DNDFs: A More Efficient Way to Intervene in FX Markets?

Márcio Garcia[1] and Tony Volpon[2]

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Abstract

We analyze the unique intervention strategy of the BCB using DNDFs (Domestic-Non-Deliverable Forwards): currency forwards that settle in domestic currency. We show the mechanisms through which DNDFs provide efficient hedging instruments for economic agents in times of reduced capital inflows and FX volatility, and how the use of DNDFs provide incentives for commercial banks to bring dollar to Brazil and so help finance the current account deficit. We discuss the limits to this strategy, which will work insofar as economic agents believe they can go from DNDFs to spot USD, i.e., that convertibility risk is negligible. We also have described how the strategy creates increasing positions within the commercial banking system (basis and roll over risks), generating possible threats to financial stability. The gain of not having to sell down hard currency reserves in the present strategy should be weighed against these risks. We conclude that the BCB's strategy does provide an alternative intervention strategy, which is made possible only due to specific features of the Brazilian financial markets and its legislation. It is not clear that other emerging markets would profit from adopting such intervention strategy in FX markets.

JEL Codes: F31, F32, F36 and F65

Keywords: Sterilized FX Interventions, Capital Flows, Macroprudential Policies, NDFs, Exchange Rate, Brazil

[1] Associate Professor, Vinci Chair, at the Department of Economics, PUC-Rio, mgarcia@econ.puc-rio.br. Márcio Garcia thanks CNPq and FAPERJ for financial support.

[2] Head of Emerging Markets Research for the Americas, Nomura Securities, NY.

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1. Introduction

Since the FED announced on May, 2013 that it would start tapering, the Brazilian Central Bank (BCB) stepped up its interventions in foreign-exchange forward markets. Until April 2013, the BCB had sold around US$ 98.4 billion in derivatives and credit lines, and promised to keep intervening until June 30, 2014[3].

Although many countries intervene in foreign-exchange markets via derivatives, the Brazilian way of intervening is quite unique. The instruments used to intervene are US dollar forward contracts that are net settled in domestic currency, the real (BRL).[4] Though other countries have recently used instruments that settle in their local currencies to buy USD in an attempt to smooth out appreciation, Brazil uses an instrument that settles in local currency to provide FX hedging. In other words, instead of providing foreign currency, those instruments provide the amount of domestic currency necessary, under normal circumstances, to purchase the desired foreign currency amount.[5] By doing so, the BCB hopes to preserve foreign reserves despite the massive exchange rate intervention, while passing the high carry cost to purchasers of the US dollar forward contracts.[6]

To make the distinction, we will call these instruments "domestic-non-deliverable forwards" or "DNDFs" to contrast them against the better-known NDFs, or "non-deliverable forwards". The Brazilian DNDFs are USD forwards that settle in local currency (BRL), while the NDFs of BRL settle in USD outside the Brazilian banking system.

Does the use of DNDFs, as opposed to the regular NDFs (that settle in USD), make any difference? We believe it does. Before we argue why, let us use data to show that, indeed, there is a difference between DNDFs and the most common methods of intervention.

Figure 1 displays the convertibility risk. It is defined as the percentage difference between the forward exchange rate, measured in BRL/USD, implicit in the NDFs traded in OTC markets in the US (the NDF), and the futures rate, always measured in BRL/USD, traded at BM&FBOVESPA,[7] in Brazil (the DNDF). Normally, the convertibility risk hovers around zero. However, during major crises, as in 2002, the USD futures traded in Brazil exhibit a large discount, i.e. becomes much cheaper than its counterpart traded in the US.

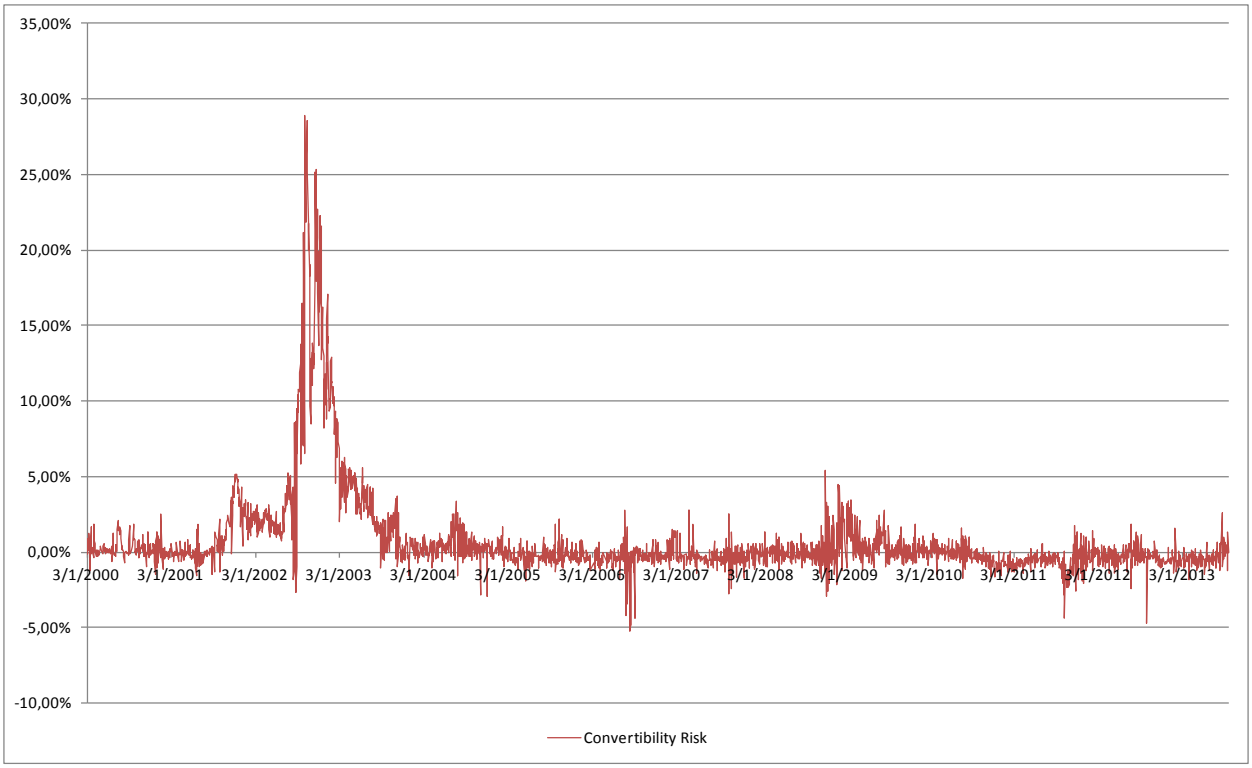
What did explain such large 25% spread in 2002? We believe market participants feared two events that eventually did not materialize:

[3] See Comunicado 25003 issued by the BCB, December 18, 2013.
[4] Later we will describe these instruments, which we call DNDFs (Domestic-Non-Deliverable Forward).
[5] During the Tequila crisis, in 1994, Mexico used Tesobonos, local fixed-income securities indexed to USD, initially settled in pesos. After the IMF stepped in, the Tesobonos were settled in dollars (Garber and Lall, 2011).
[6] Interest rates are very high in Brazil, entailing high carry costs for long positions in foreign currency. The carry costs equal the interest rate differential.
[7] BM&FBOVESPA S.A. — Securities, Commodities & Futures Exchange—is the main Brazilian exchange (http://ir.bmfbovespa.com.br/static/enu/perfil-historico.asp?idioma=enu).

- That the new government would default on the public debt. In this case, the Brazilian financial system would be compromised, including the system of guarantees that supported the derivatives central counterparty clearing, at the BM&F,[8] endangering the payments of the USD forwards, i.e., an increase in counterparty credit risk;

- That, facing a sharp shortage of international reserves and rampant depreciation of the BRL amidst massive capital flight, the BCB would intervene in the exchange rate markets by fixing the exchange rate and imposing quota restrictions on foreign exchange transactions, as it had happened in the past.[9] In this latter case, even if the investors were to receive the BRL equivalent of the USD forwards, they would not be able to access the exchange rate market at the same exchange rate used to settle the derivatives, i.e., there would be convertibility risk.[10] This is not only a theoretical risk, as was seen by Argentineans in 2001 when during their debt default the government imposed restrictions on capital leaving the country, the so-called "corralito".

FIGURE 1: Convertibility Risk



[8] In 2002, BM&F and Bovespa had not yet merged, and were two different exchanges.
[9] In the wake of the 1982 Mexican debt crisis, on 07/29/1983, the BCB, having run out of foreign reserves, determined that all transfers of funds from Brazil to a foreign country would remain deposited at the BCB until it could complete the transaction (Resolução # 851, http://www.bcb.gov.br/pre/normativos/res/1983/pdf/res_0851_v1_O.pdf).
[10] The convertibility risk may be interpreted as a form of basis risk. To buy the greenbacks, those who purchased the currency derivatives would have to pay the black market rate, supposedly with a premium to the official exchange rate.

Thus, the main difference between NDFs and DNDFs has to do with convertibility risk. Since such risk becomes prominent during major crises, our purpose in this paper is to answer the question of whether or not it makes a difference to use DNDFs in not so turbulent times, such as in the wake of the tapering talk, to intervene in FX markets? Since those instruments are settled in domestic currency, one could naively argue that the central bank could sell an unlimited amount of DNDFs, perhaps even in volumes superior to foreign exchange reserves it holds. However, the 2002 Brazilian example shows that there are limits to the sale of DNDFs. What are the limits to this type of intervention? Has the BCB introduced an important innovation that could be used by other emerging market economies facing similar pressures on their exchange rates? If we can answer these questions, we may be able to tackle the normative question of whether or not the BCB should keep using the DNDFs instead of derivatives that settle in USD or just the plain sterilized sale of foreign reserves, if it is to intervene at all. In addition, we may be able to assess if such way of intervening increases risk, by allowing the BCB to overextend its FX interventions, as the 2002 example seem to suggest.

This paper proceeds as follows. In Section 2 we explain in detail how the BCB interventions via DNDFs work. It also dissects the effect of interventions via DNDFs in Brazilian domestic financial markets, showing that banks play a fundamental role in linking the DNDFs to the spot and OTC FX markets. In Section 3 we review data on who is buying these instruments in Brazil. In Section 4 we look at econometric evidence showing that spot and forward intervention by the BCB does impact the "cupom cambial", or onshore USD rates. In Section 5 we look at other emerging markets in Asia and EMEA (Europe, Middle East and Africa) for evidence that this type of FX intervention seems, nowadays, to be conducted exclusively in Brazil. In Section 6 we discuss limits to the intervention policy, and present a simple model to explain how the fear of non-convertibility generates a discount between NDFs and DNDFs that can short-circuit the strategy if it is overused. In Section 7 we present our conclusions.

2. The BCB's intervention policy

Brazil's current intervention program is the largest in terms of amounts of foreign currency sold being followed by an emerging market economy (Figure 2). In terms of effectiveness, at first the program did not seem to stop BRL from being one of the worst performing currencies after the May 2013 "tapering tantrum", but subsequently the BRL has performed relatively quite well (Figure 3).

Figure 6 shows that interventions through unannounced sale of "swaps" started in early June, 2013. Repo lines started to be auctioned by the end of June, 2013. Despite the interventions, the BRL kept loosing value. Only after the announcement of a formal program, on August 22, promising daily sales of USD0.5 billion of swaps from Monday to Thursday, and an auction of USD1 billion of repo lines on Friday, the exchange rate appreciated. Later, the depreciation resumed and the announcement of the extension of the intervention program was made on December 18, 2013, with a lower intervention value of US$200 million per day, and FX repo auctions only on demand. This second announcement, however, did not have a similar effect in appreciating the currency, which started only in mid-February, when capital inflows resumed.

The peculiar way the BCB intervenes in FX markets has been determined by developments of the Brazilian financial system. Until the end of the eighties, the Brazilian financial market was very much

segmented from the international financial market. Nevertheless, it acquired a high degree of sophistication in financial engineering, especially in derivatives. This occurred because hyperinflation and large movements in macro variables, such as large devaluations, generated a need for hedging and speculative trading. Segmented from international markets, these trades found their way into a centralized venue, the Brazilian Commodities and Derivatives Exchange, BM&F (later merged with the stock exchange, generating the current BM&FBOVESPA).

FIGURE 2: FX intervention by major EM countries (May '13 – April '14)

FX intervention by major EM countries (May '13 - Apr'14)		
	US$ bn	% of 2013 GDP
Turkey	-23.3	-2.8
Singapore	-18.8	-6.4
Brazil	-86.9	-3.9
Russia	-65.9	-3.1
Phillippines	-4.2	-1.5
Malaysia	-14.1	-4.5
Indonesia	-11.5	-1.3
India	12.4	0.6
Taiwan	5.9	1.2
Thailand	-12.2	-3.1
S Korea	25.3	2.1
Israel	8.5	2.9
Colombia	4.8	1.3
Czech	11.5	5.8
China	323.4	3.5
South Africa	-0.1	0.0
**Note: Mexico, Poland, Chile & Turkey did not intervene in the market*		

Source: Bloomberg; Nomura Securities.

Access to the Brazilian FX spot market is very restricted. Only chartered banks may access the FX spot market. The BRL is a non-convertible currency, meaning that it cannot be traded and delivered outside Brazil. Also, Brazilian law forbids domestic accounts in foreign currency, i.e., banks domiciled in Brazil are not allowed to offer deposit accounts in foreign currency.

To bypass such limitation, an active FX derivative market evolved. The main FX derivative products traded in the Brazilian financial market are short-term USD futures and onshore dollar interest rates (known as "cupom cambial"). These products allow agents to hedge and speculate in foreign currency,

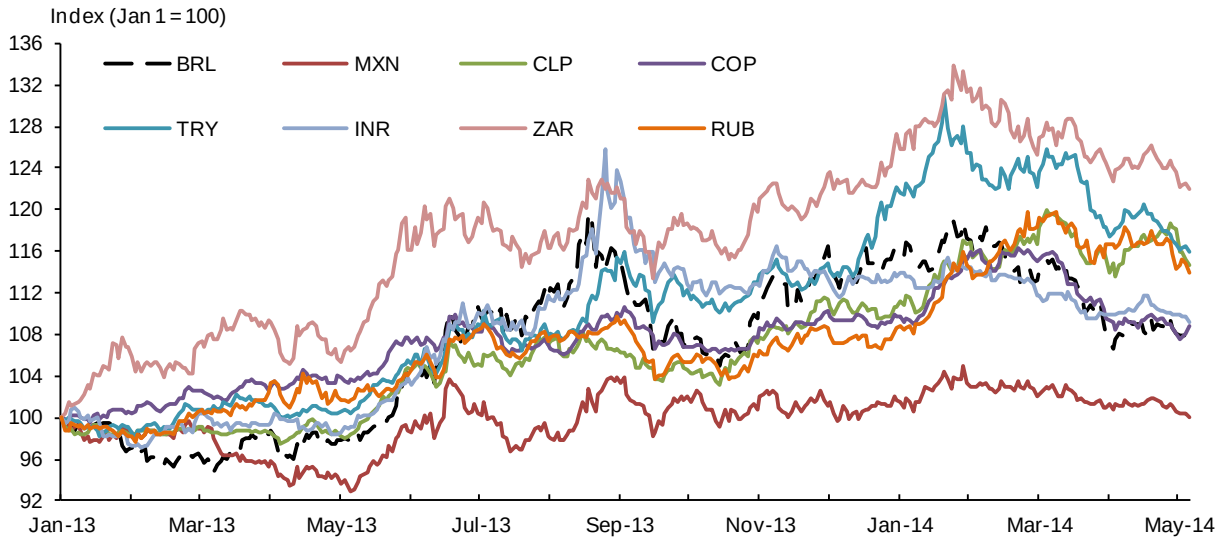
mainly the USD, with all trades being settled in BRL at the prevailing fixing of the exchange rate (the PTAX rate, a daily average of spot transactions computed by the BCB). [11]

In this unique financial structure, the BCB developed a technology of offering USD substitutes as intervention instruments. First, it was domestic public debt indexed to the exchange rate. Later, in the nineties, it started intervening directly in FX derivatives. New products were designed so that domestic financial players could buy (or sell, depending on the period) FX hedges from the BCB and repackage it into financial products offered to clients both domestically and internationally.

One of the apparent goals of intervention is to separate those that need foreign currency instruments for hedging or speculative reasons, but do not actually need to settle transactions in foreign currency, from those that do need actual USD. The former are happy to use the DNDFs as long as they are deemed a good substitute of the USD, i.e., when the expected basis risk between the DNDFs and the actual greenback is negligible.

To understand how the BCB's intervention strategy via currency forwards works,[12] we need to map out how intervention in forward rates impacts the "forward rate structure" in FX markets. This is related to, in the case of a non-deliverable currency such as BRL, how intervention changes the level of onshore short-maturity USD interest rates, known as "cupom cambial", and so provide incentives for commercial banks (and other investors) to bring spot USD on-shore in a "near perfect" arbitrage.

FIGURE 3: EMFX performances



Source: Bloomberg; Nomura Securities.

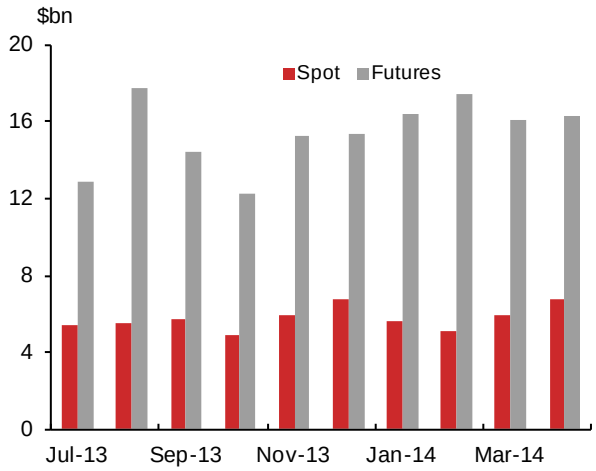
Brazil has a very active FX futures market whose volume levels exceed that seen in spot markets. For example, in the second half of 2013 the average daily volume in USD futures at the BM&FBovespa

[11] The methodology to compute the PTAX is defined by regulation 3506 (http://www.bcb.gov.br/sddsi/taxacambio_i.htm). The calculation computes an average of spot rates sampled amongst dealer banks four times during the day.

[12] A recent twist to the BCB's intervention strategy has been the increasing use of spot repo auctions, which we will also look at below.

exchange was US$15.4billion per day, against an estimated US$5.7bn in the spot market as per commercial and financial FX flows data published by the BCB (Figure 4). The existence of a derivatives market where essential "price discovery" takes place[13] open to the BCB the ability to use derivative instruments to influence not only the level of FX but also arbitrage relationships between different instruments that ultimately may influence the overall level of BRL.

FIGURE 4: Daily trading volumes (onshore)



Source: BCB.

In the late 90s, during the period when the BRL followed a crawling peg, the BCB intervened by selling the USD futures directly at the BM&F through state-owned commercial banks. Today it uses a more transparent instrument, the sales, through auctions, of so-called "FX swaps". Formally, a dealer bank enters an auction and bids for USD at a future date at a discounted price. This forward sale of FX is called a "swap" because it is the equivalent of the BCB agreeing to, at maturity, pay the PTAX FX rate (the official fixing for spot in Brazil determined by the BCB), receiving USD plus an interest rate (which depends positively on the discount agreed to at the auction). Dealers may enter bids for their clients, which, if filled, will be registered at the BM&FBOVESPA exchange, who will take on the counterparty credit risk vis-à-vis the BCB.

Being a forward sale of FX through an over the counter (OTC) instrument, it is easy for institutions that access BM&F futures to sell/buy USD against these "swaps". Given the liquidity of the BM&FBOVESPA exchange, this provides an important "distribution channel" by which BCB USD sales can meet the need of a variety of domestic and international investors and corporations through the BM&FBOVESPA.

BCB intervention affects offshore instruments prices. Dealer banks of the BCB in Brazil will often be dealers of offshore NDF. Even if they do not have commercial banking operations in Brazil, they may open what are known as "2689 accounts", or onshore custody accounts that allow them to, among other things, have an account at the BM&F exchange. Such institutions will then run "matched books",

[13] Garcia, Medeiros and Santos (2014), using high-frequency data, formally show that price discovery takes place in the futures market.

buying and selling NDF and well as USD futures, hoping to make an intermediation profit, as they will usually sell USD offshore at a premium. [14] This "wedge" reflects the fact that dealer banks will want to receive compensation for delivering USD offshore hedged against onshore instruments that settle in BRL. The risk such dealer banks run (and for which they are remunerated) is that currency restrictions could be imposed. Such possibility would generate losses on their "matched books". This, for example, occurred with the imposition of capital controls on the form of the IOF tax on spot inflows, during 2010 and 2011, which created a large wedge in the pricing of similar on and offshore instruments.[15] The wedge was due to the fact that the inflow tax restrained the ability of dealers to bring extra margin capital demanded by the exchange as collateral on-shore to support their open forward positions at the BM&FBovespa, raising the price of hedging NDF positions. If their notional position grew in size or their on-shore positions lost value (despite being hedged by offshore positions), they would need to pay the IOF tax to bring in more funds to meet the margin call from the BM&F.

Another very important effect of this intervention strategy is how the sale of forward USD by the BCB affects the shape of the FX "term structure" and so raises the "cupom cambial", the onshore dollar rate, for short maturities. This can be most easily seen by noticing that onshore USD yields will vary negatively with the price of the forward exchange rate. According to covered interest parity (equation 1):

$$F = S*(1+r)/(1+q) \qquad (1)$$

Where S is the spot rate, F is the forward rate, r is the local interest rate, and q is the onshore USD rate. By selling DNDFs, the BCB pushes F down, with q often going up in the process even as the selling might impact S, at least in the short run. We will look at statistical evidence below supporting these effects.

In fact, most of the time, given the lower liquidity in spot BRL, a sale of forward FX by the BCB will compress forward points (F/S – 1) against spot. This will lower the cost of hedging a short USD spot position, which is the same thing as saying that this has the effect of raising USD rates onshore. Higher onshore USD rates will provide incentives for banks that have access to multiple markets to bring USD onshore, a vital function in a country like Brazil running growing current account deficits, of 3.6% in 2013. This "near arbitrage" will be executed through the following set of trades:

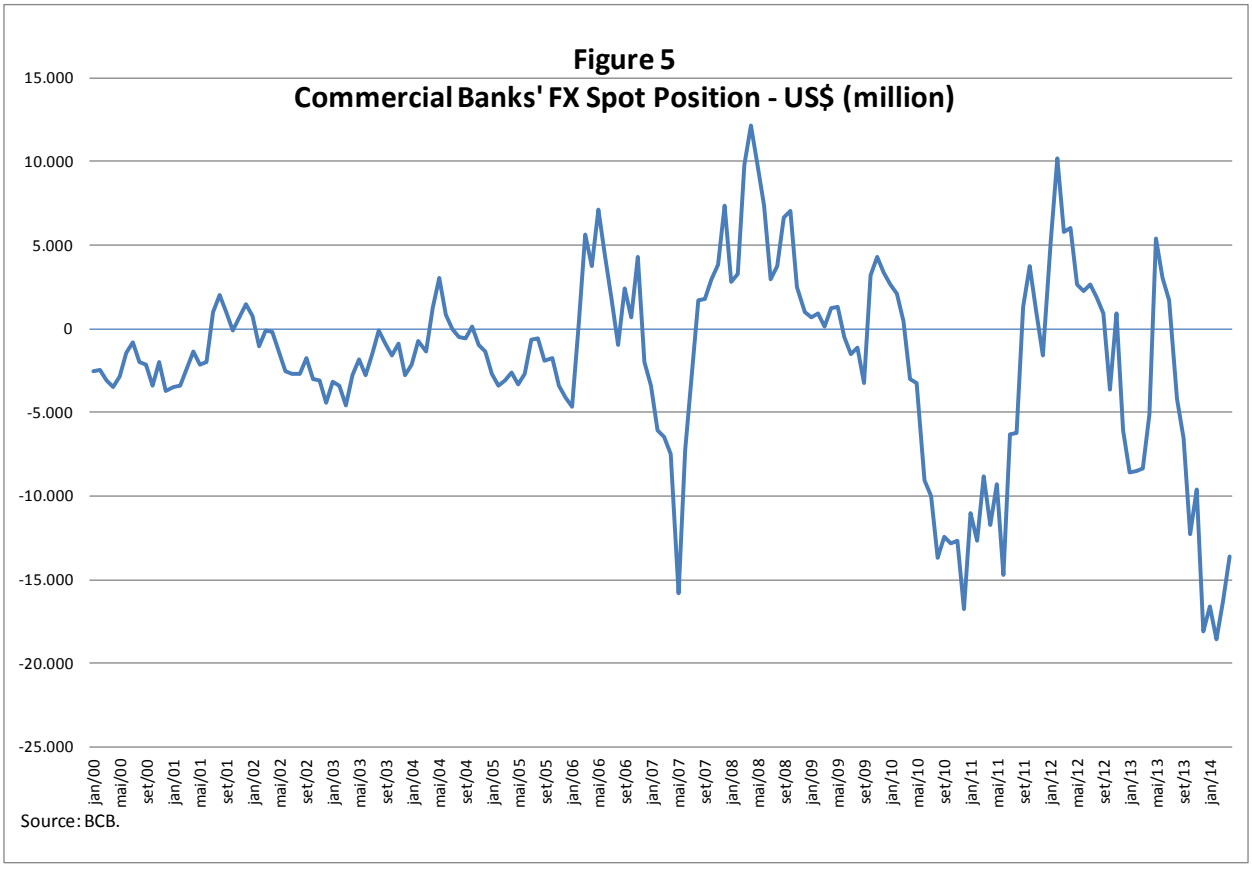
1. Borrow USD offshore at Libor plus a spread (this will often be done against an international bank's USD treasury by the local Brazilian banking operation);
2. Sell USD into the Brazilian spot market (now the bank has taken FX risk, it is short USD and long BRL);
3. Invest BRL earned by selling USD in the Brazilian money market;
4. Buy a forward USD to hedge the FX risk.

[14] For example, suppose a bank purchases a USD forward from the Central Bank at 2.5 BRL/USD (0.4 USD/BRL). If this bank enters in a BRL NDF, shorting USD and being long in BRL, for the same maturity, at a price higher than 2.5 BRL/USD (i.e., lower than 0.4 USD/BRL), it will make a profit. Of course, there are risks involved, as it will be discussed at length.

[15] Chamon and Garcia (2013).

The price of the forward USD bought as a hedge in step 4 will fall when the BCB sells its "swaps". The profit of this trade (assuming all maturities of the different instruments are matched, though banks will often chose to mismatch the terms of the funds borrowed offshore versus the funds invested on-shore) will be the spread between Brazil's money market rates and the cost of buying a forward USD plus the USD borrowing rate (Libor plus spread). Another way to look at this is that the bank has generated a long USD onshore position. The key point to understand is that the higher the "cupom cambial", the larger the incentive to bring spot USD onshore.

Therefore, raising the "cupom cambial", or, equivalently, raising USD onshore rates, is key for the BCB to incentivize banking institutions to bring spot USD onshore to finance current account deficits. One may well ask why the BCB does this, since by selling "cheap" hedges to commercial banks, it is losing money (on an expected value basis). Here the BCB is clearly willing to pay the commercial banking system a premium to bring USD to Brazil in substitution to FX spot intervention. The ability to use "cheap" swaps to hedge short spot positions has allowed Brazilian banks to increase their short spot positions,[16] which reached $13.6bn in April 2014—see Figure 5—after having reached historical records in early 2014.



[16] A short (negative) spot position signals that the bank is borrowing abroad to sell spot dollars in the Brazilian market.

We would further note that on June 25, 2013 the BCB revoked regulation that stipulated mandatory reserves be collected against short USD spot positions, a control on capital inflows instituted in the period of the "currency wars" when capital was flooding Brazil.[17] With the end of this remaining capital control, as of May 2014, there are no specific statutory limits to the open short USD position a commercial bank may carry.[18]

Onshore USD rates thus play a vital role in the financing of current account deficits and as barometer of risk. A banking institution unwinding the trade described above needs to buy spot FX in Brazil. The ability to accomplish this will not only depend on the supply of USD at the time, but also on the regulatory forbearance of the BCB to allow this transaction to occur.

The spikes seen in local USD rates in the past have occurred when markets believed there was a material risk that access to USD was going to be curtailed. This could happen for a variety of reasons, including falling FX reserves; a lack of USD financing lines for seasonal reasons (at the year end, many banks cut financing lines to show smaller levels of leverage) or due to a political decision to change the FX regime. This can increase cupom cambial volatility. An example were fears of a "centralization" of FX transactions through the BCB, which would allow the monetary authority to disburse USD at its own discretion, as happened in the 1980s (see below). This was the case in 2002, mentioned in the Introduction, during the election process that eventually elected Lula da Silva as President.

The 2002 experience points to one limit to the type of intervention strategy being used by the BCB today. Selling USD "swaps" settled in BRL, the DNDFs, do not explicitly compromise hard currency reserves. However, they will only be marketable and effective intervention instruments if investors perceive them to be "near substitutes" for actual USD spot. In effect, one can think of these FX "swaps" as being "collateralized" by the BCB's international reserves. Thus, even as the program has sold US$98 billion in swaps,[19] further increases in the size (or supply) of the swap book will, all other things being equal, lead to falling prices/higher USD on-shore rates. Higher rates will, up to a point, raise the return to the "near perfect" arbitrage of bringing USD on-shore, but as seen in 2002 there is point where the supply curve of spot USD will significantly steepen and may even "invert" if political risk becomes too relevant a concern, with higher on-shore USD rates signaling a distress condition leading to further capital flight. A simple model in Section 6 will illustrate this point.

Another important tool in the recent arsenal of intervention has been "FX spot repos" transactions. Here the BCB sells spot USD to a dealer bank, with an agreement to repurchase those amounts in the future. Once again, the "cupom cambial" prices the transaction, as dealer banks buying USD will pay an onshore USD rate to borrow USD from the BCB.

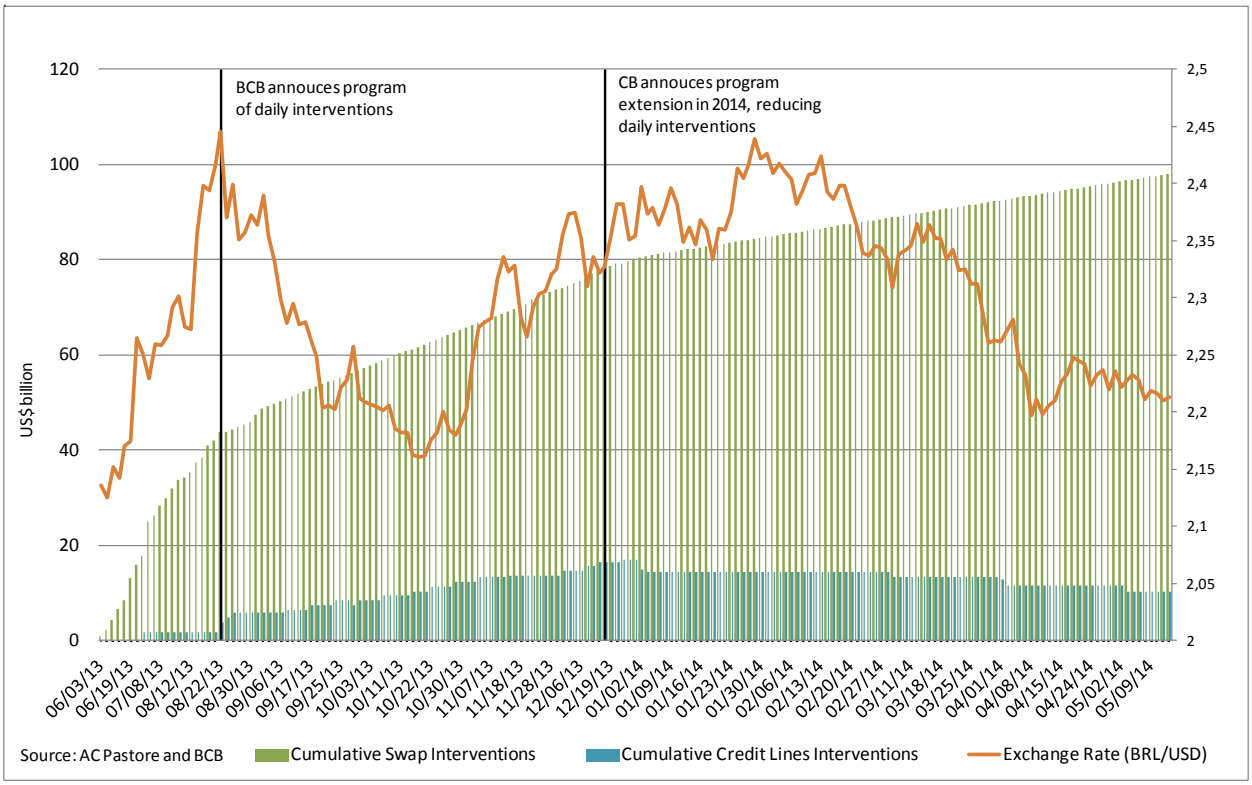
In the past, such transactions were used to meet short-term, often seasonal, demand for USD. In the end of the year period many banking institutions will curtail international lending lines, generating temporarily illiquidity that can be met by repo FX sales. A novel feature today is that the BCB has sold US$11.7 billion in repos (by end-April), but is continuously rolling over most of these positions (Figure 6). Note that at a limit a repo transaction that is expected to be rolled over forever is equal to a

[17] Chamon and Garcia (2013) analyze the effectiveness of controls on capital inflows in Brazil.
[18] Of course, banks have their own limits, imposed by their internal risk management system.
[19] These are the total swap sales. Since the BCB has let a few swap expire without rolling them over, the corresponding stock is lower, USD86.7 billion.

definitive sale of spot from reserves, but these transactions do not count as either sales from reserves, or as short USD positions on the part of commercial banks.

This is important because, as in the case of FX "swaps", agents undertaking these transactions will ultimately look to the availability of international reserves as "collateralizing" these transactions. To avoid pressure on BRL, the BCB would have to close out these repos and to sell spot into the market. In essence, if there is a balance of payment surplus over and above that needed to finance the current account deficit, there would be sufficient funds for the BCB to close out the repo position without upward pressure on BRL. As it stands, it is unlikely Brazil will see a balance of payment surplus any time soon, and the unwinding of these growing positions would most likely create market volatility.

FIGURE 6: Central Bank Interventions: Swaps and Repo Credit Lines



3. Who is buying what from the BCB?

By looking across data from the BCB, the BM&F, and the CETIP,[20] we can get a fairly good handle on who are the final buyers of the forward USD being sold by the BCB, as well as the important role commercial banks play in intermediating between the BCB and different agents within the system.

[20] CETIP (http://www.cetip.com.br/) is a central securities depository in Brazil. Most non-financial firms book their exchange-rate hedges there, because it is cheaper and does not require collateral to insure against credit risk.

As of April of 2014, the BCB had an open interest of US$86.7 billion in swaps. Commercial banks now hold 69% (US$59.7) of these instruments, with most of the balance being held directly by domestic institutional investors.

Showing their key role as distributors of risk within the system, commercial banks were also short US$16.0 billion in USD instruments at the BM&F as well as short US$15.9 billion in OTC forward contracts registered at the Cetip (Figure 7).

The residual of the long USD position in derivatives by commercial banks is made up in short spot positions. Short spot is generated by commercial banks by borrowing repo lines from the BCB and borrowing abroad. The data shows commercial banks have sold US$30.7 billion.

Looking across derivative and spot flows, the data shows banks are, as of the end of April 2014, net short of US$2.9 billion. Part of this may be speculative, i.e. banks betting on further BRL appreciation. Given the risk averse behavior of Brazilian banks, and the large profits by arbitraging against instruments without taking on price risk, we believe that the largest part of this short USD position is matched by expected, and often already negotiated, future inflows from banking clients, such as issuers of fixed-income instruments abroad. Banks will often offer bridge loans to issuers, and so will sell USD in expectation of future inflows. These transactions are not public until they occur, and so we cannot ascertain what percentage of the current short USD positions is hedged by future client inflows.

FIGURE 7: Commercial bank positions in FX derivatives (cumulative, since end-May)

	Long USD	Short USD		*Residual*
($mn)	**FX swaps**	**DDI & USD futures**	**USD forwards**	*Banks' own position*
Jun-13	**15,810**	**-15,256**	**-4,061**	*-3,507*
Jul-13	**22,830**	**-16,170**	**-6,457**	*203*
Aug-13	**34,960**	**-8,570**	**-13,208**	*13,182*
Sep-13	**43,050**	**-18,188**	**-14,373**	*10,489*
Oct-13	**50,641**	**-14,824**	**-10,159**	*25,657*
Nov-13	**53,794**	**-13,580**	**-5,326**	*34,887*
Dec-13	**58,514**	**-18,823**	**-11,072**	*28,619*
Jan-14	**60,997**	**-25,601**	**-13,377**	*22,020*
Feb-14	**61,803**	**-16,892**	**-16,177**	*28,734*
Mar-14	**62,638**	**-10,527**	**-20,828**	*31,282*
Apr-14	**59,670**	**-16,026**	**-15,888**	*27,756*

What are other agents doing? Data show that, as of April of this year, domestic institutional investors were long US$6.7 billion. These positions are, we believe, mostly driven by a desire of local investors to partially dollarize investment portfolios given the widely held view that we will see a higher USD globally. Here is an example were the use of DNDFs can meet USD demand without compromising BCB hard currency reserves.

The data also shows foreign institutional investors long US$36.9 billion. If we look at data provided by the Brazilian Treasury[21], we see that this is equivalent to 21.1% of the outstanding positions foreigners hold in the Brazilian debt market. Here we may yet see demand for spot USD, but if foreign institutional investors maintain their commitment to being invested in Brazil, they are likely to be happy using DNDFs to actively manage their currency risk, and here too we see how these instruments are helpful in limiting demand for actual BCB hard currency reserves.

Finally, data show that the non-financial corporate sector is long US$18.1 billion. This is equivalent to about 33.2% of maturing hard currency obligations due over the next year[22]. In this case, whether the stock of DNDFs will become demand for USD will depend on the ability and desire, given the costs, of these agents to roll over these liabilities.

When looking at the way DNDFs are distributed across different agents, we can reach some tentative conclusions. First, the commercial banking system has a key role in distributing risks from the BCB to other agents, as well as in providing spot USD to finance the country's current account deficit. The BCB's intervention strategy has thus created a larger set of positions across instruments between itself, commercial banks, and other agents in the financial system. The unwinding of these growing positions may create issues around financial stability. Second, as long as credibility in the ability of agent's to go from DNDFs into spot USD is maintained, it is quite likely most of the current DNDF positions will not become future demand for actual USD (we look at this issue in Section 5 below). In this sense, the BCB's intervention strategy is a successful manner to meet the need of private sector agents without selling from its hard currency reserves. Of course, a cost-benefit analysis would have, at least, to consider the effect of BCB´s interventions on the cupom cambial, creating extra costs for the BCB. This, however, would need a not very straightforward counterfactual analysis.

4. Can the BCB influence on-shore USD rates?

We now look at econometric evidence that the BCB's intervention strategy does affect the spread between the cupom cambial and the libor of the same maturity, providing incentives for private sector agents, especially commercial banks, to bring USD to Brazil.

We should note there have been three periods of recent BCB intervention. The first two were attempts to stem BRL appreciation, which lasted from June of 2006 to September of 2008. During those periods, the BCB was intervening by buying spot USD, which also influences the level of on-shore USD rates as much as the selling of forwards.

We define DCCnM as the spread between n=1,3 month on-shore USD rates and one or three month Libor. The larger the spread, the larger the incentive for commercial banks (or corporate) to bring USD to Brazil. We regress a daily three day average sample of this data onto (a) a constant; (b) a one day lag; (c) the purchase of spot USD by the BCB, in millions (see appendix for results).

[21] See Monthly debt report (Relatório Mensal da Dívida) from the Brazilian National Treasury (https://www.tesouro.fazenda.gov.br/pt/relatorio-mensal-da-divida) retrieved May 13, 2014.
[22] See Banco Central do Brasil, Historical Series of the Gross External Debt and of the Short-term External Debt by Residual Maturity (http://www.bcb.gov.br/?GEDHSERIES), retrieved May 13, 2014.

We can see that in both the one and three month cases the coefficient measuring the impact of USD spot intervention spread between on-shore USD rates and Libor were significant at conventional levels. Thus purchasing spot will compress the spread.

We now look at the following period (which we can call the "currency war" period), from June of 2009 until August of 2011, when after a surprise cut in the Selic policy rate BRL began depreciating. Here we use as explanatory variables spot USD purchases as well as the flow of spot USD from commercial and financial transactions as a control variable. Once again, we have a significant coefficient for the effect of intervention on the on-shore USD rates/Libor spread.

Finally, we reach the current period of capital outflows from May of 2013 until mid-March of this year. Now we use the intervention in the form of forward sales of USD through DNDFs as an explanatory variable. Here we see a significant coefficient only for the three-month spread. We would note that the BCB's strategy of selling a fixed amount of forward USD every day (currently US$200 million) means that there is no variation in this explanatory variable, which may explain the inability of the regression to generate a significant coefficient at the one-month frequency. Nonetheless, we believe these results show the BCB can impact the spread between on-shore USD rates and Libor through its intervention policy.

In the same period of the taper tantrum, we were able to document (see appendix) that the commercial banks´ FX spot position is influenced by the spread between the cupom cambial and the libor of the three months, once controlled for the swap sales and the FX flows. Since the quantity variables all have a unit root, a cointegration relation was estimated, and the relation shown is one where the integrated variables appear in first-differences .In summary, both the purchase of spot dollars and the sale of DNDFs by the BCB increase the spread between the cupom cambial and the libor of the same maturity, thereby enticing banks to bring dollars to sell in the Brazilian spot market. One should note that during the periods of massive capital inflows, when the BCB was trying to deter the appreciation of the BRL, the banks´ actions of bringing more USD ran contrary to BCB´s objectives. However, during the period when capital was flowing out of the country, the banks´ actions were precisely what the BCB wanted. Furthermore, note that if the BCB were to conduct sterilized sales of its foreign reserves, no increase in the spread between the cupom cambial and the libor of the same maturity would occur.

5. Comparison with other markets

As we argued above, the onshore USD rate plays a variety of key roles in the Brazilian FX market. Its value reflects the relative scarcity of USD spot funding, as well as perceptions about convertibility risk. Its level may also influence capital inflows, and provide incentives for banks and other investors to bring USD to Brazil. Given this, the BCB undertakes the selling of DNFDs to, amongst other reasons, influence its level. Therefore, alongside the basic interest rate in BRL, the Selic, the on-shore USD rate may be seen as a policy rate of the BCB. Of course, both may not be set independently, but we have seen on Section 4 evidence that the BCB may affect the onshore dollar rate with its sterilized purchases of spot USD or with its sales of DNDFs, akin to sterilized interventions.

When looking at other emerging markets, currently we do not find one where the onshore USD rate serves the same purpose as in Brazil.

In the case of Asian markets, we see attempts to use different instruments to bring USD in times of scarcer capital inflows. Indonesia, for example, uses a central bank deposit facility that paid a small premium above Libor. India, for example, has made access to its capital markets easier. None of these types of policies resembles the key role plaid by "cupom cambial" in the case of Brasil.

One interest example is China. Currently, China maintains capital controls but has allowed the bourgeoning of a growing off-shore FX market. Some agents have access to both, and the authorities can influence both markets. This opens up a question of what one considers "convertibility": in the case of China the currency trades off-shore, but few would consider the Renminbi convertible.

Something akin to "cupom cambial" can be found in the basis swap market that uses cross currency swaps.[23] This allows banks to borrow foreign currency in exchange for local currency, paying the difference in interest rates. Such a market is heavily used in countries like Mexico for banks to manage their foreign currency funding levels. In times of market volatility, the basis can become very volatile, but here we do not see the basis as being a type of policy variable that is targeted by central bank policy.

6. Limits to the BCB intervention strategy

Are there limits to the BCB's intervention strategy? Certainly, the example of 2002 shows that these limits exist despite the BCB's ability to print unlimited amounts of BRL. Fortunately, in 2002, none of the market fears materialized, Lula not only avoided default, but paid off all Brazilian public foreign debt. In order to provide an actual example of what the markets feared in 2002, we provide in Section 6.1., below, a short description of what happened last time an "exchange rate centralization" happened in Brazil. Then, in Section 6.2., we provide a simple model that rationalizes the large (25%) discount that appeared in 2002 between NDFs and DNDFs.

6.*1 The case of DFA*

In thinking about the risks and limits to the present intervention strategy, what happened in Brazil during the 1980s debt crisis may be illustrative.

In 1982 the Brazilian current account reached US$8.8 billion, and international reserves fell to US$3.9 billion. In an attempt to stay solvent facing the effects of the tightening of monetary policy in the United States, Brazil received a US$3 billion in bridge loans from public and private sector borrowers. After announcing a harsh economic stabilization plan, the government of Dictator João Figueiredo entered negotiations with Brazil's creditors.

The 1983 agreement included four distinct facilities covering US$25.3 billion. Project 2 of "deposit facility agreement", as it was called, covered medium term debts coming due in 1983 equal to US$4.3

[23] See Du and Schreger (2013) for an analysis of cross-currency swaps.

billion involving 669 lending institutions. The debt would then be paid off in 8 years with a 2.5 year grace period. Debtors in Brazil, both private and state-owned, deposited owned amounts in local currency at the Central Bank, who in turn took on the obligation with the commercial banks. Unfortunately, Brazil could not meet its obligations as stipulated in the agreement, and the original DFA mechanism suffered its first, but not last, modification in January of 1984.

By forcing local debtors to deposit local currency at the BCB which would then pay debtors on a different schedule, the DFA agreement broke convertibility and "centralized" the FX market. In other words, at the prevailing exchange rate, set by the Brazilian authorities, foreign debt payments were not allowed to transit through the exchange rate market. In 2002, markets feared something similar might happen.

6.2 A simple model of convertibility risk

Assume there are two forward contracts. One, traded in the US, is a NDF of BRL that settles in USD, according the USDBRL exchange rate. The other, traded in Brazil, is the DNDF of USD that settles in BRL. Taking a common maturity, say, one year, define the forward prices, both quoted as the price of one-year-ahead BRL in terms of USD (disbursed one year ahead), as USNDF and BRDNDF. Normally, as shown in Figure 1, the difference between these two forward quotes hover around zero. According to ISDA rules, both contracts settle according to same exchange rate, the PTAX (or BRL09) rate, a daily average computed by the BCB.

The focus of our analysis is the difference between the two quotes, or the premium that must be paid in the jurisdiction devoid of convertibility risk (the US) to buy USD with BRL. This premium is the convertibility risk (CR).

CR = ln (BRDNDF/USNDF)

Our simple model assumes that the probability of non-convertibility, that will make the convertibility risk positive, is an increasing function of the expected depreciation (in risk-neutral terms) of the BRL vis-à-vis the USD. Initially, we abstract from other factors that should impact such probability as the current account deficits and the amount of foreign reserves, among others. In the way we defined the exchange rate, this means that the lower the USNDF, the higher the probability of non-convertibility is. This is because large depreciations are usually associated with episodes of massive capital flights that trigger the deleterious episodes of sudden stops (Calvo, 1998). Therefore, the BCB could resort, as in the past, to extraordinary measures to fix the exchange rate and curtail convertibility during such episodes. This is what is referred here as non-convertibility.

Suppose, to simplify, that the BRL can only depreciate during such crises, which is quite reasonable. Then, one simple way to proceed is to normalize initially USNDF=BRDNDF=1, and to assume that the probability of non-convertibility is:

λ = 1 – USNDF **(2).**

Since the convertibility risk affects only BRDNDF, and assuming that investors are risk neutral, and that there is 100% loss given non-convertibility, we have:

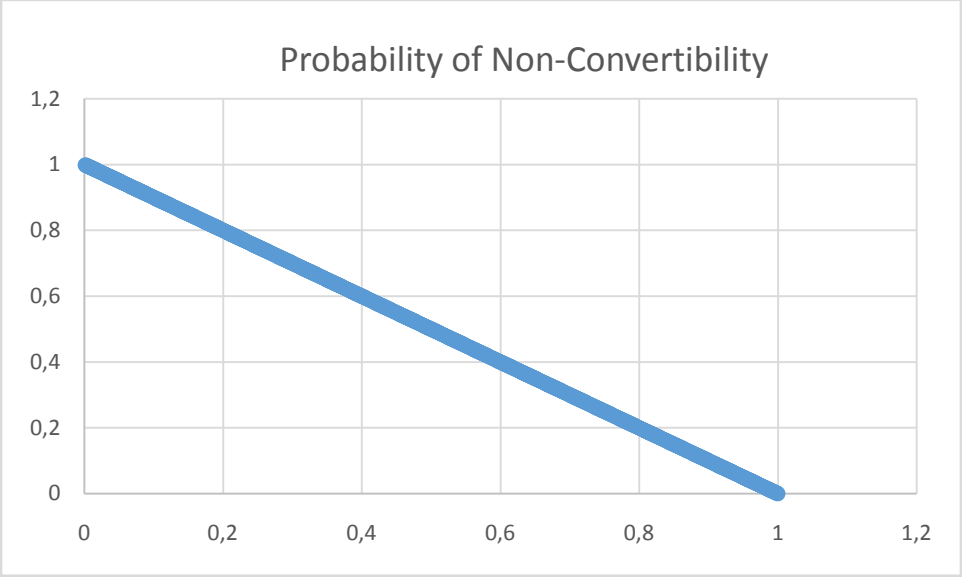
BRDNDF (1- λ) = USNDF **(3).**

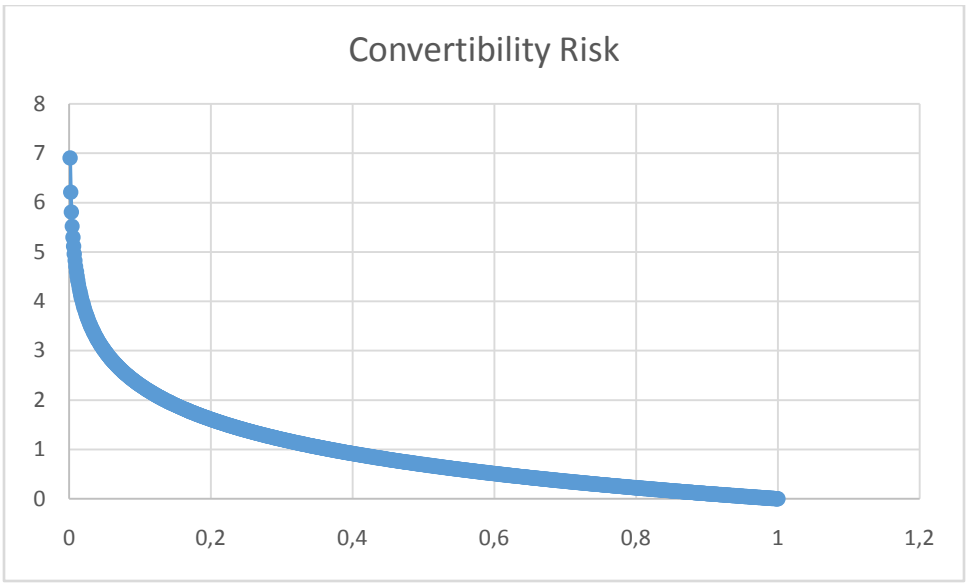
Therefore, the convertibility risk would be:

CR = ln (BRDNDF/USNDF) = ln (1/(1- λ)) **(4)**

Figures 8A and 8B illustrate the behavior of the probability of non-convertibility, as well as the convertibility risk. As it happened in 2002, a high depreciation being associated with an increasing probability of non-convertibility triggers a high discount between the two forward prices.

This model is the simplest possible one. To really tackle the issue, many other aspects would have to be considered in the model. Risk aversion is quite prominent in exchange rate markets. Exchange rate forward contracts suffer from wrong way counterparty risk, i.e., it is precisely when the agent who is buying protection against depreciation of the BRL has a lot to gain from the DNDFs that the probability of nonconvertibility is higher.





6.3 Limits to intervention through DNDFs

One near term constraint may be the willingness of commercial banks to increase their near-arbitrage positions across different instruments and across borders. From a risk management perspective, increasing these positions will only happen if, at the margin, profitability increases, taking account of the extra risk. For this to happen, the cost must either be borne by those looking for hedging instruments, or by the tax payer as the BCB sells swaps at increasingly cheaper levels. Overall, one must ask if the price of using these instruments instead of selling from reserves is actually worth it.

In any case, in light of historical figures (see Figure 5), it is unlikely that banks will increase the size of their matched FX books so that their total short spot position becomes much greater than highest negative values recently achieved, around -20bi USD. That is, if and when another illiquidity event as the one caused by the tapering tantrum in 2013 happens, it is unlike that the BCB can achieve its objectives only by intervening via DNDFs.

As we have argued above, though on an accounting basis the sales of FX "swaps" and FX repos do not directly compromise FX reserves, which in fact have remained stable, these instruments will only be in demand if they are perceived to be effectively "collateralized" by reserves. Nevertheless, at the given comfortable level of foreign reserves (almost 400bi USD) it is likely that the limits imposed by banks´ risk management will bite before a confidence crisis like the 2002 one erupts.

7. Concluding Remarks

We have discussed the intervention strategy of the BCB using DNDFs. We have shown the mechanisms by which these instruments provide efficient hedging instruments for economic agents in times of reduced capital inflows and FX volatility. We have also shown how the strategy using DNDFs provides incentives for commercial banks to bring USD to Brazil and so help to finance the current account deficit.

We have discussed the limits to this strategy, which will work insofar as economic agents believe they can go from DNDFs to spot USD, i.e., that convertibility risk is negligible. Of course, outside this limit we should keep in mind that these instruments are BRL denominated/USD indexed liabilities of the BCB, and so in the case of a severe fall in BRL they would generate losses that would have to be financed by the government.

We also have described how the strategy creates increasing positions within the commercial banking system (basis and roll over risks), generating possible dangers around financial stability. Thus, we believe the gain of not having to sell down hard currency reserves in the present strategy should be weighed against these risks.

In summary, we conclude that the BCB's strategy does provide an alternative intervention strategy. Nonetheless, it is made possible only due to specific features of the Brazilian financial markets and its legislation. It remains to be seen whether other emerging market countries with different characteristics would profit from adopting a similar approach.

8. References

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Appendices

(1) Relationship between *Cupom Cambial-Libor spread* and *spot dollar purchase intervention* during periods of capital inflows

Where:

- DCC1M(DCC3M) is the spread between 1m (3m) cupom cambial and 1m (3m) Libor, expressed in basis points;
- Spot_buy is the amount of daily spot dollar purchases by the BCB, in $mn;
- Daily_flow is the sum of daily commercial and financial FX transactions in the spot market, in $mn;
- All data are on daily frequencies, expressed as 3-day moving average.

Dependent Variable: DCC1M

Method: Least Squares

Sample (adjusted): 1/06/2005 9/12/2008

Variable	Coefficient	t-Statistic	Prob.
C	4.41	1.43	0.15
DCC1M(-1)	0.79	33.56	0.00
SPOT_BUY	0.05	4.20	0.00
R^2	0.6436	S.E. of regression	67.73
Adj. R^2	0.6429	Durbin-Watson	1.66

Dependent Variable: DCC3M

Method: Least Squares

Sample (adjusted): 1/06/2005 9/12/2008

Variable	Coefficient	t-Statistic	Prob.
C	3.61	2.29	0.02
DCC1M(-1)	0.86	37.76	0.00
SPOT_BUY	0.01	2.21	0.03
R^2	0.7612	S.E. of regression	34.76
Adj. R^2	0.7607	Durbin-Watson	1.79

Dependent Variable: DCC1M

Method: Least Squares

Sample (adjusted): 5/06/2009 8/31/2011

Variable	Coefficient	t-Statistic	Prob.
C	23.78	4.16	0.00
DCC1M(-1)	0.86	31.22	0.00
SPOT_BUY	0.03	3.10	0.00
DAILY_FLOW	-0.01	-1.56	0.12
R^2	0.7580	S.E. of regression	54.38
Adj. R^2	0.7568	Durbin-Watson	1.52

Dependent Variable: DCC3M			
Method: Least Squares			
Sample (adjusted): 5/06/2009 8/31/2011			
Variable	Coefficient	t-Statistic	Prob.
C	5.76	2.33	0.02
DCC3M(-1)	0.96	47.21	0.00
SPOT_BUY	0.01	2.11	0.04
DAILY_FLOW	-0.01	-1.55	0.12
R^2	0.9227	S.E. of regression	27.45
Adj. R^2	0.9223	Durbin-Watson	1.37

Source: BCB, Bloomberg, Nomura Securities.

(2) Relationship between *Cupom Cambial-Libor spread* and *swap dollar auction intervention* during periods of capital outflows

Where:

- DCC1M(DCC3M) is the spread between 1m (3m) cupom cambial and 1m (3m) Libor, expressed in basis points;
- Swap_sell is the amount of daily swap dollar auctions by the BCB, in $mn;
- Daily_flow is the sum of daily commercial and financial FX transactions in the spot market, in $mn;
- All data are on daily frequencies, expressed as 3-day moving average.

Dependent Variable: DCC1M			
Method: Least Squares			
Sample (adjusted): 5/1/2013 3/14/2014			
Variable	Coefficient	t-Statistic	Prob.
C	8.997	3.079	0.00
DCC1M(-1)	0.810	17.616	0.00
SWAP_SELL	-0.004	-1.274	0.20
DAILY_FLOW	-0.009	-3.544	0.00
R^2	0.7395	S.E. of regression	18.25
Adj. R^2	0.7359	Durbin-Watson	1.40

Dependent Variable: DCC3M			
Method: Least Squares			
Sample (adjusted): 5/1/2013 3/14/2014			
Variable	Coefficient	t-Statistic	Prob.
C	7.195	2.357	0.02
DCC3M(-1)	0.876	22.940	0.00
SWAP_SELL	-0.003	-2.316	0.02
DAILY_FLOW	-0.003	-3.330	0.00
R^2	0.8686	S.E. of regression	7.03
Adj. R^2	0.8668	Durbin-Watson	1.39

Source: BCB, Bloomberg, Nomura Securities.

(3) Relationship between *Banks´ FX Spot Positio*n and *Cupom Cambial-Libor spread* during periods of capital outflows

Where:

- DCC3M) is the spread between 3m cupom cambial and 3m Libor, expressed in basis points;
- SWAP_SELL100 is the 100-day moving average of the amount of daily swap dollar auctions by the BCB, in $mn;
- DAILY_FLOWS100 is the 100-day moving average of the sum of daily commercial and financial FX transactions in the spot market, in $mn;
- BP10 is the 10-day moving average of the Commercial Banks´ Spot FX Position.

Dependent Variable: D(BP10)
Method: Least Squares
Date: 05/08/14 Time: 17:24
Sample: 5/02/2013 2/28/2014
Included observations: 212
Convergence achieved after 7 iterations
HAC standard errors & covariance (Bartlett kernel, Newey-West fixed bandwidth = 5.0000)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
DCC3M	-0.514811	0.264385	-1.947201	0.0529
D(DAILY_FLOWS100)	0.025666	0.005731	4.478111	0.0000
SWAP_SELL100	0.000805	0.002148	0.374715	0.7083
AR(1)	0.948895	0.034416	27.57133	0.0000

R-squared	0.914325	Mean dependent var	-49.57217
Adjusted R-squared	0.913089	S.D. dependent var	326.5977
S.E. of regression	96.28303	Akaike info criterion	11.99115
Sum squared resid	1928248.	Schwarz criterion	12.05448
Log likelihood	-1267.062	Hannan-Quinn criter.	12.01675
Durbin-Watson stat	1.446259		

Inverted AR Roots	.95