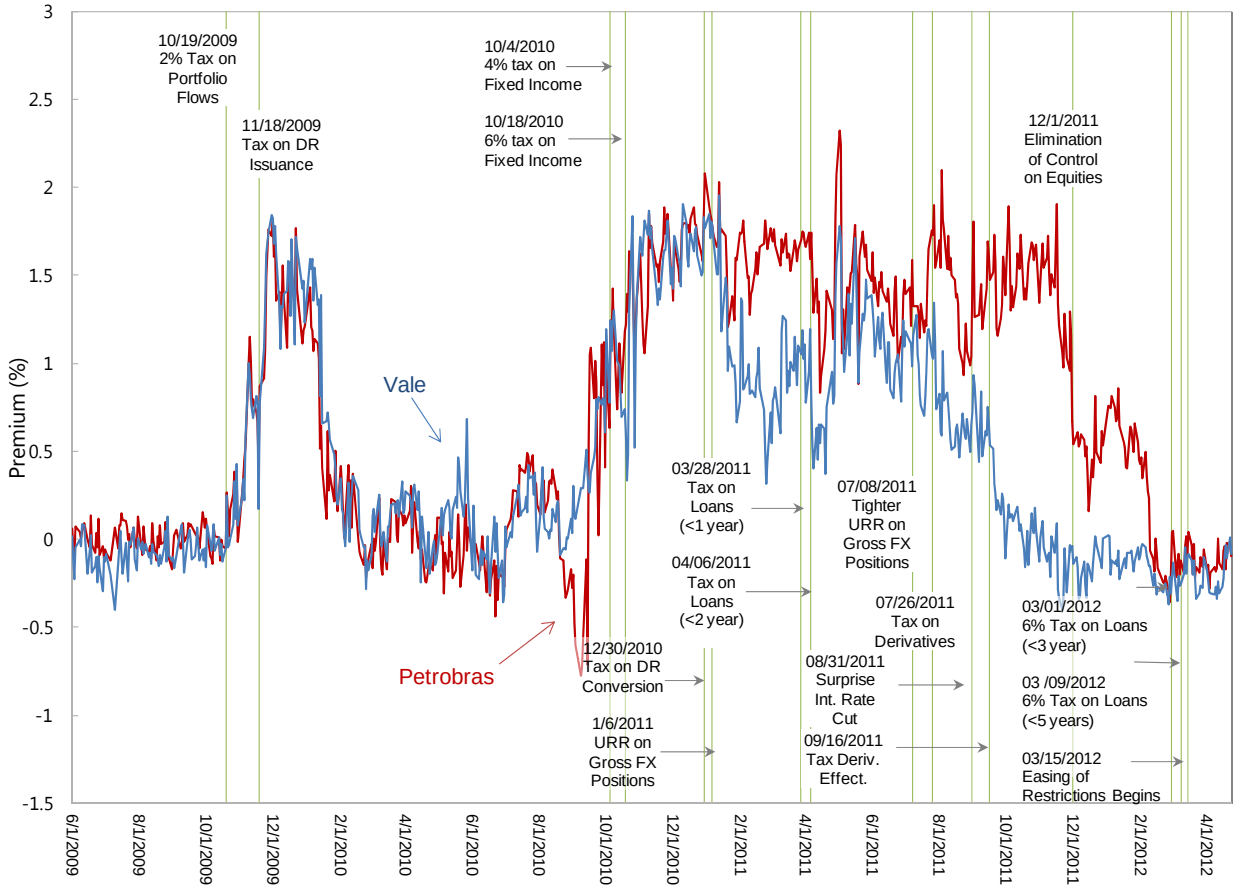
Source: Bolsa Mercantil de Futuros (BMF).

Figure 4. External Debt Flows By Original Maturity.



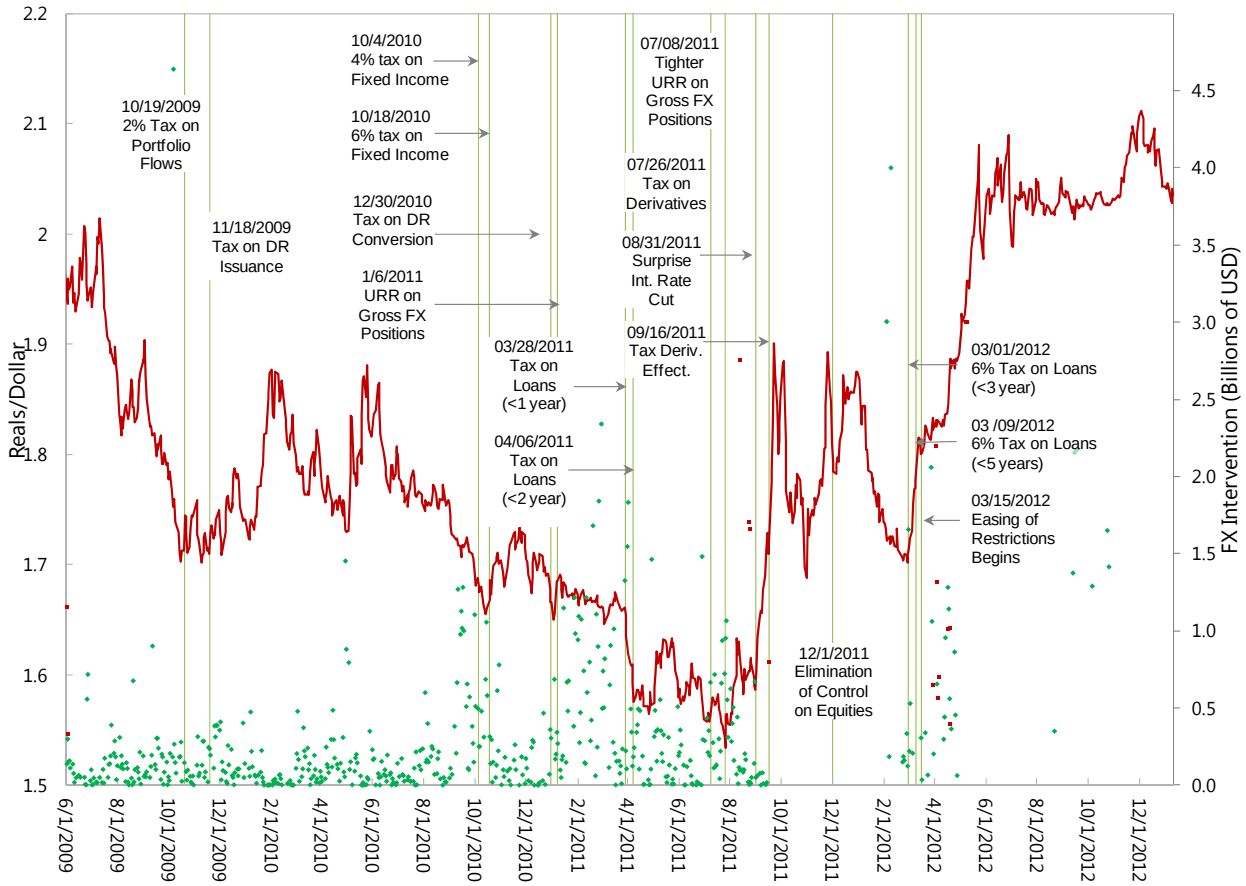
Source: Central Bank of Brazil.

Figure 5. Evolution of the Premium for Petrobras and Vale ADRs.



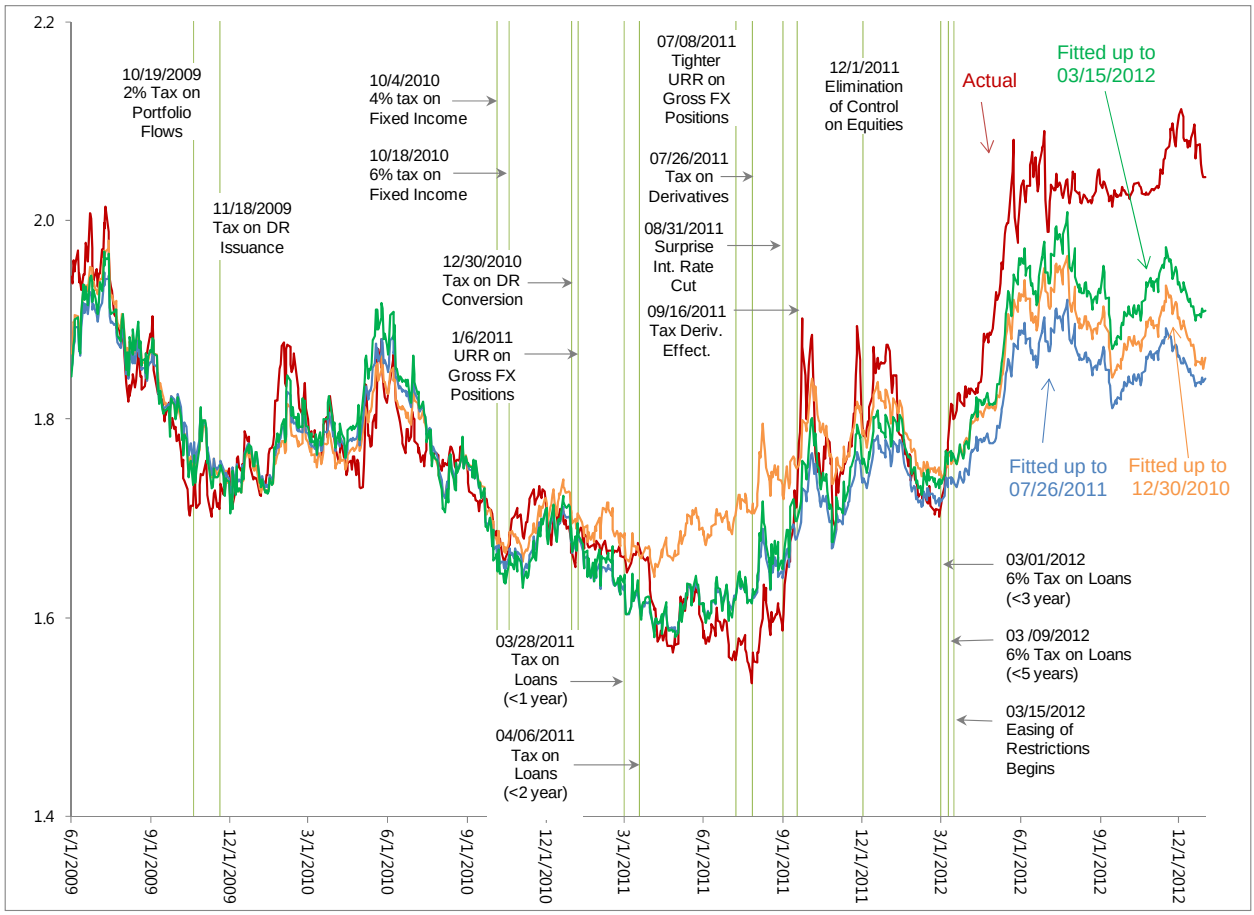
Source: Bloomberg.

Figure 6. Evolution of the Real-Dollar bilateral exchange (LHS) rate and FX Interventions (RHS)



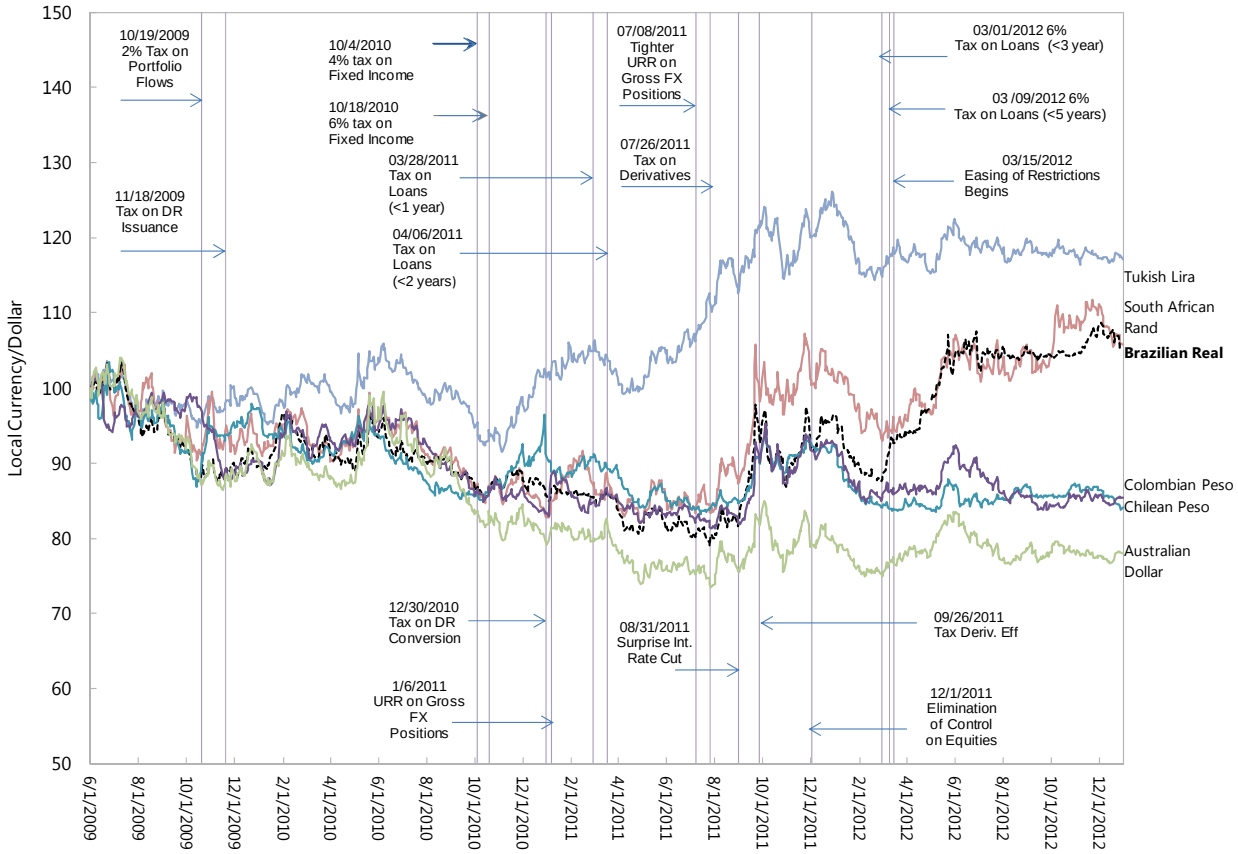
Notes: Green dots correspond to interventions where the central bank purchases dollars, and red dots to interventions where the central bank sells dollars (magnitudes in the right-hand-side axis).
Source: Central Bank of Brazil.

Figure 7. Real-Dollar Exchange Rate and Counterfactual from Regressions.



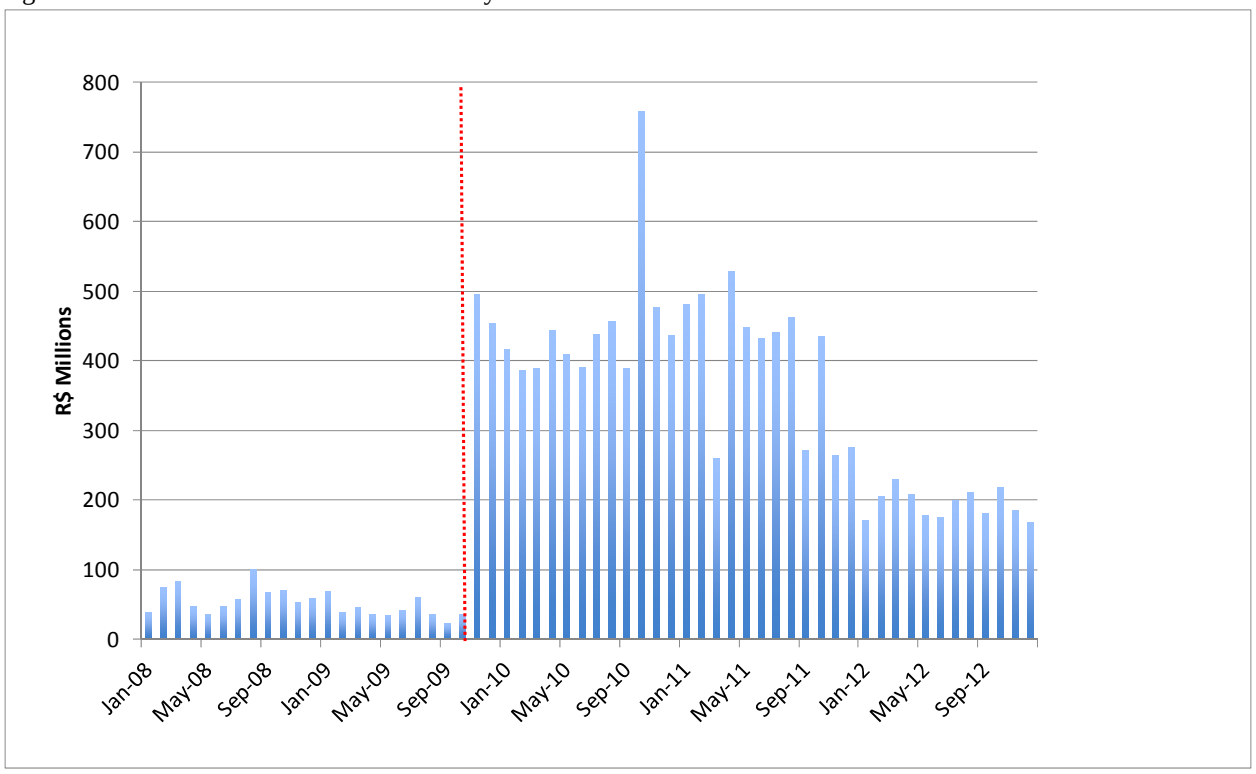
Notes: Red line corresponds to the actual real-dollar exchange rate (an increase denotes a depreciation of the real); Remaining lines plot the results of a regression of the log of the exchange rate on the log of the interest rate differential, onshore dollar rate, local stock market, commodity prices, dollar currency index and VIX. Orange line is based on a regression sample up to the last tightening of controls on portfolio inflows (Tax on DR Conversion on 12/30/2010); Blue line on a regression up to the announcement of the tax on the notional amount of derivatives (07/26/2011); Green line on a regression up to the end of our sample in Table 2 (when the restrictions begin to be eased on 03/15/2012).

Figure 8. Real-Dollar Exchange Rate and Other Currencies.



Note: Increase in the exchange rate (June 1, 2009 = 100) denotes a depreciation of the respective currency. Source: Bloomberg and Central Bank of Brazil.

Figure A1. IOF Revenues Related to Currency Transactions.



Notes: Vertical line indicates the month where the 2 percent tax on portfolio inflows was imposed.
Source: Finance Ministry of Brazil.

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