CAPITAL CONTROLS IN BRAZIL: EFFECTIVE?

Marcos Chamon and Márcio Garcia[1]

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Abstract

We analyze the impact of the controls and restrictions on capital inflows that Brazil has adopted since late 2009. We document that these measures had some success in segmenting the Brazilian and global financial markets, as measured by wedges between onshore and offshore prices of similar fixed and variable income assets. However, that failed to translate into significant changes in the exchange rate, at least in the immediate aftermath of these measures, suggesting limited success in mitigating real appreciation. But capital controls/restrictions may have contributed to the sizable depreciation of the *real* in 2012, possibly amplifying the effect on the exchange rate of cuts in the interest policy rate during that period.

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[1] Chamon: Research Department, International Monetary Fund, mchamon@imf.org; Garcia: Visiting Scholar at the Sloan School, MIT, and NBER, and Associate Professor at the Department of Economics, PUC-Rio, mgarcia@econ.puc-rio.br. **The views expressed are those of the authors and should not be attributed to the IMF or any other institution.** We thank BM&F Bovespa for data; many traders for enlightment of the pratical implications of the controls; and Stijn Claessens, Mercedes Garcia-Escribano, José de Gregorio, Anton Korinek, Hyun Shin and participants of the 2013 ASSA meetings for comments. Diego Barrot, Julia Bevilaqua, Hyeon Ji Lee, Guilherme Lima, and Guido Maia provided excellent research assistance. Márcio Garcia thanks CNPq (Brazil) for financial support. Any errors are our own.

I. INTRODUCTION

There has been a strong recovery in capital inflows to emerging market economies since the systemic sudden stop in late 2008-early 2009. Flows are reaching 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 can in principle bring numerous benefits, helping finance investment opportunities that may be otherwise missed, smooth shocks to consumption, and facilitate 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, there is a concern that this 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 can play a useful role in managing the macroeconomic and prudential risks associated with flows (e.g. Ostry et al 2010 and 2012, Korinek 2011). 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 was the first country to seek 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.

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. Anticipating some of the results, there is little or no effect on the exchange rate following the adoption of most measures. While the exchange rate seems to revert from an appreciation trend following some measures, we fail to establish a statistically significant effect on the variety of specifications considered. It is possible that measures are adopted during times of unusually favorable global financial conditions (and hence tend to be in the vicinity of local peaks of the exchange rate), a hypothesis that is supported by the behavior of other emerging market currencies around those dates.

While the Brazilian currency, the *real* (BRL), does not respond in the aftermath of most measures, there seems to be a stronger response following a tax on the notional amount of currency derivatives in July 2011 (the last major restriction imposed). In Brazil, due to historical reasons, the US dollar futures market (first to mature contract) concentrates most of the liquidity of currency markets. Ventura and Garcia (2012) show that the price discovery process occurs in the derivative market, being then transferred to the spot market. The 1% tax on the notional amount of currency derivatives was highly successful in repressing the onshore exchange rate market. And there is a marked depreciation of the real following a surprise policy rate cut in late August 2011, which was interpreted by the market as a signal of future deep and persistent cuts in interest rates (and, indeed, it initiated a year-long cycle that reduced the policy rate from 12.5% to 7.25%). It is difficult to assess whether the marked response of the exchange rate to the lower interest rates would have been as dramatic in the absence of the capital control measures adopted. At a minimum, the controls reinforced the effect of the interest rate cuts by the Brazilian Central Bank, particularly considering that empirical studies (including ours) typically do not find much of an effect of interest rate differentials on the Brazilian real (e.g. Vervloet, 2010).

We also document violations of the law of one price caused by the controls. For example, if stocks are traded in two jurisdictions, and one of them imposes a tax on the purchase of the stock, we should observe a wedge between the prices of the stocks traded in both jurisdictions[2]. We show that this is indeed what happened in Brazil, both for fixed and variable income assets.

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 (Jinjarak et al 2012, Ostry et al 2012). In the Brazilian context, Carvalho and Garcia (2008) showed that there was 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.

Other noteworthy experiences with 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. Cardenas and Barrera (1997) find that the Colombian URR in the 1990s did not affect the volume of flows, but had

[2] Auguste et al. (2002) document a somewhat similar, albeit much stronger, effect for Argentine ADRs during the 2001 Argentine crisis.

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. While most studies tend to focus on macroeconomic and financial stability outcomes, one should bear in mind that benefits should be weighed against costs. In the Chilean context, Forbes (2007) has shown that capital controls can increase financing costs, particularly for small and medium enterprises.[3]

Our study adds value to this vast literature for a number of reasons. The recent Brazilian experience provides an ideal context to study the effect of capital controls and restrictions. Brazil has a very sophisticated financial market (arguably the most sophisticated among emerging markets), with deep and liquid instruments that can gauge the effectiveness of capital controls in segmenting the domestic and global markets. One can construct daily sterilized intervention data (including through futures and swaps). Brazil is an investment grade country, and credit risk/default considerations are minimal, which was not the case for previous studies on capital controls in Brazil (or most other emerging markets). The measures adopted were transparent and market-based, which facilitates the analysis. Last but not least, Brazil is an interesting case to study since no other country with a similar level of openness has ever experimented as actively with market-based capital controls[4], placing Brazil on a category of its own.[5]

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 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 **out**flows have a long history in Brazil, since financial repression was the norm until the early nineties. In 1991, real interest rates were significantly raised to avoid capital flight. With the low rates prevailing in the US, capital started flowing in the country. So much so, that, starting in 1993, controls on capital **in**flows were enacted. Unlike the Chilean or

[3] Korinek (2011) argues that a successful and welfare increasing prudential regulation, which deters over borrowing, should precisely increase debt costs. First, one should not that Forbes (2007), among others, have not found a significant effect on total capital inflows, only on its composition. Second, it remains to be shown that such increase in debt costs are indeed welfare enhancing.

[4] Some previous noteworthy examples include the Unremunerated Reserve Requirements in Chile (1990s), Colombia (1990s, 2007), and Thailand (2006). But none of these past examples compares to the level of active experimentation in the recent Brazilian experience.

[5] In the preface of their book "Who needs to open the capital account?" (Jeanne et al. 2012), the authors name only two countries, China and Brazil, the first as a country that maintains tight restrictions on its capital account, and Brazil as a country that has actively experimented with market-based prudential capital controls since the crisis.

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,[6] which taxes most financial transactions in Brazil with different tax rates. During the nineties, the top IOF tax rate on capital inflows destined to fixed income (carry trade) was 9%.[7] 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 to equalize foreigners and domestic investors, who had to pay income tax. With the resumption of massive capital inflows, as early as February 2009, capital inflows were again reemployed.

Table 1 lists the measures that have been adopted in Brazil since October 2009, which are the object of the current paper. On October 20th, 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 Lehman debacle that the government, concerned with the exchange rate appreciation, decided to include stocks in the controls.

One obvious channel, which allowed investors to bypass the controls in the case of equity flows, was the conversion of American Depositary Receipts (ADRs). ADRs are securities issued by a custodian bank, which buys the underlying stock in Brazil, and issues a corresponding stock that is traded in the U.S. markets. In the absence of controls, an ADR tends to track the price of the underlying stock quite closely, when the exchange rate prevailing at each instant is accounted for. When a foreign investor buys an ADR, it has the right to convert that ADR 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. There are some transaction costs involved, but they are less than the inflow tax, at least for large investors. As a reaction to the wide use of this tax avoidance instrument, on November 11, 2009, a tax of 1.5 percent was introduced on the issuance of new ADRs. 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 ADRs 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.

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[6] 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 the inflow tax already existed, and the Ministry of Finance can change its rate (including setting it to zero) without congressional approval.

[7] 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.

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 nontaxed subset (e.g. FDI) it would not incur the IOF tax. Therefore, foreign investors wanting to do carry trade could buy (Non-Deliverable Forward) BRLs 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 BRLs in order to offset the position (which causes the same pressure on the exchange rate as if the foreigners had come directly). It is very difficult to gauge how much such strategies have been used during the last episode of capital controls.

On January 6th, 2011, an unremunerated reserve requirement was imposed on banks' gross FX positions beyond US$ 3 billion (on the spot market only),[8] which limited the extent to which the strategies described above could be used to bypass the controls. On March 29th, 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 27th, 2011 a new law gave the Ministry of Finance the power to tax the notional amounts of currency derivatives, with the initial tax rate being set at 1 percent, and the maximum rate being set at 25%. This tax is levied whenever a currency derivative 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).

The tax on equity inflows was set to zero on December 1st, 2011. This was the first measure relaxing the restrictions previously imposed. But on February and March 2012, additional restrictions were put in place (limiting the anticipation of payments to exporters, 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 to Brazil waned. Also, the BRL depreciated much more than other similar currencies, prompting inflationary concerns, especially after the large reduction of the basic interest rate by the Brazilian Central Bank. By the end of 2012, a movement to withdraw some of the capital controls started, aimed at attracting capital inflows, as 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 has hovered

[8] 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).

around a relatively narrow band above 2 BRL/USD since mid-2012).. The tax on foreign borrowing was limited to loans with maturities up to 2 years on June 2012, and eventually limited to loans with maturities up to 1 year in December 2012.

III. EFFECTIVENESS OF MEASURES

Figure 1 reports the gross capital inflows to Brazil broken down by different types of flows. 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 may at least partly reflect a relabeling of flows as FDI so as to avoid the inflow tax.[9] Since it is difficult to quantify the extent of this relabeling, we will focus our analysis on the effectiveness of the controls in segmenting domestic financial markets and affecting the exchange rate.

As previously discussed, there are a few meanings for effectiveness of capital controls. 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 focus was to promote the depreciation of the BRL. The Brazilian authorities were quite candid about competitiveness concerns. For example, on October 21, 2009 (the day 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*"[10] Therefore, a measure of their effectiveness is to conceive a counterfactual of what the exchange rate would have been had the capital controls not been put in place.

However, we will start with a narrower measure of effectiveness. 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

[9] One often hears the argument that intra-company loans are classified as foreign direct investment, thereby avoiding the IOF tax. We asked the Brazilian Central Bank whether this was true, and the answer was that this was not the case. According to the explanation given to us, the classification of intra-company loans as FDI is merely for statistical purposes. Those loans are taxed as any other loan.

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

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).

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, in the thirties). Banks, in Brazil, are not allowed to offer deposit accounts in any other currency but the BRL. Nevertheless, there are liquid markets for currency derivatives (currency derivatives did not exist in Brazil during the 1930s, and, *ipso facto*, were not included in the prohibition). 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 BRLs 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 price of currency futures, one can easily recover, through Covered Interest Parity, the implied onshore dollar interest rate:

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

If the onshore dollar interest rate is higher than the world interest rate, foreigners could gain by arbitrating that difference, without incurring currency risk. But if there are limits to that arbitrage, a persistent wedge between the onshore and offshore dollar rates would arise.[11] The evolution of the onshore dollar rates 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). [12] It is possible to profit from the appreciation of the BRL and the positive interest rate differential via the onshore derivatives traded at BM&FBovespa.[13] The

[11] 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.

[12] 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 (so the net benefit to a foreigner paying the IOF tax is smaller). 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.

[13] 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

(continued)

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, which may differ from the day when the tax was firstly incurred. 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 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 soon after it starts to gradually increase, most likely because there was a delay for that measure to squeeze liquidity in the domestic dollar market.[14] 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

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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)

[14] 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. 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.

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 (although in this particular case, the new tax could be avoided simply by borrowing longer-term). 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 (and the same 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 announcement).

The gradual decline in the onshore dollar rates after the spike in May of 2011 may also be due to the fall in foreign investors' interest in Brazil. 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 is announced. Typically, the net exposure in a derivative contract is a small fraction of its notional amount, so a 1 percent tax on the notional amount can be prohibitively expensive, not to mention that it could be raised overnight up to 25%, at the governments discretion. Since then, volatility of the BRL/USD exchange rate has substantially felt, as liquidity dried up (two-way intervention by the central bank has also contributed to that stability).

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 ADRs involves a small transaction cost, but provides foreigners the ability to buy and sell the ADR among themselves without incurring the inflow tax multiple times. Historically, ADR 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 an 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 ADRs to increase their supply (although that also involves some transaction costs). On the flipside, if the ADR 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 ADR 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 25 percent 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 day light savings 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 always open simultaneously (and drop days when either stock exchange is closed).

Figure 4 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[15] 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. While foreigners could use the cancellation of ADRs as a gateway to the Brazilian local markets, foreign accounts for fixed income and stocks are separately maintained/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. 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 causes investors to significantly decrease their portfolio allocations to Brazil in both bonds and equities."

Figure 5a shows the issuance and cancellation of Petrobras ADRs over time, measured in logs of shares (always positive). As the figure indicates, it is common for both issuances and cancellations to take place at the same time (which was the case even before the controls further segmented the local and ADR markets).[16] The same is true for Vale's ADR (Figure 5b). Issuances can help meet growing demand for ADRs by foreigners, while converting an ADR into the local stock may be advantageous to a foreigner even in the absence of controls (for example, if a foreigner has established a presence in Brazil and would rather trade in a more liquid market

[15] 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)

[16] One possible explanation is that banks perform several different arbitrage and investments strategies involving issuance and cancelation of ADRs, not only the simple arbitrage of buying low and selling high. Also, the custodian bank charges its fees in both operations, issuances and cancelations.

with a wider range of investment options). Table 2 provides a regression of the log of the issuances and cancellations as a function of the ADR premium during the period in which there were taxes on equity flows (November 20, 2009 to December 1, 2011). As expected, issuances of ADRs tend to occur when the premium is high, whereas cancellations tend to occur when the premium is low (even though investors may have reasons to enter/exit the local market at different points in time, all else equal it is more beneficial to time the issuance/cancellation when the premium is more advantageous). The premium alone can explain a good amount of the variation, with the R-squares being relatively high. The R-square is highest (27 percent) for the cancellations of Petrobras ADRs, which is reasonable since Petrobras is the most liquid stock in the Brazilian exchange, and as a result this is the most effective way to enter the local market via ADR cancellations.

Pushing our results maybe too far, one could argue that capital controls moved the demand for ADRs, while the supply of underlying stocks remained mostly fixed. Therefore, the regressions' coefficients could be interpreted as the slope of the supply curve, which was identified by the movements of the demand curve prompted by the changes in capital controls. Indeed, it is positive for issuances and negative for cancellations. Using the Frish-Waugh-Lovell theorem, the difference of the coefficients provide the coefficient of the regression with the [log(issuances)-log(cancellations)] as the dependent variable. Therefore, an increase in the premium of 1 percentage point would increase the net issuance of ADRs by 6.6 and 5.5 percentage points for Petrobras and Vale, respectively.

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. According to Forbes et al, (2012), foreign investors in equities "… 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 2009, the IOF revenues related to currency transactions were R$ 1,307 billion in 2009. That figure rose to R$5,544 and R$4,676 billion in 2010 and 2011 respectively. However, other currency transactions are taxed by the IOF, such as credit card purchases made by residents

abroad, thereby clouding the interpretation of those amounts collected by the IOF tax on currency transactions.[17]

C. Effect of controls on the exchange rate

Figure 6 plots the evolution of the real-dollar nominal exchange rate during this period. We follow the convention in Brazil, reporting the exchange rate in terms of reais per dollar, so an increase denotes a depreciation of the real. While appreciation trends seem to half after some of the measures are adopted, the plots do not suggest sizable discrete responses. 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. 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:

$$\begin{aligned}\Delta e_t = c + \beta DControl_t + \gamma_1 \Delta(CDI - LIBOR) + \gamma_2 \Delta Onshore\ Dollar\ Rate \\ + \gamma_3 \Delta \log(Ibovespa) + \gamma_4 \Delta \log(VIX) + \gamma_5 \Delta \log(Comodities) \\ + \gamma_6 \Delta \log(Dollar\ Index) \\ + \gamma_7 FX\ Intervention\ (Purchases) + \gamma_8 FX\ Intervention\ (Sales) + \epsilon_t\end{aligned}$$

Where *e* is the equal to the log of the dollar-real bilateral exchange rate (an increase in *e* denotes a depreciation of the real), $DControl_t$ is a variable that equals 1 on the day that capital control/restriction is implemented (and for symmetry, -1 when a restriction is lifted). Additional controls 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 broadest 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 Fed 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 can provide an error correction feature to the dynamics).

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

[17] So far, we have not been able to gain access to disaggregated data.

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). 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. 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).

Table 3 reports the results from this regression. The first column excludes the intervention variable. All the coefficients on the non-dummy variables are significant and have the expected sign, except for the interest rate differential, a result already found by Vervloet (2010), with monthly data, and the onshore dollar rate. The latter may seem puzzling, but confirms that the periods where the onshore dollar rate was higher (for example, when controls temporarily succeeded in squeezing liquidity) were not accompanied by reduced appreciation pressures[18]. The point estimates suggest that a 1 percent increase in the local stock market or in commodity prices is associated with a 0.19 and 0.11 percent appreciation of the real, respectively. A one percent increase in the VIX or in the value of the dollar against advanced economy currencies are associated with a 0.03 and 0.46 depreciation of the real, respectively. The magnitudes are plausible and in line with previous estimates, and the coefficients in these variables remain comparable across all specifications in Table 3. The coefficient on the Capital Controls/Restriction Dummy is small, negative (suggesting they appreciated the real) and not statistically significant. The dummy for the surprise cut in the policy rate points to a depreciation of over 2 percent, which is statistically significant[19].

In Column 2 we add the central bank's intervention as an additional variable. The estimates suggest that an intervention where the central purchases dollars have no effect on the exchange rate. 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 when the central bank purchases dollars, it bids-up the onshore dollar rate, which can attract more inflows. Interventions where the central bank sells dollars have a statistically significant effect, with a 1 billion USD sale appreciating the real by 0.47 percent. While this result is statistically significant, it should be interpreted with caution as there were only six instances where the central bank intervened by selling dollars in our sample (and these sales may have had

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

[19] On the COPOM (Brazilian MPC) meeting of August 30, 2011, it was decided to revert the course of monetary policy. The basic rate, which had been climbing amid concerns of inflation acceleration, was unexpectedly cut by 50 bps, ushering in a long period of cuts that totaled 5.25 bps in a year.

an unusually strong "signaling" 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 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. Therefore, to the extent that this effect is relevant, sterilized sales should produce a larger effect on the exchange rate than sterilized purchases of foreign currency.

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 sterilized interventions where the central bank buys dollars have a statistically significant result in column 6 but with the "wrong" sign (selling dollars causing the real to further appreciate). The coefficients on the lagged levels are not reported for the sake of conciseness, but the coefficient on the lagged level of the log exchange rate is -0.04, -0.034 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 0.034 percent correction towards that level, respectively). That coefficient is not statistically significant in column 6.

In the regressions above we combined all the different capital controls and restrictions into a single dummy variable. One alternative is to code every capital control/restriction measure as a separate singleton dummy variable. We ran the same regressions from Table 3 replacing the single capital control/restriction variable by a full set of singleton dummies. The point estimates and standard errors for those dummies are reported in Table 4. The only dummies that are statistically significant with the "right" sign correspond to the initial capital control, which depreciated the *real* by 1.5 percent, and the extension of the tax on loans up to five years, which further depreciated the *real* by 1.5 percent. None of the other dummies associated with restrictions are statistically significant, except for the tax on external loans up to 720 days, which is significant but suggests an appreciation of 1.8 percent (which has the "wrong" sign relative to what would be expected). An F-test for the sum of the coefficient on all the dummies related to capital controls and restrictions has a point estimate close to zero which is not statistically significant.

It is conceivable that some measures may have had a muted effect on impact, but could have had a larger effect in the aftermath, once the market got a better sense of their implications. Indeed Figure 6 seems to suggest the potential for breaks in trends following the announcement of some of the measures. One way to gauge whether the breaks suggested in Figure 6 are driven by the controls/measures or global factors is to compare the behavior of the real with that of other emerging market currencies around the time of those measures. While the Brazilian controls/measures could have some spillovers to other currencies, this effect should be second-order vis-à-vis the direct effect of changing global financial conditions. Figure 7 plots the evolution of the Australian dollar, Chilean and Colombian pesos, South African rand, and Turkish lira during this period. All of these currencies, except the Chilean peso, seem to reverse an appreciation trend following the initial capital control. All of these currencies, except the Australian dollar also seem to change their appreciation trends following the increase in the tax on fixed income flows. The trends in the rand and the Chilean peso also seem to "respond" to the restrictions on gross FX positions. The rand and the lira also revert appreciation trends following the tax on short-term external loans. And all of them tend to appreciate after the imposition of the tax on the notional amount of derivatives and the surprise rate cut. But the only currencies that seem to stabilize at a significantly more depreciated level towards the end of the sample are the real and the rand, both of which had domestic factors contributing to this outcome.

In Figure 8 we plot the actual exchange rate as well as the fitted exchange rate implied by the regressions in columns 1 and 4 of Table 3 (excluding the capital control/measure dummies). These "counter-factual" exchange rates are estimated in the sample up to March 15, 2012, and the out-of-sample counterfactuals (and actual data) are indicated by dashed lines. There is a vast literature beginning with Meese and Rogoff (1981) 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 to gauge whether the breaks in-sample can be explained by factors other than the capital controls/measures implemented, and whether the sustained depreciation of the real in 2012 can be explained by the variables in our regression. The counterfactual plots also point to a break around the time of the first control. But once we condition for the other variables, there does not seem to be sizable breaks around the times of the other measures. However, in the out-of-sample range (post March 15, 2012), the counterfactuals tend to hover around 1.8-1.9 reais/dollar, which is about 10 percent below the levels of the actual exchange rate. [20]In Figure7b we base the counterfactuals only on the external variables (commodity prices, VIX, and dollar vis-à-vis other advanced economy currencies). As in the case of Figure 7a, the out-of-sample counterfactuals suggest that the real should have been 10-20 percent stronger than it actually was. That is, the external variables in mid to late 2012 pointed to conditions that were similar to the ones in place when the real to hovered around 1.7-1.9.

[20] Please note that since the fitted values are based on a regression of changes in the exchange rate, the average counterfactual levels will not necessarily be the same as the actual average levels even within sample.

In order to more formally test for an effect of the controls at different horizons, we ran similar regressions to the ones in Table 3 but including sets of dummies that are equal to one in the day of the event, in the first five, and in the first ten working days once a measure is announced. Table 5 reports the combined effect associated with capital controls and restrictions. The first row in Table 5 is based on the same dummy variable used in Table 3, equal to one in the days when a capital control/restriction is announced. The point estimates are similar to the ones in Table 3 but ten times larger (since we report the combined effect of 11 measures associated with restrictions and one associated with a reduction in restrictions). Columns 1-6 of Table 5 are based on regressions analogous to the ones in Columns 1-6 of Table 3 (except for the inclusion of the dummies with longer horizon), while Column 7 of Table 5 reports an "unconditional" effect when we do not control for any variable (other than the dummies). The results reported for the error correction specifications correspond to the cumulative short-term effect (since by construction, the long-term effect of the dummy will be zero). The point estimate for the combined effect of the controls/restrictions remains small, with a negative sign, except in column 7. For comparison purposes, we also report the effect of the dummies related to the surprise rate cut from that same regression. We also run regressions with an alternative measure of capital controls/restrictions, where a "1" is only assigned for new measures and a "1/2" is assigned for events that only tighten existing restrictions. The results from this alternative metric are similar to the ones used in our baseline. The table also reports the results based on a full set of dummies for each separate measure adopted.

In the second set of results, we also include dummies that are equal to one in the first five working days after which a control/measure is adopted. The results reported multiply the estimated combined effect by five to capture the cumulative effect over that horizon. The combined effect of the capital controls/restrictions now point to a positive result, ranging from 1.7 in column 4 to 6.9 in column 7, but which is never statistically significant. In contrast, the dummies for the surprise rate cut have a combined effect that ranges from 3.9 to 5.7 percent in columns 1-6 and is always statistically significant. The third set of results also includes dummies equal to one during the first 10 working days after a control/measure is adopted. The point estimates on the combined effect of the capital controls/restrictions is large (but not significant) in the unconditional regression (column 7), but remains small or negative when we control for other variables (columns 1-6). In contrast the surprise rate cut has a statistically significant cumulative effect that ranges from 12.7 to 15.3 percent in columns 1-6. While the regressions with a full set of dummies for each separate measure have a large and statistically significant effect in column 7, that effect disappears once we control for other variables in columns 1-6.[21]

[21] The results above are based on a sum of the coefficients on the different dummies. This indeed corresponds to a permanent effect in the regressions in columns 1-3. But in columns 4-6 we have an error correction term, and by construction the long-run effect will be zero. But for the sake of comparability, we also report the sum of the point estimates in those regressions, without adjusting for the model's dynamics.

To summarize, the results above show that we fail to find a statistically significant effect even when we consider longer windows for the capital controls/restrictions to affect the exchange rate. But while these measures may not have impacted the exchange rate (at least not in the immediate aftermath), they may have amplified the effects of other policies on the exchange rate. For example, the capital controls/restrictions may have amplified the effect of cuts to the policy interest rate on the exchange rate. Table 6 presents the results of regressions similar to the one in Column 1 of Table 3, but where the interest rate differential variable is also interacted with a dummy for the period following a given measure. For ease of comparison, Column 1 of Table 6 reports the same regression as Column 1 of Table 3. In Column 2 of Table 6, we add an interaction of the interest rate differential with a step dummy equal to one in the period after the initial tax on inflows. The coefficient on that interaction is negative, small in magnitude and not statistically significant. The same applies to the specifications in Columnns 3-10. But once we interact the interest rate differential with a dummy for the period post-surprise rate cut (Column 11), the results point to a large and statistically significant coefficient, with a 100bp cut in the interest rate depreciating the real by 4.3 percent. This effect is much larger than the effect estimated for the sample as a whole, as well as standard estimates in the literature. This large point estimate can explain much of the exchange rate dynamics in the end of our sample, given the large cuts in the policy rate that took place (275 bp from that point until the end of our regression sample in March 2012 when the controls/restrictions start being removed; 525bp over the entire easing cycle until November 2012). The results are qualitatively similar if we consider an error-correction specification analogous to Column 4 of Table 3 (which would also suggest a sizable break taking place after the surprise rate cut). In principle, sterilized intervention could also have gained traction after the imposition of the controls/restrictions. But an analysis similar to the one in Table 6 fails to indicate any structural breaks that make sterilized dollar purchases more effective at depreciating the real.

In theory, it is more reasonable to attribute a structural break on the relationship between the interest rate differential and the exchange rate to capital controls/restrictions than to the beginning of the monetary easing cycle per se (since a priori, changes in the interest rate should not have an effect on the regression coefficient). Perhaps limited variation in that interest differential after enough capital controls/restrictions were implemented and the easing cycle began make identifying that break more difficult (while there are sizable monetary policy tightening and loosening cycles in our sample, there is relatively little variation around the time that the capital controls/restrictions were at their peak). One reason for why a break may only become sharper in the data after the rate cut is if the exchange rate adjusts strongly at that point in expectation of future interest rate cuts.[22] This result that capital controls amplified the effect of

[22] Since the exchange rate is a forward-looking variable, it may respond strongly to the expectation of future cuts in the policy rate, even if the actual interest rate differential is only being reduced gradually. In practice the interest rate futures did respond more strongly than the initial rate cut, but their response was also gradual (the one-year interest rate swap declined by only 100 bp one month after the initial 50bp rate cut).

interest rate cuts on the exchange rate is also consistent with the large discrepancy between the actual and counterfactual exchange rates reported in Figure 8 (since the latter held the coefficient on the interest rate differential constant).

While Brazil's policy rate is at a historically low level, it remains very high to advanced economies, and that differential should have continued to attract flows searching for yield, especially given the very low volatility of the exchange rate. Maybe foreign investors were willing to pay the inflow taxes (or jump through a series of hoops in order to avoid it) when the interest rate differential was double digit, but may be much less inclined now that the differential is narrower. If those restrictions succeed in creating a wedge of 2-3 percent, they would bring the "adjusted" return differential more in line with other Latin American countries (e.g. Chile and Mexico where the policy rate is currently 5 and 4.5 percent respectively).

While the focus of our analysis has been the effect of the controls/restrictions on the exchange rate, 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. In March 2011 short-term (less than 360 days) 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 measure will certainly make Brazil much more resilient during the next global systemic sudden stop.

A full fledged assessment of the welfare implications of the controls would have to include the costs associated with them. If the "benefit" is small, but so are the costs, the policy could be worthwhile. 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 is, 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).

IV. CONCLUSION

Controls on capital inflows have gained renewed interest in the last years. From the theoretical point of view, many models have shown the desirability of some forms of prudential controls of capital inflows to enhance welfare in an environment of incomplete markets with pecuniary externalities (for a review, see Korinek 2011). From the policy perspective, the IMF, most notably, has changed the tone on capital controls (IMF 2012).

Therefore, the interest on practical experiences with controls on capital inflows increased substantially. Brazil provided the most cited example, because it has been experimenting with many different forms of controls on capital inflows. These controls are market-based in an open-economy with developed capital markets with low credit risk.

Our results indicate that the controls were effective in the sense of creating distortions in the pricing of financial assets, i.e., making the domestic assets more expensive, which is one of the goals of the controls. Therefore, controls were effective in partially segmenting the Brazilian financial market from the international market. However, the controls do not seem to have been effective to deter the appreciation of the *real* when capital inflows were strong, a stated objective of the Brazilian authorities. We cannot rule out, however, that the cumulative effect of the controls strengthened the effect of the large cut of the basic interest rate (Selic), by 5.25bps, in depreciating the real since March 2012.

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 many of the controls have been undone. Controls may have helped Brazil to avoid a bubble and perhaps worse, had it welcomed foreign capital with open arms. However, given the very low domestic saving rate of the Brazilian economy (16%), those controls may also have a lasting effect on lowering foreign savings and increasing the cost of capital, thereby jeopardizing investment and growth.

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

Date	Tighten or Looser Restrictions?	Measure
10/19/2009*	Tighten	Tax of 2 percent on portoflio equity and fixed income inflows
11/19/2009	Tighten	Tax of 1.5% on the Conversion of ADRs 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
1/6/2011	Tighten	Unremunrated reserve requirement of 60 percent on bank's gross FX positions beyond US$3 billions
3/29/2011	Tighten	Tax of 6 percent on loans abroad with maturity below one year
4/6/2011*	Tighten	Tax of 6 percent on loans 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
12/1/2011	Loosen	Tax on portfolio equity inflows eliminated
2/29/2012*	Tighten	Tax of 6 percent on loans 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 loans 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)
6/13/2012	Loosen	Tax on 6 percent on loans 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 loans 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

Notes: * indicates a measure was announced after the Brazilian market was closed. For the purposes of our regressions, these events are coded as of the following day. In addition to the measures above, there was a surprise 50bp rate cut in the policy rate on 09/01/2011, whose impact we also discuss in detail.

Table 2. Regression of ADR Issuance and Cancellation on the ADR Premium.

	Log(1+Issuance)		Log (1+Cancellation)	
	Petrobras	Vale	Petrobras	Vale
Petrobras	2.571***		-4.130***	
ADR Premium	[0.260]		[0.257]	
Vale		3.473***		-2.067***
ADR Premium		[0.251]		[0.307]
Constant	2.999***	0.665***	8.233***	3.936***
	[0.268]	[0.194]	[0.265]	[0.238]
N	709	701	709	701
R-Squared	0.121	0.215	0.267	0.061

Notes: Standard errors in brackets. *, **, and *** denote statistical significance at the 1, 5 and 10 percent level, respectively.

Table 3. 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	0.033	0.037	0.052	-0.035	-0.027	0.012
	[0.107]	[0.107]	[0.128]	[0.109]	[0.110]	[0.147]
Δ Onshore Dollar Rate (90d)	-0.059	-0.032	0.105	-0.089	-0.062	0.048
	[0.087]	[0.092]	[0.284]	[0.087]	[0.091]	[0.323]
ΔLog(Ibovespa)	-0.185***	-0.192***	-0.228***	-0.188***	-0.194***	-0.215***
	[0.030]	[0.029]	[0.050]	[0.029]	[0.028]	[0.058]
ΔLog(Vix)	0.033***	0.032***	0.026***	0.033***	0.032***	0.029***
	[0.007]	[0.006]	[0.009]	[0.007]	[0.007]	[0.009]
ΔLog(CRB Commodity Index)	-0.106**	-0.111**	-0.105*	-0.109**	-0.107**	-0.079
	[0.054]	[0.053]	[0.061]	[0.051]	[0.051]	[0.061]
ΔLog(Dollar Currency Index)	0.456***	0.472***	0.532***	0.458***	0.467***	0.497***
	[0.070]	[0.071]	[0.131]	[0.071]	[0.071]	[0.132]
Lagged Level of Log(Exchange Rate)				-0.040**	-0.034*	-0.013
				[0.019]	[0.019]	[0.047]
Lagged Levels of Exp. Variables Above				YES	YES	YES
Intervention (Purchase, Billion USD)		0.008	-0.565		-0.004	-0.603**
		[0.056]	[0.400]		[0.055]	[0.289]
Intervention (Sale, Billion USD)		-0.477***	-3.029		-0.388**	-2.238
		[0.163]	[2.535]		[0.191]	[3.021]
Capital Controls/Restriction Measure	-0.006	-0.018	-0.006	-0.067	-0.062	-0.029
	[0.260]	[0.259]	[0.259]	[0.251]	[0.252]	[0.265]
Dummy for Surprise Rate Cut	2.170***	2.187***	2.157**	1.968***	1.979***	1.884**
	[0.722]	[0.718]	[0.850]	[0.718]	[0.716]	[0.810]
Constant	0.003	0.008	0.165	1.259	0.889	0.467
	[0.027]	[0.032]	[0.119]	[8.805]	[8.830]	[9.554]
Observations	622	622	622	622	622	622
R-squared	0.459	0.464	0.25	0.472	0.475	0.334

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

Table 4. Regression Results for the Change in the log of the Exchange Rate Using Separate Dummies for Each Capital Control/Restriction Measure.

Dummy on Day of Event	1	2	3	4	5	6
	OLS	OLS	IV	OLS	OLS	IV
Initial Tax on Inflows	1.455**	1.402*	1.011	1.352*	1.330*	1.12
	[0.723]	[0.721]	[0.846]	[0.710]	[0.708]	[0.804]
ADR Conversion	-0.289	-0.301	-0.374	-0.428	-0.425	-0.407
	[0.716]	[0.714]	[0.829]	[0.700]	[0.698]	[0.789]
4% Tax on Fixed Income	-1.104	-1.094	-1.07	-1.118	-1.118	-1.161
	[0.720]	[0.717]	[0.833]	[0.703]	[0.701]	[0.792]
6% Tax on Fixed Income	0.332	0.326	0.359	0.345	0.346	0.354
	[0.717]	[0.715]	[0.830]	[0.700]	[0.698]	[0.789]
URR on Bank's Gross FX Position	0.345	0.33	0.339	0.376	0.377	0.391
	[0.717]	[0.715]	[0.831]	[0.700]	[0.698]	[0.789]
Tax on Short-Term Loans	-0.813	-0.832	-0.922	-0.784	-0.81	-0.98
	[0.716]	[0.714]	[0.829]	[0.698]	[0.696]	[0.790]
Tax on Short-Term Loans up to 720 Days	-1.797**	-1.820**	-1.958**	-1.751**	-1.778**	-2.002**
	[0.717]	[0.714]	[0.830]	[0.701]	[0.699]	[0.795]
Tightening of URR on Bank's Gross FX Position	0.24	0.228	0.454	0.15	0.187	0.493
	[0.716]	[0.715]	[0.837]	[0.704]	[0.702]	[0.802]
Tax on Notional Amount of Derivatives	0.025	0.046	0.665	-0.117	-0.073	0.52
	[0.723]	[0.723]	[0.870]	[0.709]	[0.708]	[0.833]
Tax on Short-Term Loans up to 3 years	0.208	0.198	0.149	0.081	0.093	0.108
	[0.716]	[0.714]	[0.829]	[0.702]	[0.699]	[0.791]
Tax on Short-Term Loans up to 5 years	1.482**	1.462**	1.239	1.408**	1.398**	1.217
	[0.718]	[0.715]	[0.834]	[0.704]	[0.702]	[0.797]
Surprise Rate Cut	2.155***	2.172***	2.149**	1.939***	1.950***	1.876**
	[0.722]	[0.720]	[0.837]	[0.708]	[0.706]	[0.801]
Removal of Tax on Equity Inflows	0.028	0.028	-0.102	0.157	0.113	-0.169
	[0.718]	[0.716]	[0.833]	[0.702]	[0.700]	[0.801]

Notes: For conciseness, table reports only the coefficients on the dummy variables above. Each column corresponds to the analogous regression from Table 3. Standard errors in brackets. *, **, and *** denote statistical significance at the 1, 5 and 10 percent level, respectively.

Table 5. Combined Effect of Capital controls/Restrictions Across Different Specifications and Horizons.

	1	2	3	4	5	6	7
	OLS	OLS w/ Interv.	IV	OLS w/ Lag. Levels	OLS w/ Interv. w/ Lag. Levels	IV w/ Lag. Levels	Unconditional
Dummies on day of event							
Combined Effect	-0.061	-0.177	-0.063	-0.672	-0.549	-0.295	1.881
	[2.112]	[2.107]	[2.482]	[2.12]	[2.115]	[2.352]	[2.817]
Surprise Rate Cut	2.17***	2.187***	2.157**	1.968***	1.981***	1.884**	1.883*
	[0.727]	[0.724]	[0.85]	[0.728]	[0.727]	[0.81]	[0.97]
Combined Effect w/	0.411	0.313	0.538	-0.088	0.04	0.398	2.718
Alternative Metric	[1.831]	[1.827]	[2.157]	[1.836]	[1.83]	[2.043]	[2.436]
Combined Effect of Separate	0.113	-0.027	-0.209	-0.329	-0.351	-0.515	1.344
Dummies for Every Measure	[2.517]	[2.51]	[2.925]	[2.523]	[2.518]	[2.782]	[3.369]
Dummies on day of event and							
for 5 working day window							
Combined Effect	4.324	3.851	4.543	1.724	1.883	2.456	6.871
	[4.749]	[4.751]	[4.967]	[4.858]	[4.857]	[5.381]	[5.797]
Surprise Rate Cut	5.73***	5.655***	4.89***	5.09***	4.931***	3.878***	7.76***
	[0.673]	[0.659]	[0.819]	[0.884]	[0.894]	[1.407]	[2.481]
Combined Effect w/	2.799	2.465	2.965	1.074	1.172	1.639	5.125
Alternative Metric	[3.366]	[3.366]	[3.501]	[3.404]	[3.406]	[3.787]	[4.214]
Combined Effect of Separate	5.077	4.519	4.505	2.829	2.819	2.286	7.365*
Dummies for Every Measure	[3.362]	[3.355]	[3.718]	[3.567]	[3.59]	[3.959]	[3.943]
Dummies on day of event and							
for 5 and for 10 working day window							
Combined Effect	1.4	0.154	0.61	-6.794	-6.619	-5.187	11.265
	[6.781]	[6.77]	[7.309]	[7.689]	[7.697]	[8.17]	[9.335]
Surprise Rate Cut	14.844***	14.756***	13.37***	15.328***	15.001***	12.661***	17.707***
	[3.232]	[3.196]	[3.213]	[3.53]	[3.452]	[4.16]	[4.87]
Combined Effect w/	0.881	0.043	0.39	-4.515	-4.407	-3.375	7.957
Alternative Metric	[4.601]	[4.595]	[4.931]	[5.144]	[5.151]	[5.499]	[6.342]
Combined Effect of Separate	5.81	4.428	2.929	-1.139	-1.315	-2.484	16.398**
Dummies for Every Measure	[5.107]	[5.032]	[5.552]	[5.681]	[5.684]	[6.068]	[7.125]

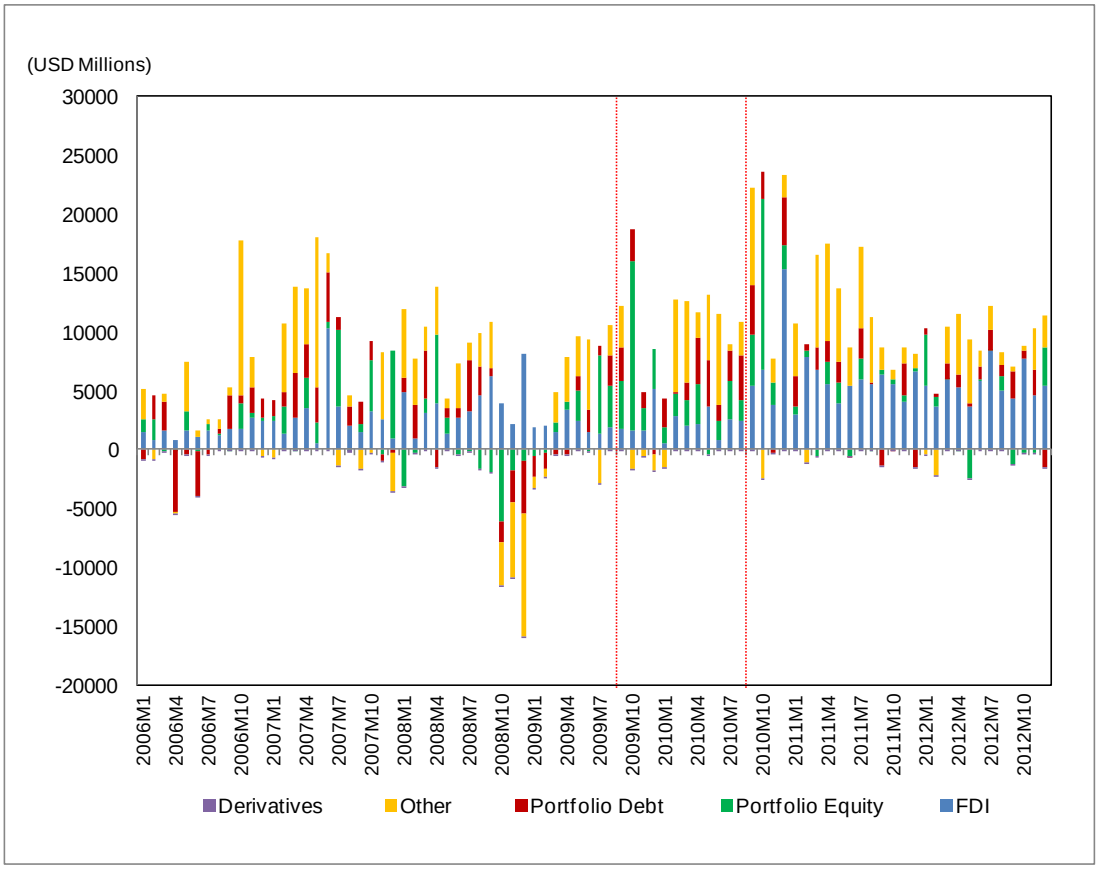
Notes: Each cell reports the combined effect of the dummies on controls/restrictions or the surprise rate cut. The first row reports the combined effect when capital controls are measured by assigning a value of 1 to the days when a restriction is imposed (-1 when it is removed), similar to the one in Table 3. The values reported multiply the point estimate by the total number of restrictions imposed in the sample. The values reported for the surprise rate cut come from that same regression. The results for "Combined Effect w/ Alternative Metric" assign a value of 1 when a new type of restriction is imposed and ½ when an existing restriction is tightened. Values reported multiply the point estimate by the total number of (weighted) restrictions imposed. The estimation is repeated including dummies that are equal to one during the five working days, and five and ten working days after the event. Results reported are based on 63 separate regressions. Columns 1-6 are based on regressions analogous to Columns 1-6 of Table 3 (except for the dummies covering longer horizons). Column 7 (Unconditional) does not include any variable as a control other than the dummies. Standard errors in brackets (Newey-West HAC errors except for singleton dummies). *, **, and *** denote statistical significance at the 1, 5 and 10 percent level, respectively.

Table 6. Structural Breaks on the Effect of the Interest Rate Differential on the Exchange Rate.

VARIABLES	1	2	3	4	5	6	7	8	9	10	11
Δ Spread CDI - LIBOR and Its Interaction w/											
Period After Control/Measure:											
Δ Spread CDI - LIBOR	0.033	0.246	0.079	-0.013	0.022	0.055	0.051	0.051	0.049	0.036	0.058
	[0.107]	[0.325]	[0.301]	[0.158]	[0.156]	[0.136]	[0.120]	[0.118]	[0.111]	[0.110]	[0.107]
Δ Spread CDI - LIBOR After		-0.268									
Initial Tax on Inflows		[0.342]									
Δ Spread CDI - LIBOR After			-0.06								
ADR Conversion			[0.318]								
Δ Spread CDI - LIBOR After				0.112							
4% Tax on Fixed Income				[0.203]							
Δ Spread CDI - LIBOR After					0.028						
6% Tax on Fixed Income					[0.200]						
Δ Spread CDI - LIBOR After						-0.08					
URR on Bank's Gross FX Position and						[0.201]					
Δ Spread CDI - LIBOR After							-0.116				
Tax on Short-Term Loans							[0.247]				
Δ Spread CDI - LIBOR After								-0.127			
Tax on Short-Term Loans up to 720 Days								[0.262]			
Δ Spread CDI - LIBOR After									-0.216		
Tightening of URR on Bank's Gross FX Position									[0.415]		
Δ Spread CDI - LIBOR After										-0.049	
Tax on Notional Amount of Derivatives										[0.455]	
Δ Spread CDI - LIBOR After											-4.259***
Surprise Rate Cut											[1.487]
Δ Onshore Dollar Rate (90d)	-0.059	-0.052	-0.057	-0.059	-0.059	-0.059	-0.058	-0.058	-0.058	-0.059	-0.069
	[0.087]	[0.088]	[0.087]	[0.088]	[0.087]	[0.087]	[0.087]	[0.087]	[0.087]	[0.087]	[0.088]
ΔLog(Ibovespa)	-0.185***	-0.185***	-0.185***	-0.184***	-0.184***	-0.185***	-0.185***	-0.185***	-0.185***	-0.185***	-0.191***
	[0.030]	[0.030]	[0.030]	[0.030]	[0.030]	[0.030]	[0.030]	[0.030]	[0.030]	[0.030]	[0.029]
ΔLog(Vix)	0.033***	0.033***	0.033***	0.033***	0.033***	0.033***	0.033***	0.033***	0.033***	0.033***	0.033***
	[0.007]	[0.007]	[0.007]	[0.006]	[0.006]	[0.007]	[0.007]	[0.007]	[0.007]	[0.006]	[0.006]
ΔLog(CRB Commodity Index)	-0.106**	-0.102*	-0.105*	-0.106**	-0.106**	-0.105*	-0.105*	-0.105*	-0.104*	-0.105*	-0.094*
	[0.054]	[0.055]	[0.054]	[0.054]	[0.054]	[0.054]	[0.054]	[0.054]	[0.054]	[0.054]	[0.052]
ΔLog(Dollar Currency Index)	0.456***	0.460***	0.457***	0.455***	0.456***	0.456***	0.455***	0.455***	0.456***	0.456***	0.448***
	[0.070]	[0.071]	[0.071]	[0.070]	[0.070]	[0.070]	[0.070]	[0.070]	[0.070]	[0.070]	[0.068]
Capital Controls/Restriction Measure	-0.006	-0.016	-0.007	0.001	-0.005	-0.006	-0.003	-0.003	-0.003	-0.006	0.008
	[0.260]	[0.259]	[0.261]	[0.261]	[0.261]	[0.260]	[0.261]	[0.261]	[0.261]	[0.261]	[0.267]
Dummy for Surprise Rate Cut	2.170***	2.152***	2.165***	2.194***	2.176***	2.148***	2.133***	2.129***	2.093***	2.152***	0.519
	[0.727]	[0.727]	[0.728]	[0.729]	[0.729]	[0.730]	[0.734]	[0.735]	[0.744]	[0.748]	[0.927]
Constant	0.003	0.003	0.003	0.003	0.003	0.002	0.002	0.002	0.002	0.002	-0.015
	[0.027]	[0.027]	[0.027]	[0.027]	[0.027]	[0.027]	[0.027]	[0.027]	[0.027]	[0.027]	[0.027]
Observations	622	622	622	622	622	622	622	622	622	622	622
R-squared	0.459	0.46	0.459	0.459	0.459	0.459	0.459	0.459	0.459	0.459	0.466

Notes: Notes: Standard errors in brackets (Newey-West HAC standard errors). *, **, and *** denote statistical significance at the 1, 5 and 10 percent level, respectively. Column 1 corresponds to the regression in Column 1 of Table 3. Each successive regression is the same as the one in Column 1 except for the inclusion of a variable equal to the interest rate differential interacted with a step dummy equal to one in the period after the indicated capital control/measure is adopted.

Figure 1. Gross Capital Inflows to Brazil.



Notes: Data corresponds to liabilities to foreigners in the capital and financial account.
Source: Central Bank of Brazil.

Figure 2a. Evolution of the 90- and 360-Day Cupom Cambial.

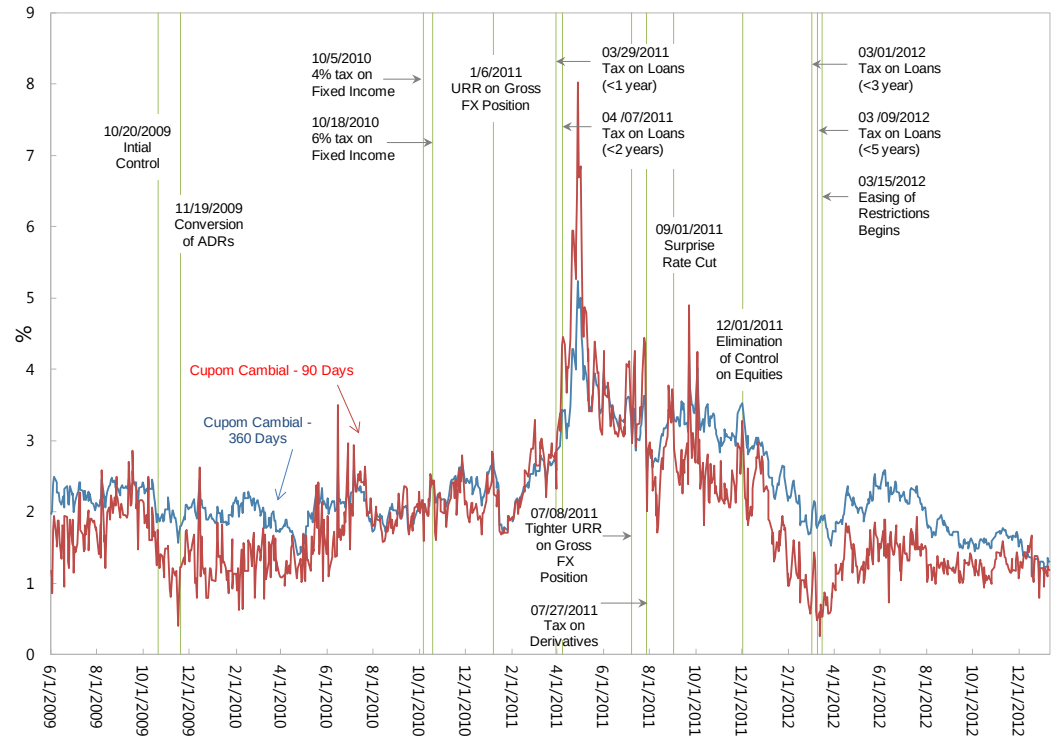


Figure 2b. Evolution of the Spread Between the 360-Day Cupom Cambial, the One-Year LIBOR, and Brazil's One-Year CDS spread.

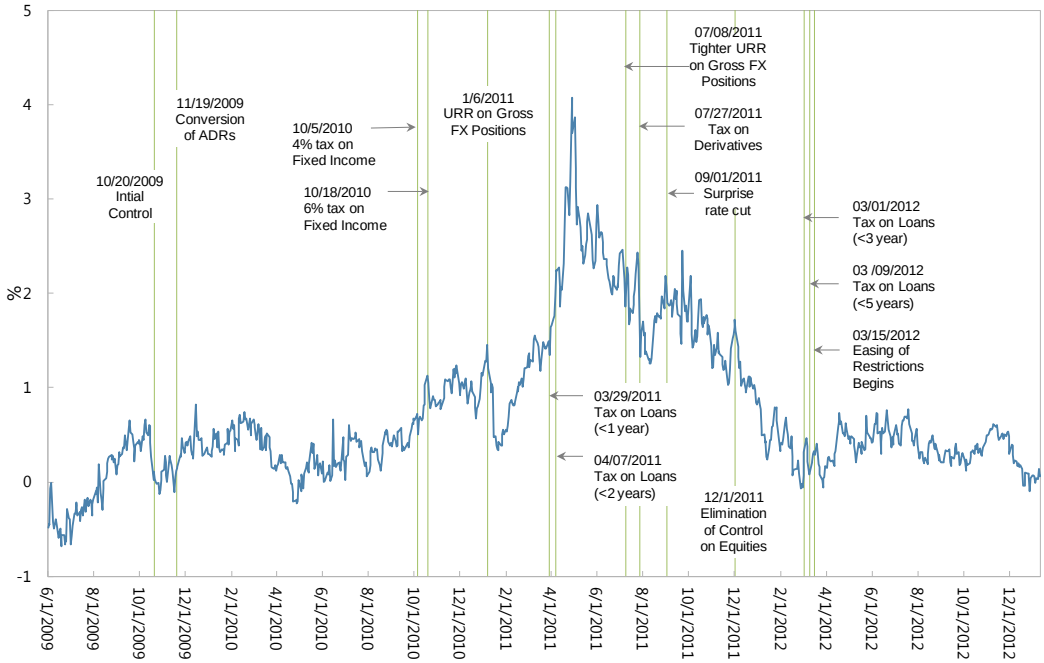


Figure 3. Net Foreign Investor Position in Fixed Income Derivatives at the BMF.

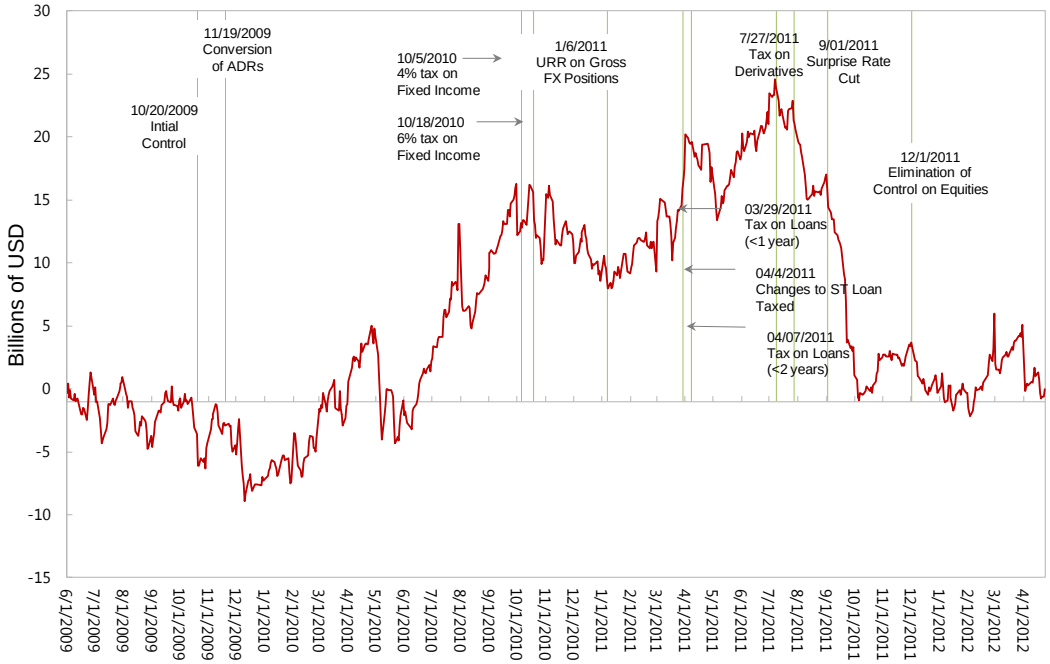


Figure 4. Evolution of the Premium for Petrobras and Vale ADRs.

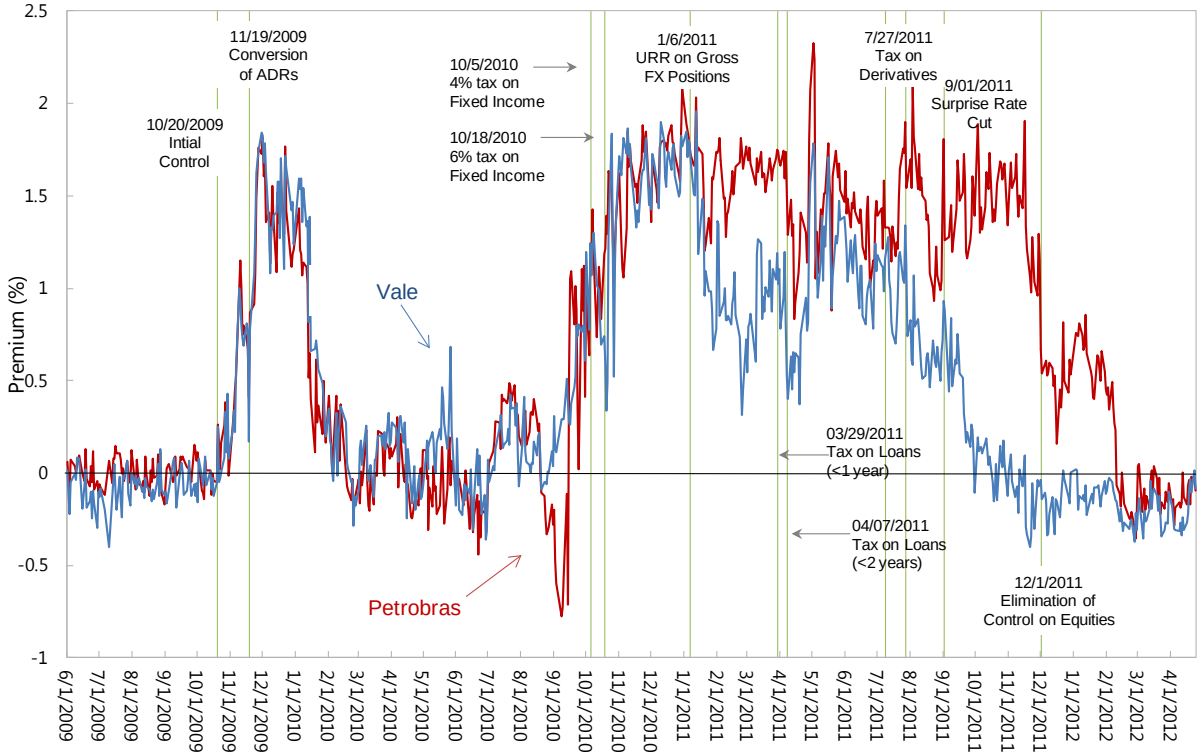


Figure 5a. Petrobras ADR Premium, Issuance and Cancellation

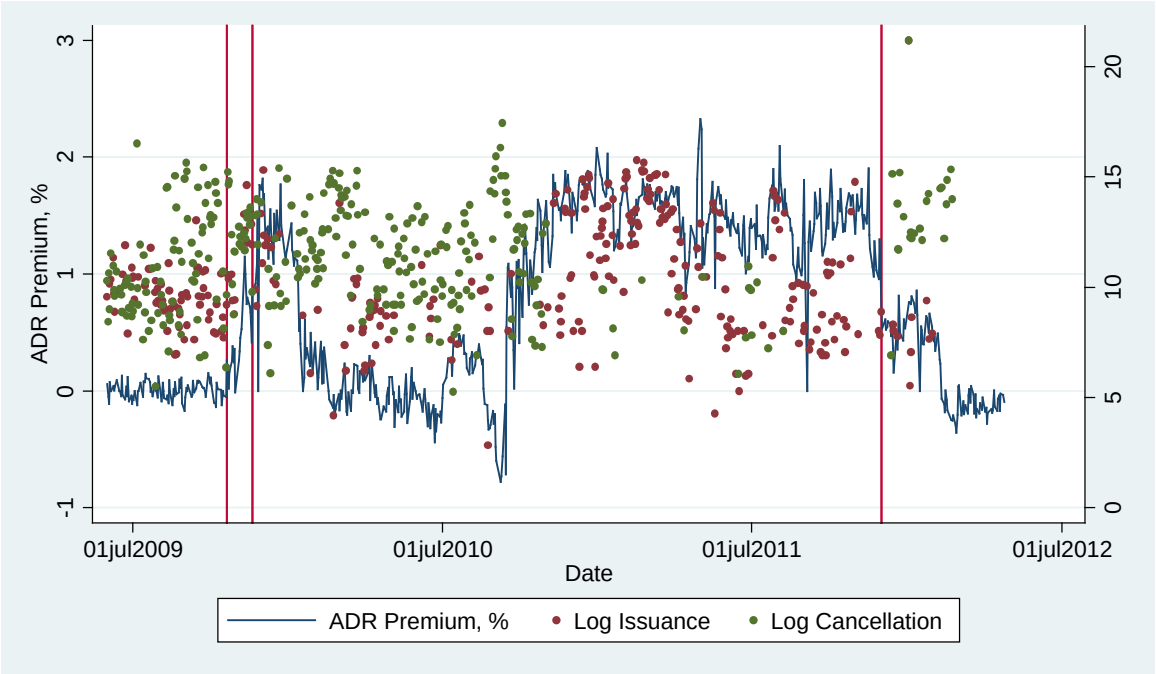


Figure 5a. Vale ADR Premium, Issuance and Cancellation

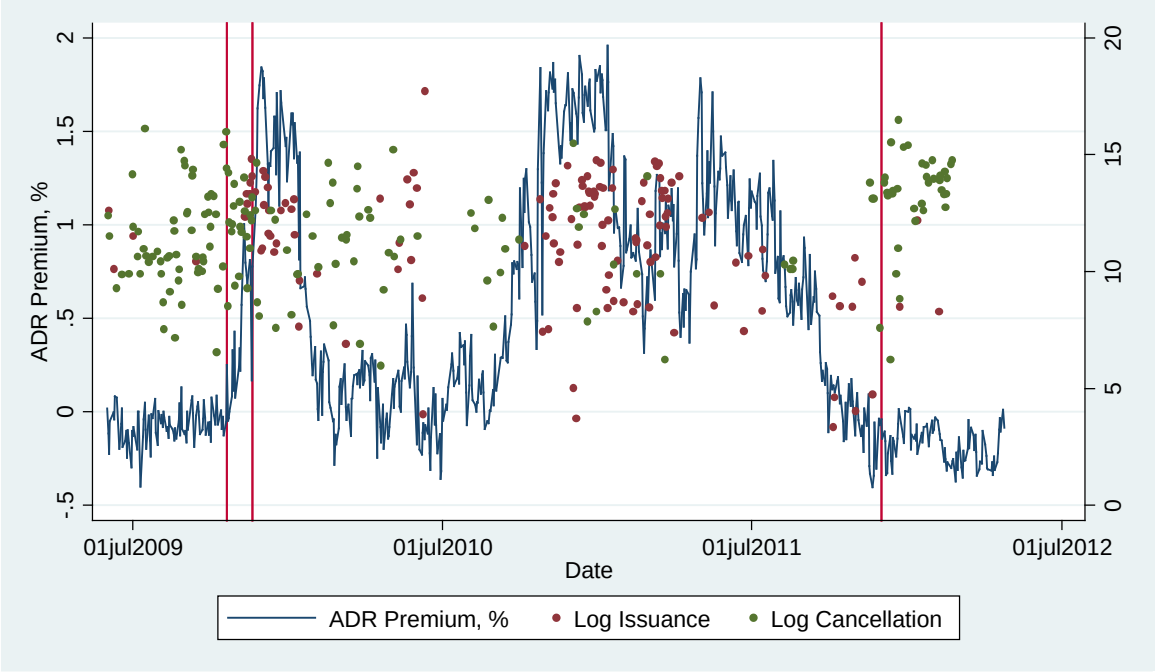
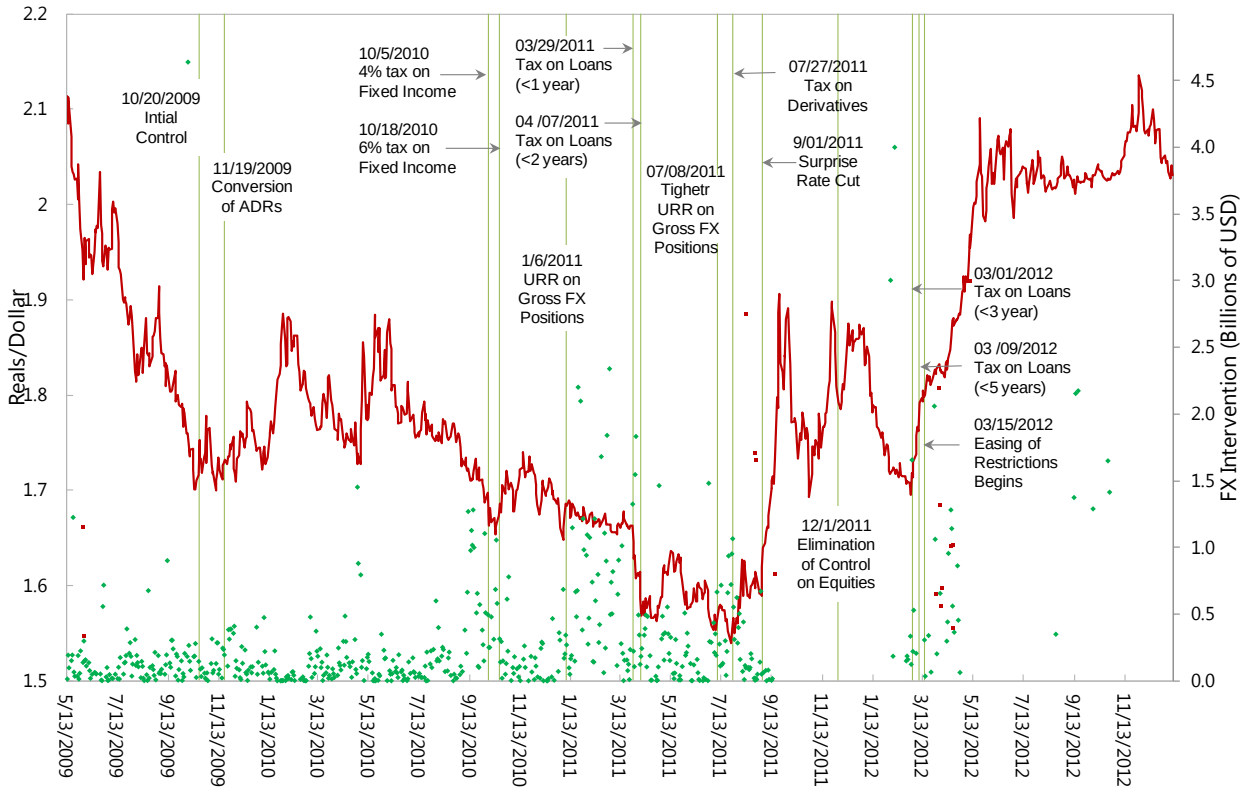


Figure 6. Evolution of the Real-Dollar bilateral exchange (LHS) rate and FX Interventions (RHS)



Notes: Interventions in Billions of U.S. Dollars. 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).

Figure 7. Real-Dollar Exchange Rate and Other Currencies.

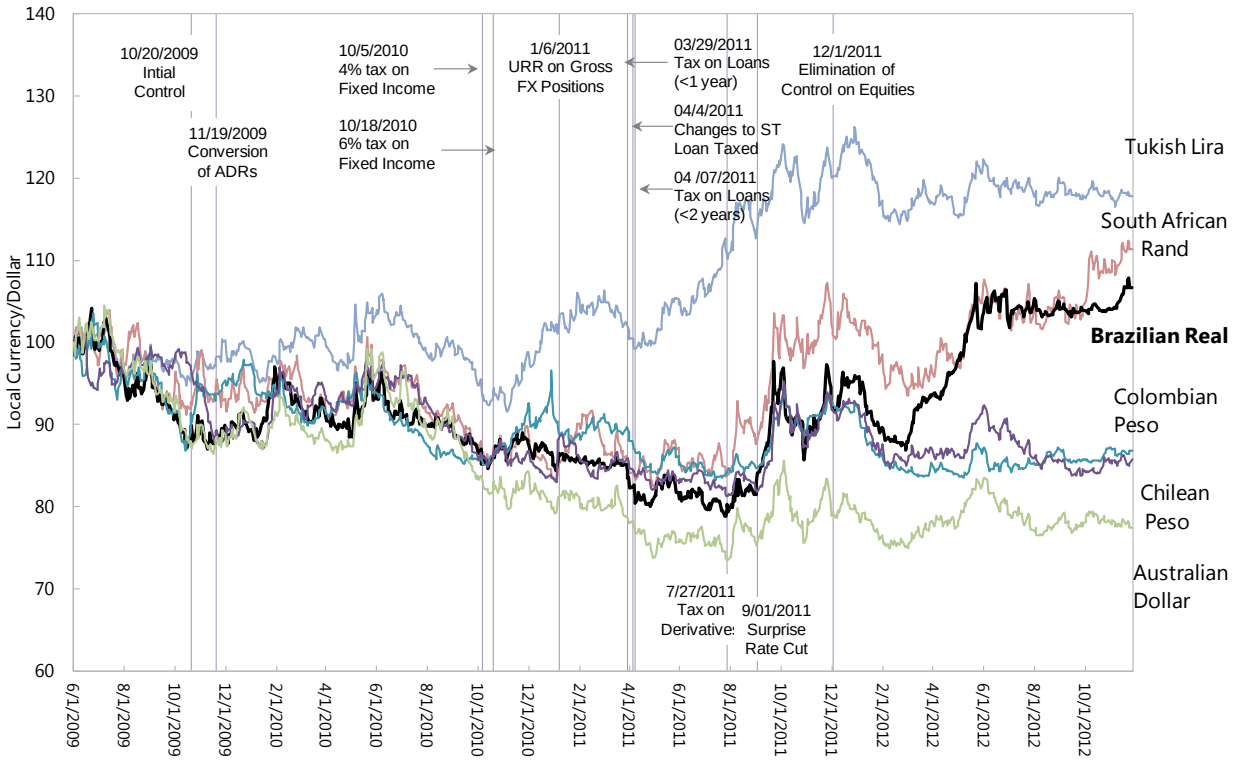


Figure 8. Real-Dollar Exchange Rate and Counterfactual from Regressions.
Figure 8a. External and Domestic Explanatory Variables

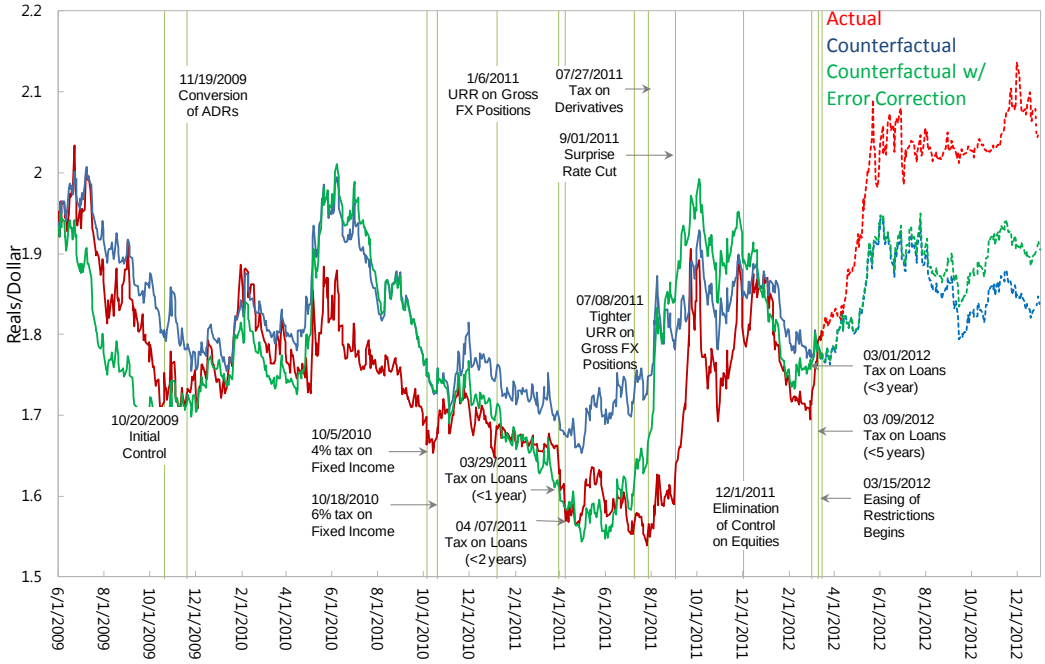
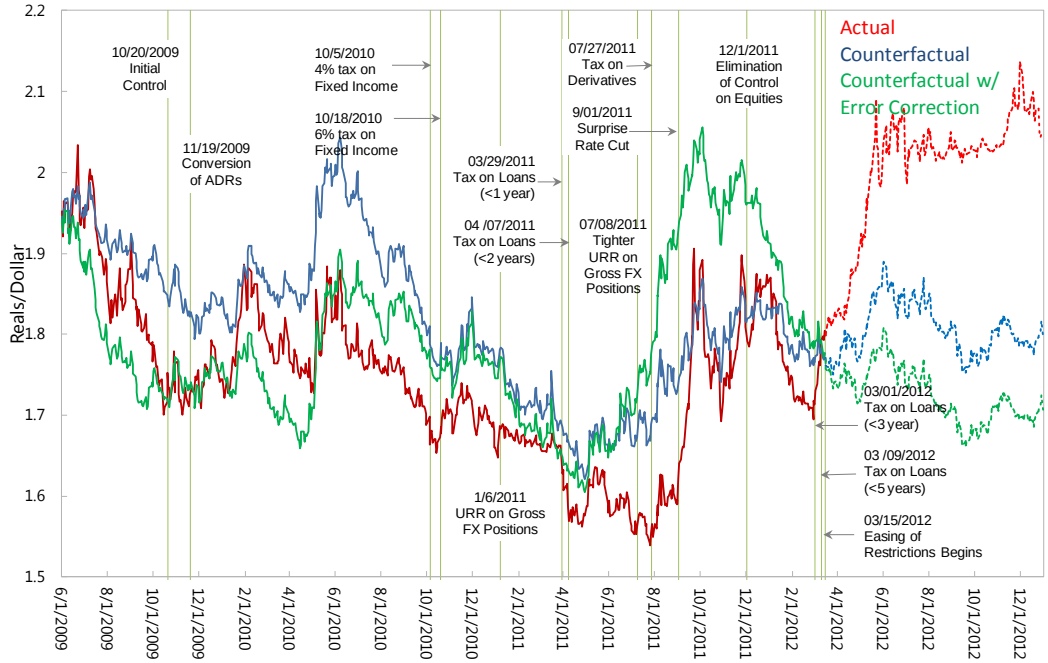


Figure 8b. Only External Explanatory Variables



Notes: Red line corresponds to the actual real-dollar exchange rate (an increase denotes a depreciation of the real); Blue and green lines correspond to a counterfactual based on regressions analogous to those in Columns 1 and 4 of Table 3, respectively, where the capital control/restriction dummies are dropped from the regression. In Figure 6b only commodity prices, the VIX, and the dollar index vis-à-vis other advanced economy currencies are included in the regression. Please note that fitted values are based on a regression of the change in the exchange rate.