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BRAZIL

SELECTED ISSUES

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Approved By
Western Hemisphere Department

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PROFITABILITY AND DETERMINANTS OF FX INTERVENTION IN BRAZIL[1]

> *It would be little harm for a government agency to speculate in the exchange market provided it held the objective of smoothing out temporary fluctuations [...]. And there should be a simple criterion of success—whether the agency makes or loses money.*
> *Milton Friedman (1953).*

This note examines the profitability of the FX swaps issued the Central Bank of Brazil (BCB) between May 2013 and February 2019 to shed light on the rationale for FX intervention. If FX swaps are used to smooth temporary excessive fluctuations of the exchange rate rather than resisting fundamental movements, they should be profitable in expectation. Indeed, using interest rate and exchange rate forecasts, we find that FX swaps were profitable in expectation, even though actual returns were negative due to unexpected exchange rate depreciations. Moreover, the scale of FX intervention was correlated with the expected profitability of the swaps, further suggesting that the BCB used FX intervention to stem abnormal movements of the exchange rate.

A. Introduction

1. In most emerging markets, central banks intervene in the exchange rate market. This is the case even in countries with flexible exchange rates for which exchange rate fluctuations are an integral part of macroeconomic adjustment. In most cases, central banks argue that they intervene to lean against temporary excessive movements of the exchange rate which are not driven by fundamentals. This is in line with IMF advice which supports FX intervention in case of disorderly market conditions. Nonetheless, there are concerns that in some instances central banks may intervene to resist fundamental movements in the exchange rate which is generally considered inappropriate.[2]

2. To shed light on the rationale for FX intervention, we analyze its profitability. This idea was first expressed by Friedman (1953). He argued that if FX intervention is used to lean against temporary excessive fluctuations of the exchange rate—reflecting deviations from uncovered interest parity (UIP)—the central bank should make a profit. Indeed, by going long in the domestic currency when the exchange rate is undervalued, the central bank would make money as the

[1] Prepared by Damiano Sandri with outstanding research assistance from Daniel Cunha. The paper benefited from insightful comments by Gustavo Adler, Marcos Chamon, Aasim Husain, Jonathan Ostry, Antonio Spilimbergo, Krishna Srinivasan, and Alejandro Werner.

[2] There are cases when FX intervention could be warranted even against fundamental movements of the exchange rate. For example, intervention might be optimal to slow down a fundamental-driven exchange rate depreciation that could otherwise pose financial stability concerns.

exchange rate recovers to its equilibrium level over time.[3] Similarly, by shortening the local currency when it is temporarily overvalued, the central bank would make a profit as the currency depreciates over time. If instead the central bank tries to resist fundamental movements in the FX market, for example by going long in the local currency when it is bound to depreciate, it would incur losses.

3. Recent academic literature provides theoretical underpinnings for this argument. Gabaix and Maggiori (2015) present a theory of exchange rate determination where the market can become disconnected from fundamentals. This is because financial frictions constrain the trading operations of financial intermediaries, leading to departures from UIP and generating excessive volatility in the exchange rate market. Central banks can use FX intervention to stabilize markets by going long in the local currency when undervalued and taking a short position when overvalued, thus earning profits in the process. Making money is thus a by-product (not a goal) of a well-managed FX intervention strategy.

4. The Central Bank of Brazil (BCB) intervenes in the FX market using swaps. Brazil has a large amount of FX reserves of about 375 billion USD which in principle allows the central bank to intervene robustly in the spot exchange rate market. However, price discovery takes place mostly in the derivative market since it is more liquid than the spot market. Therefore, the BCB intervenes in the FX derivative market by offering swaps through which it provides insurance against a depreciation of the *real*, thus propping up its market value.[4]

5. FX intervention through swaps is well-suited for an analysis of profitability. Measuring the profitability of FX intervention using swaps is relatively straightforward since these instruments have an explicit maturity date. This makes it possible to precisely compute the financial returns on each individual swap, both in realized and expected terms. The latter are computed using market projections for the exchange rate and the Selic at the time of the swap sale. Analyzing the profitability of FX intervention in the spot market is much more challenging since when the central bank buys or sells FX reserves it is not known how long the central bank plans to keep that position for. Therefore, the profitability of a spot-market intervention depends on arbitrary assumptions of when the central bank intends to reverse the position.

6. Besides analyzing the overall profitability of FX intervention, we also test if the scale of intervention varied over time with the swap profitability. This provides a more stringent test of the BCB intentions. A positive correlation between the number of swaps sold and their profitability would imply that the BCB intervened more strongly when the exchange rate was perceived to be more undervalued. To further understand the drivers of FX intervention, we will also

[3] This argument does not require that FX intervention is successful in boosting the exchange rate. It only relies on the assumption that the currency will return to its fundamental values once temporary shocks dissipate. In fact, if FX intervention is effective in reducing UIP deviations, it would also lower the expected profits for the central bank.

[4] Evidence about the impact of FX swaps on the exchange rate is provided in Kohlscheen and Andrade (2014), Chamon et al. (2017), and Nedeljkovic and Saborowski (2019).

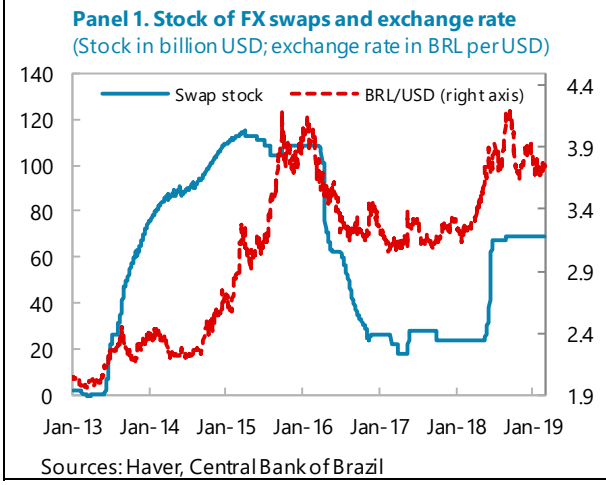
consider other possible determinants of FX intervention, among which movements in the exchange rate or the *cupom cambial* (i.e. the onshore USD interest rate).

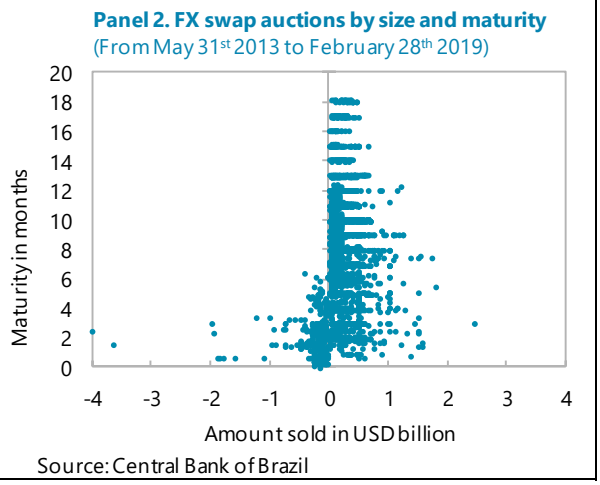
B. Average Profitability of FX Swaps

7. The BCB has made considerable use of FX swaps since May 2013. As illustrated in panel 1 of Figure 1, the outstanding stock of FX swaps increased significantly between 2013 and 2015 to almost 120 billion USD. After declining to about 20 billion, swaps increased again in 2018 to almost 70 billion and have remained stable since then. These episodes coincided with periods during which the *real* came under pressure and were motivated by the BCB with the need to "provide liquidity to the market" and "ensure the smooth operation of the exchange market".[5]

8. FX swaps are sold through auctions in different quantities and with variable maturities. We collect information about each FX swap issued between May 31, 2013 and February 28, 2019. The size and maturity of each auction is plotted in panel 2 of Figure 1. The vertical axis shows that the maturity varies from a few days to two years, with an average of about 7 months. The average value of FX swaps sold in a given auction is 200 million USD, but in some instances the auction size reached a few billion USD. The auction size can be negative in which case the BCB reduces the outstanding stock of swaps, thus putting downward pressure on the *real*.

Figure 1. Outstanding Stock, Auction Size, and Maturity of FX Swaps





9. By selling FX swaps, the BCB takes a long position in the *real* against the US dollar. Swaps provide compensation for exchange rate fluctuations of the BRL against the USD. The BCB pledges the repayment of 50,000 USD at a future maturity date T converted in BRL at the spot exchange rate of the previous day. Through an auction, market participants bid for the swaps by offering a discounted value relative to the 50,000 USD face value, which is paid to the BCB in BRL at the exchange rate of the day before settlement. The discount rate is referred to as the *bid cupom*

[5] BCB press release on August 22, 2013 and August 30, 2018 when announcing significant increases in FX swaps.

cambial. Furthermore, market participants pay the BCB the Selic rate between settlement and maturity, reflecting the fact that the BCB is taking a long position in BRL.

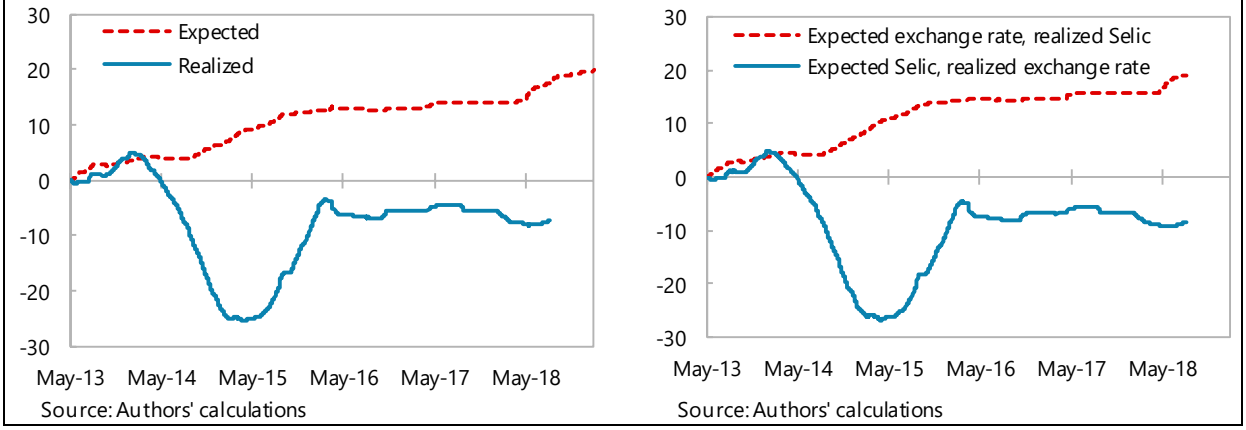
10. Swaps are profitable for the BCB if the *real* does not depreciate more than the differential between the Selic and the onshore dollar rate. On a given swap, the BCB earns net revenues expressed in USD equal to

$$\text{Net revenues} = 50{,}000\left[\frac{e_{S-1}}{e_{T-1}} * \frac{\prod_{t=S}^{T-1}(1+i_t)^{\frac{1}{252}}}{1+cc\frac{T-S}{360}} - 1\right] \quad (1)$$

where e_t is the exchange rate in BRL per USD, the subscripts S and T denote the day of the swap settlement and maturity, and the product operator cumulates the Selic rate i_t over the working days between settlement and maturity. The variable cc is the *bid cupom cambial* which reflects the on-shore U.S. dollar rate that investors earn using forward exchange rate contracts in Brazil. When issuing a swap, net revenues for the BCB are thus inversely related to the depreciation of the *real* and positively related to the differential between the Selic rate and the *bid cupom cambial*. The opposite applies when the BCB takes a short position in swaps. Equation (1) calculates *realized* net revenues (different from *expected*) since it uses values of the exchange rate and Selic that were not known at the time of the auction.

11. Considering realized returns, the BCB incurred significant losses on FX swaps. The blue line in panel 1 of Figure 2 shows that between May 2013 and September 2018 FX swaps generated cumulative losses of about 7.3 billion USD.[6] Losses peaked to 25.6 billion USD in April 2015. Considering realized losses, it appears that the BCB did not react to temporary exchange rate fluctuations, buy tried to lean against fundamental exchange rate movements.

Figure 2. Cumulated Net Revenues on FX Swaps for the Central Bank



[6] We stop the calculations of realized losses in September 2018 since subsequent swaps will mature in the future relative to the time of this writing.

12. However, it would be improper to assess the BCB's FX intervention strategy by considering realized returns. This is because realized returns over a relatively short period of time are affected by shocks to the exchange rate and changes in the Selic that were not foreseeable at the time of intervention. These shocks may thus generate arbitrary losses or gains on FX swaps which do not reflect the intentions of the BCB at the time of intervention.

13. We thus focus the analysis on the *expected* profitability of FX swaps at the time of intervention. This provides a more accurate test of whether the BCB intervened when the exchange rate was perceived to be away from UIP equilibrium conditions and expected to return to its fundamental value over time. To compute expected returns at the time of each auction, we rely on market expectations collected by the BCB through the Market Expectations System. Survey respondents report their end-of-the-month forecasts for the Selic and BRL/USD exchange rate over the 18 months ahead and can update their forecasts every day.[7] By linearly interpolating monthly forecasts, we create daily projections over 18 months. To compute expected net revenues, we replace the exchange rate and Selic in equation (1) with their expected values at the time of each swap auction.

14. FX swaps have been profitable in expectation, consistent with the idea that the BCB intervened against temporary excessive movements of the exchange rate. The red dashed line in panel 1 of Figure 2 shows that swaps generated positive cumulative gains in expectation, reaching 19.8 billion USD by the end of February 2019. The average profitability of FX swaps was about 5 percent in annual terms, against an average expected excess return of the BRL over the USD of about 3.5 percent. This suggests that the BCB used FX intervention to lean against temporary deviations from UIP, issuing swaps when the exchange rate was undervalued relative to medium-term expectations and vice versa.

15. Despite being profitable in expectation, swaps incurred realized losses due to unexpected exchange rate depreciations. The gap between realized and expected revenues can be driven by unexpected movements in the Selic or in the exchange rate. To understand which factor is more important, we perform the following exercise. The blue line in panel 2 of Figure 2 shows a hybrid measure of expected revenues obtained by using only expectations for the Selic, while using realized exchange rates. This line tracks closely the realized revenues plotted in panel 1, showing that shocks to the Selic do not explain the difference between realized and expected revenues. The red dashed line in panel 2 repeats the exercise by using expectations only for the exchange rate. This line is very similar to the expected revenues in panel 1. This shows that realized

[7] In line with BCB practice, we measure exchange rate expectations using the median of survey participants. For some swaps, the settlement day occurs before the first forecast reported in the Market Expectations System. In this case, to measure the expected exchange rate at the time of the swap settlement, we use a linear interpolation between the spot exchange rate at the time of the auction and the expected exchange rate at the end of the month of settlement. We follow the same procedure to construct the expected Selic. For those swaps whose maturity exceeds the 18-month forecast horizon reported in the Market Expectations System, we assume that expectations are constant after the forecast horizon. We subtract 10 basis points to the Selic forecast to obtain the market Selic rate which is the one contractually paid on the swaps.

revenues have been negative because of unexpected movements in the exchange rate, notably during the sharp depreciations in 2015 and 2018.

16. A possible concern with the analysis is that the results could be affected by delays in the update of exchange rate forecasts. In principle, survey participants to the Market Expectations System can update their forecasts every day, but they tend to do so only occasionally. This could distort the measurement of the expected profitability of swaps. For example, assume that a depreciation of the exchange rate in the spot market leads to a downward revision of the exchange rate forecast. If this is not timely recorded in the survey, we would overestimate the expected profitability of a swap sale by using an artificially strong expected exchange rate. Note that the same argument would apply in reserve—thus leading to a downward bias in the expected profitability of swap sales—when the exchange rate appreciates.

17. Swaps are profitable in expectation even if we control for delays in survey updates. To ensure that the results are not driven by delays in the update of exchange rate forecasts, we re-compute the expected profitability of swaps by using survey forecasts collected several weeks after the auction date. Table 1 shows that the average expected returns on FX swaps using the forecasts recorded on the day of the action is 5.6 percent. If we use the forecasts reported one week later, the expected return declines to 3.3 percent. However, average returns remain positive even if we use the forecasts reported four weeks after the auction dates. This suggests that the finding that swaps were profitable in expectation is not driven by delays in the update of the exchange rate forecasts.

Table 1. Brazil: Expected Returns on FX Swaps Using Delayed Surveys

Average expected returns on swaps using survey projections collected:				
On the auction day	One week after auction	Two weeks after auction	Three weeks after auction	Four weeks after auction
5.6	3.3	2.0	1.7	1.1

C. Determinants of FX Intervention

18. To further understand the rationale for FX intervention by the BCB, we perform a regression analysis. Up to this point, we have documented that on average FX intervention by the BCB was profitable in expectation. We now perform a more stringent test of whether FX intervention was targeted to temporary excessive movements of the exchange rate. We do so by testing whether the extent of intervention varied over time with the expected profitability of swaps. The idea is that the central bank should issue more swaps when their expected profitability increases, i.e. when the exchange rate is more undervalued.

19. We find that the issuance of swaps is positively correlated with their expected return. We compute the expected return on individual swaps by dividing expected net revenues by the swap face value of 50,000 USD. Annualized returns vary between -61 to 107 percent, with an

average level of 5 percent. In Table 2 we regress the face value of swaps in millions of USD issued in a given auction over their expected return. Column (1) shows that the regression coefficient is positive and highly statistically significant. This suggests that the BCB intervened more strongly in the FX market when the exchange rate was perceived to be further away from equilibrium. Despite the tight correlation between swap sales and their expected returns, the regression has a low R-squared.

Table 2. Brazil: Value of Swaps Sold in a Given Auction over Financial Variables
(In million USD)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
		excluding pre-announced and rollover swaps						
				controlling for swap sales over prior ten days				
	all swaps			no outliers				
Expected return on swap	4.82***	17.43***	15.82***	11.58***	11.98***	10.72***	11.45***	11.73***
	(1.2)	(2.2)	(2.4)	(2.3)	(2.3)	(2.3)	(2.4)	(2.3)
ER depreciation over last day			-14.79	2.24	2.47	6.79	3.27	5.74
			(10.1)	(9.6)	(8.6)	(9.5)	(9.9)	(13.4)
ER depreciation over last ten days			13.63***	1.03	0.99	-2.39	-0.44	0.97
			(4.6)	(3.5)	(3.3)	(3.4)	(3.9)	(3.6)
Cupom cambial - US rate			-119.06***	-59.43***	-62.76***	-52.82***	-76.52***	-59.89***
			(20.7)	(17.1)	(17.0)	(17.1)	(27.1)	(17.3)
Two-year soreign spread						48.99***		
						(14.6)		
Two-year CDS							0.24	
							(0.4)	
Stock price increase over last day								-4.79
								(9.0)
Constant	176.26***	116.08***	298.69***	134.50***	144.92***	137.47***	130.94***	134.58***
	(8.4)	(18.7)	(27.1)	(28.8)	(26.8)	(28.4)	(30.9)	(29.1)
Number of swap auctions	2,898	731	712	712	712	712	712	706
R-squared	0.02	0.19	0.23	0.46	0.49	0.47	0.46	0.46

*** p<0.01, ** p<0.05, * p<0.1. Robust standard errors in parentheses

20. The regression fit improves considerably if we drop auctions that were pre-announced or used to rollover maturing swaps. In several instances, the BCB pre-announced a schedule of future auctions.[8] Being decided in advance, these auctions should be less responsive to the expected returns on swaps based on the expectations on the day of issuance. Furthermore, the BCB often issued swaps to simply rollover maturing ones, thus keeping constant the outstanding stock of swaps as seen in the flat segments in panel 1 of Figure 1. Column (2) shows that if we exclude pre-announced and rollover swaps, the regression R-squared increases considerably to 19 percent.[9]

[8] For example, on August 22, 2013 the BCB announced that "swap auctions will take place every Monday, Tuesday, Wednesday and Thursday, when 500 USD million will be offered for each day" at least until December 2013.

[9] We consider "rollover" swaps those for which on settlement date the stock of outstanding swaps differs less than 0.5 billion USD from the previous day.

21. Swap issuances were also affected by short-term movements in the exchange rate and in the *cupom cambial*. Column (3) shows that the BCB increased swaps in response to a depreciation of the exchange rate during the previous ten days. Swap issuance was also inversely related to movements in the 6-month *cupom cambial* in deviation from the U.S. Fed Fund Rate. The *cupom cambial* captures the onshore USD rate in Brazil.[10] A decline relative to the U.S. Fed Fund Rate reflects pressures in the forward exchange rate market, possibly due to strains in the ability of financial intermediaries to absorb currency risk. Even after controlling for movements in the exchange rate and *cupom cambial*, the issuance of swaps remains tightly correlated with their expected returns. In terms of magnitudes, a one-standard-deviation shock to the expected return, exchange rate, and *cupom cambial* affects issuance by 179, 46, and 70 million USD, respectively.

22. The regression results are robust to controlling for additional variables and winsorizing outliers.

- In column (4) we control for serial correlation in swap auctions by adding among the regressors the sales during the prior ten days. The coefficients (not reported for space considerations) tend to be positive, reflecting autocorrelation in the scale of intervention. The inclusion of lags leads to a further considerable increase in the R-squared and absorbs the effects of exchange rate movements. The statistical significance of swaps returns and the *cupom cambial* is unchanged.
- In column (5), we exclude outliers by winsorizing 1 percent of the data with respect to the auction size and swap returns. The regression results are broadly unchanged.
- In columns (6), (7), and (8), we add other financial variables among the regressors. Swap issuances are positively correlated with sovereign spreads, defined as the difference between the two-year sovereign yields and the Selic. There is instead no association between 2-year CDS on sovereign bonds and the performance of the domestic stock market.[11]

D. Conclusion

23. The analysis suggests that the BCB used FX intervention to lean against temporary excessive movements of the exchange rate. On average, FX swaps were profitable in expectation, implying that the BCB issued swaps when the exchange rate was temporarily undervalued and vice versa. Furthermore, the regression analysis shows that the BCB increased swap sales when the degree of undervaluation was more severe, i.e. when the expected profitability of swaps was higher. FX intervention was also shaped by additional factors, notably movements in the *cupom cambial* and sovereign spreads, and displayed significant autocorrelation.

24. The expected profitability of FX swaps can be monitored in real time and may thus provide guidance on the appropriate level of intervention. The expected return of swaps can be

[10] It is the USD-equivalent interest rate that is earned by investing *reais* at the domestic interest rate and converting the proceeds at the forward USD exchange rate traded in BM&FBOVESPA.

[11] For sovereign yields and CDS, we focus on a relatively short-term two-year horizon since swaps have a maturity of less than two years.

computed in real time since it depends on expectations at the time of the issuance rather than on future realizations of exchange rates and interest rates over the life of the swap. If the central bank wants to use FX intervention to lean against UIP deviations, it could thus decide on the scale of intervention by openly monitoring the expected returns of swaps.

25. If FX intervention is profitable in expectation, it alleviates concerns regarding the central bank's balance sheets. Given that FX swaps provide insurance against the depreciation of the *real* and are issued when the exchange rate is under pressure, there is often a perception that these instruments are prone to incur losses. Therefore, they are financially sustainable only if they are matched by large holdings of FX reserves by the central bank. In this case, the losses incurred on FX swaps when the exchange rate depreciates do not undermine the central bank's balance sheets since they are compensated by valuation gains on reserves. The analysis suggests that this argument might be overstated. Even though it is true that an unexpected depreciation of the exchange rate generates losses on FX swaps, well-intended FX intervention tends to be profitable in expectation.

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LIQUIDITY MANAGEMENT AND PUBLIC DEBT: INSTITUTIONS, UNFORESEEN CONSEQUENCES, AND RECENT REFORMS[1]

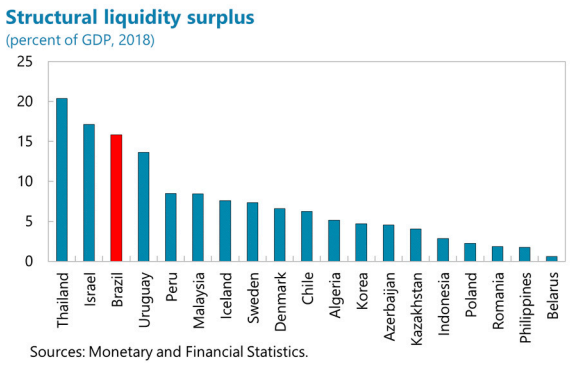
This chapter analyzes Brazil's liquidity management framework and supporting institutional setup, and their implications for public debt dynamics and fiscal rules. While the setup has not hindered the effectiveness of monetary policy transmission, it has blurred the relation between fiscal policy and public debt, impaired debt management, and impacted fiscal operations. The implementation of the 2019 reform of the accounting of central bank profit/losses and the proposed expansion of the central bank's liquidity management toolkit—in line with international experience—will strengthen the monetary framework and its transparency.

A. Introduction

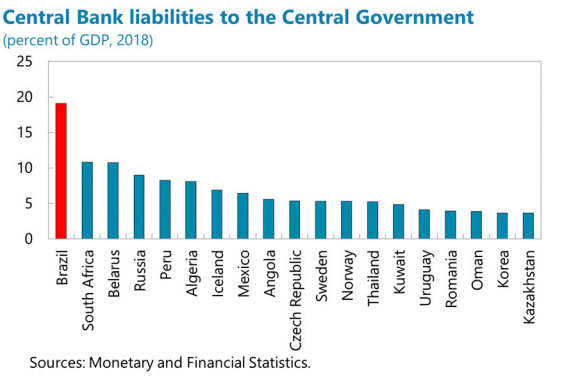
1. The balance sheet of the Central Bank of Brazil (BCB) stands out in international comparison for two reasons. On the monetary side, the level of structural liquidity[2] managed by the BCB is among the highest in a group of 43 advanced and emerging economies. On the fiscal side, Brazil has the largest holding of government deposits within the same group (Figure 1). *What explains these patterns?*

Figure 1. Central Bank Liabilities to the Banking Sector and Central Government

The BCB manages very high structural liquidity.



Brazil's government cash buffer at the CB is very high.



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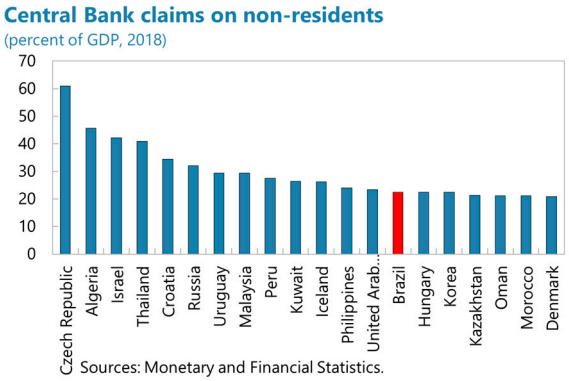
[2] See Robertson (2017), Aamodt and Tafjord (2013), and Nessén, Sellin and Åsberg Sommar (2011). Structural liquidity is defined as the difference of the central bank's liability to banks (not considering the reserve requirements), and the central bank's claims on the banking system.

2. Managing the financial system's liquidity is a core function of central banks. Structural liquidity is defined as the amount of excess funds of the banking system that would exist (*ex-ante*) in the absence of a central bank's Open Market Operations (OMOs). Thus, a liquidity surplus implies that OMOs are a liability on the central bank's balance sheet. A liquidity deficit means that OMOs are a central bank's asset—the bank injects liquidity as it purchases assets. *How did Brazil's very high structural liquidity surplus build up over time?*

3. Many central banks hold the government's accounts. Among the same group of economies, Brazil's central bank holds—by far—the largest stock of liabilities to the central government in the form of the Treasury Single Account (TSA). *Did the institutional setup contribute to the very high TSA balance? What are the implications of these high balances?*

4. Foreign exchange purchases and their holdings are the leading explanation for Brazil's structural liquidity surplus and the high TSA balance. In international comparison, the BCB also holds a significant stock of foreign reserves (FX), however, its holdings are not unusually high (Text chart). As will be explained below, the purchase of FX increases domestic liquidity, and the valuation of FX reserves has impacted government cash balances. But as will become clear, the system's high liquidity is also explained by other factors, including features of the liquidity management framework, fiscal performance, low debt rollover rates, and the liquidity dynamics of these components in a high interest rate environment.



5. In 2019 a reform was approved that changes the financial relationship between the BCB and the National Treasury. The new framework (Law 13.820/2019) was enacted in May 2019 and comes into force in July 2019. At the core of the reform is a change to the rules of profit and loss distribution.

6. This chapter is organized as follows. Section II shows how economic developments interacted with Brazil's specific institutional setup and resulted in the large positions in the BCB's balance sheet. Section III details the consequences that can result from this institutional setup. Section IV describes how the recent reform will improve the current setup and bring it closer to international practices. Section V concludes and offers some recommendations.

B. The Balance Sheet of the Central Bank of Brazil

7. The balance sheet of the BCB nearly doubled over the past decade. In response to the Global Financial Crisis, central banks in advanced economies saw a significant expansion of their balance sheets, primarily as a result of asset *purchases* in the context of quantitative easing while providing liquidity to markets. In turn, in emerging markets, liquidity management called for the *sale* of assets by central banks to absorb abundant liquidity. Within this context, the BCB stands out

among emerging markets for having significantly expanded its balance sheet during the time. In fact, the BCB balance sheet's rate of expansion and current size is among the highest in the world, third only to China and Japan. And in the case of China, more recently, the PBOC's balance sheet has shrunken in size, leaving the BCB with the largest balance sheet relative to GDP among emerging markets (Figure 2).

8. The BCB's balance sheet expanded as global liquidity conditions eased, commodity prices boomed, and the currency appreciated. A significant interest rate differential attracted capital inflows to Brazil as central banks in advanced economies began operating near the Zero Lower Bound and interest rates in EMs—notably Brazil—remained high for structural and conjunctural reasons. The BCB's inflation targeting (IT) regime builds on a tight control of the financial system's liquidity and the expansion of the BCB's balance sheet has not been reflected in an increase in monetary accommodation. To absorb liquidity stemming from FX purchases, the BCB conducts OMOs through Reverse Repurchase Agreement Operations (Reverse REPOS or *operações compromissadas*).

Assets

9. FX reserves. Brazil pursued a strategy of self-insurance against external shocks by accumulating FX reserves. The FX purchase by the BCB also helped stem the appreciation of the currency in view of sustained capital inflows, including from carry trade. Until 2005 FX reserves had been moderate, at around USD 50 billion, but they increased to USD 374 billion by 2018. At market value, FX reserves stood at 20 percent of GDP end-2018. FX reserves impact liquidity in the following way:

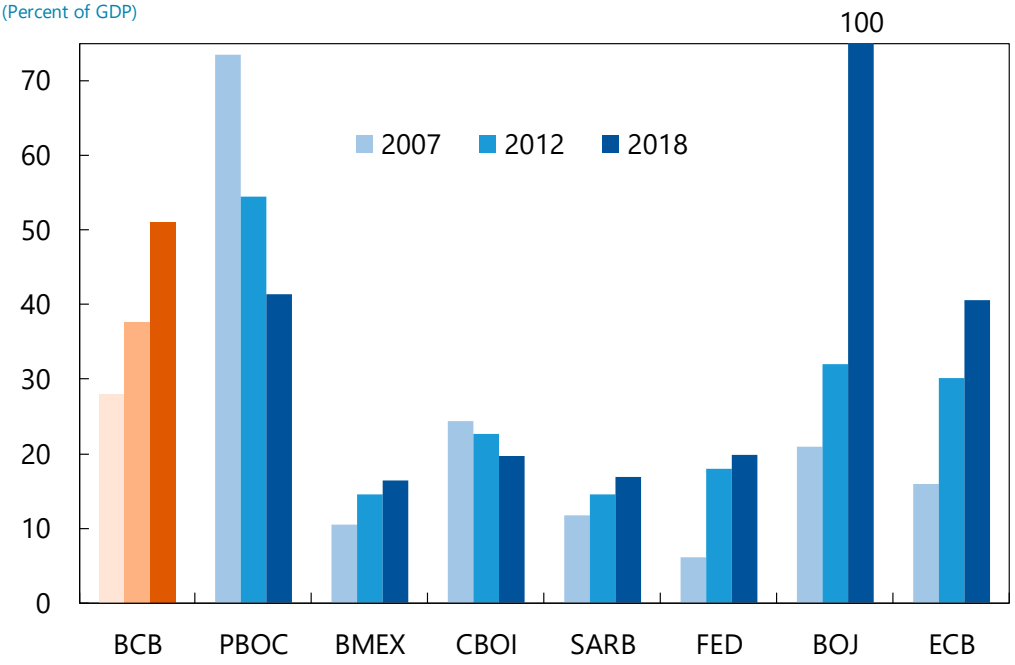
- *FX purchase.* A purchase of FX increases domestic liquidity (selling BRL for USD), and requires a sterilizing liquidity operation (*compromissada*). An outright sale of FX reserves, in turn, would reduce liquidity in the system, prompting the unwinding of repo operations. However—except for a brief intervention at the height of the 2008 Global Financial Crisis—the BCB has not sold significant amounts of FX reserves in the recent past.

- *Valuation gains.* Foreign assets are valued at end-of-period exchange rates. A depreciation of the BRL increases the local currency value of FX reserves (valuation gains). Under the old framework (until July 2019) valuation *gains*, even if unrealized, were credited semi-annually to the Treasury Single Account (TSA). However, valuation *losses* were treated differently: a valuation loss was compensated by a bond issuance from the Treasury to the BCB. As a result of this treatment, in the hypothetical case of a period of depreciation and subsequent equivalent appreciation, the BCB's balance sheet would be larger, the BCB would hold more government bonds, and public debt and TSA balances would be higher (a *ratchet* effect that is more pronounced in periods of FX volatility).

Figure 2. Brazil: The BCB's Balance Sheet in International Perspective and Over Time

The BCB's balance sheet has expanded rapidly and is now the largest among EMs

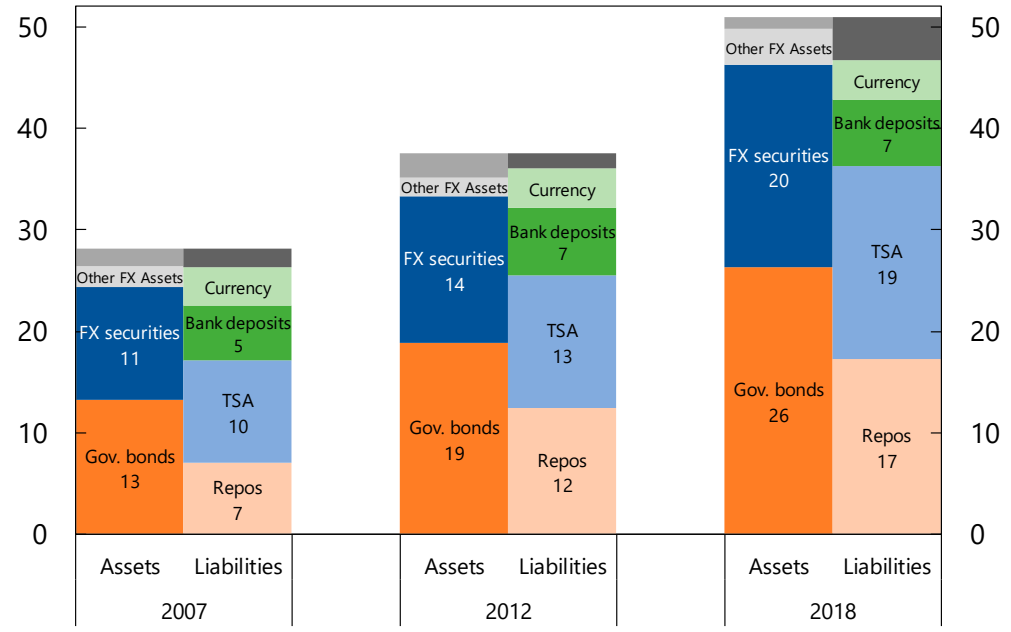
Central Bank Assets
(Percent of GDP)



Source: Haver Analytics

The increase is driven by four balance sheet items: FX securities, government bonds, TSA balances, and Repos

Brazil: Central Bank Balance Sheet
(Percent of GDP)



Sources: BCB, IMF Staff calculations

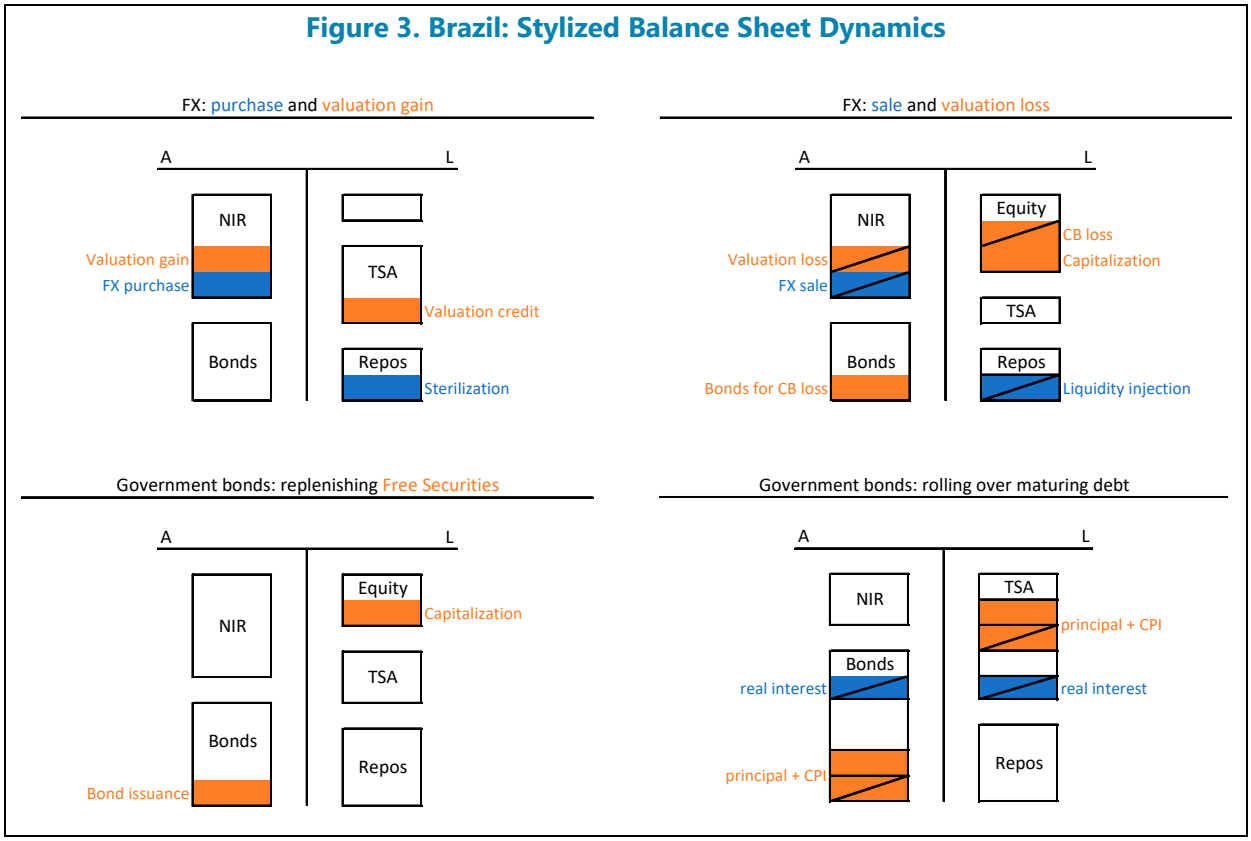
10. Government bonds. The Fiscal Responsibility Law of 2000 prohibits the BCB from issuing its own securities, and the BCB has since used government bonds for liquidity operations (See Leister, 2016). The stock of government bonds held by the central bank has doubled from 13 to 26 percent of GDP in a decade. The BCB may obtain treasury securities in three different instances:

- *To compensate financial losses.* The Treasury, by law, covered the BCB's financial loss (of which the above-mentioned FX valuation losses are the most relevant part) by issuing bonds to the BCB.

- *To roll over maturing debt.* There is an automatic rollover mechanism to exchange maturing government bonds in the BCB's portfolio for new treasury securities. This mechanism covers the principal value of the securities, adjusted by a consumer price index.

- *To maintain a minimum Free Securities (FS) portfolio for the conduct of monetary policy.* Free Securities are bonds held by the BCB (assets) that are not (yet) used as collateral in reverse repos (they are not "compromised"). These bonds are issued directly to the BCB without any financial compensation to the Treasury.

Figure 3. Brazil: Stylized Balance Sheet Dynamics



11. The government bond portfolio has the following important properties:

- **Interest on government bonds.** The BCB's government bond portfolio earns interest just like any other government paper. Nonetheless, by law, the Treasury can only roll over its principal value adjusted by a consumer price index. This leave a portion, the real interest rate earned on government bonds, that is paid to the BCB in cash.

- **Free Securities and debt perimeter.** The FS portfolio is also at the core of the difference between the IMF's and the BCB's definition of public debt (see also BCB, 2019). The IMF, following Government Finance Statistics Manual (GFSM) 2014 standards for the public sector coverage and debt accounting, considers all government debt held by the central bank as a liability of the government. Under the common public debt definition used in Brazil (BCB definition), bonds issued to the BCB are not included as debt, but the stock of BCB held government bonds in the hands of the public through OMOs is. As a result, any direct issuance of bonds to the BCB by the Treasury will immediately impact the IMF definition of public debt, whereas the BCB definition will only be affected if and when the FS portfolio is used in OMOs.

Liabilities

12. Treasury Single Account. Fiscal revenues and expenditures, financial revenues and public debt operations are the key variables that drive TSA dynamics. The balance on the TSA has increased from 10 to 19 percent of GDP over the past decade, *despite* an overall expansionary fiscal policy stance and an average annual fiscal deficit of 4 percent of GDP. The key factors behind this are:

- *BCB profits from valuation gains.* Under the old framework, whenever the currency depreciated, as was repeatedly the case since 2008, the TSA was credited, semi-annually, with the FX valuation gain. When the currency appreciates, however, there is no drawdown in the TSA, because the Treasury capitalizes the BCB through public bonds.

- *TSA accrued interest.* TSA balances earn interest equivalent to the average cost of public bonds held by the BCB, which in turn is close to average cost of domestic public debt. This value therefore corresponds, roughly, to the real interest payment that the government pays the BCB for its government debt holdings (see above).

- *Debt management buffer.* The National Treasury earmarks several *financial* revenues such as interest earned on TSA balances and debt repayments from loans operations with subnational governments and from the public bank BNDES, to build, and maintain, a cash cushion that can be used anytime to redeem government debt.

- *Earmarking of TSA subaccounts*. Many sub-accounts of the TSA are legally earmarked to serve specific purposes. The process of re-allocating TSA balances is complex, often requiring parliamentary approval (National Treasury Secretariat, 2017).

13. Repos (*compromissadas*). Reverse repos are the only relevant open market operation instrument used by the BCB, and its stock has increased from 7 to 17 percent of GDP over the last

decade. These reverse repos are a transaction in which the BCB (borrower) sells a government bond (collateral) to another agent (lender) with a repurchase commitment. The operation is akin to a collateralized loan, which reduces liquidity in the financial system.

14. Reserve Requirements. Bank deposits are traditional reserve requirements levied on banks for regulatory purposes. Like repos, they also have a contractionary impact on liquidity and are thus a (second best) monetary policy instrument to control liquidity. An increase in reserve requirements triggers an outflow from banks to the BCB, reducing liquidity. These compulsory reserve requirements are partially remunerated, and while they have a permanent effect on liquidity, significant changes to reserve requirements are rare.

Drivers of Liquidity

15. Structural liquidity in Brazil has increased from 1.7 percent of GDP to 17 percent of GDP from 2005 to 2018. The *liquidity drivers* are the factors that explain the inflows and outflows between the BCB and the money market. Whenever the BCB receives a cash inflow, there is a reduction in the liquidity of the system, and a cash outflow from the BCB increases liquidity. According to BCB (2018), in **accounting terms**, these drivers are (Figure 4):

- *FX purchase.* The purchase of FX for BRL increases liquidity, which is immediately sterilized by reverse repo transactions.
- *Interest on OMOs.* A repo transaction initially reduces the monetary base, which represents a liability for the BCB (liquidity reduction), and an increase of the same amount in repo operations (loans), which are also a liability for monetary authority. On the day of the closing of the repo, liquidity increases due to the repayment of the nominal value of the repo *and* the payment of interest. All else equal, to keep liquidity constant in the system, the BCB will typically carry out a new repo on the closing day (rollover). The nominal value of the new repo, however, will be higher due to the interest payment.
- *Debt operations.* A net debt issuance of debt by the Treasury to the market reduces liquidity, as TSA balances increase.
- *Fiscal flows (other than debt operations).* These flows reflect fiscal operations, they include tax collection and expenditures. In addition, financial revenues, including repayments from on-lending (e.g., BNDES loans), have a bearing on liquidity. Expansionary fiscal policy increases liquidity, triggering an OMO.
- *FX swaps.* FX swaps involve payments between the BCB and the market, thus impact liquidity. The FX swaps are drawn based on the BCB's short position on USD and *coupon cambial*[3] with a corresponding long position in SELIC. A negative net result on FX swaps leads to an increase in

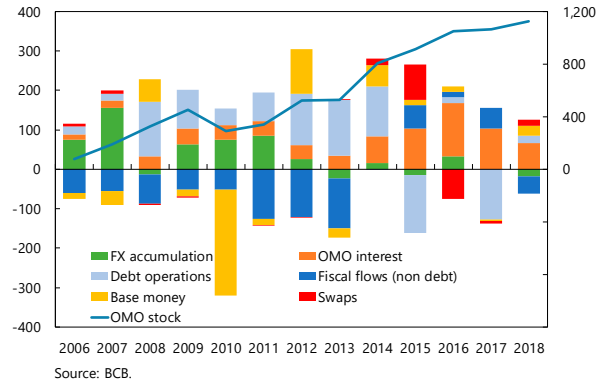
[3] The *coupon cambial* is the surcharge charged in the onshore US$ market.

liquidity because it represents an outflow from the BCB to the financial system, requiring sterilization.

- *Reserve requirements.* Requirements were increased in 2010 to curb credit growth, resulting in a decline in the monetary base, a measure that was partially reversed in 2012 when credit growth slowed.

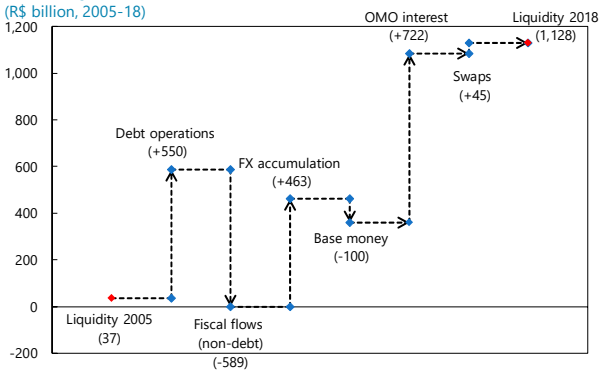
Figure 4. Brazil: Liquidity Drivers

FX purchases increased liquidity early on; interest on OMOs and an expansionary fiscal stance gained importance later.



Source: BCB.

Overall, liquidity rose significantly from 2005 to 2018



Source: BCB.

16. **In economic terms**, the drivers of liquidity are rooted in fiscal, monetary, and exchange rate policies, and can be summarized as follows:

- **Fiscal policy.** From 2007 to 2014, fiscal policy had, on average, an *expansionary* impact on liquidity, as primary surpluses[4] and other fiscal inflows were offset by the expansionary impact of average debt rollover ratios below 100 percent. From 2015 onwards, the impact of fiscal policy on liquidity turned *contractionary*, because the liquidity enhancing primary deficits were offset by two factors, repayments of loans from BNDES and average debt rollover ratio above 100 percent. Thus, for much of the last decade, the liquidity impact of fiscal policy had the *opposite* direction of fiscal policy (Figure 5). Paradoxically, due to liquidity management, a debt redemption is immediately offset by an increase in reverse repos, leaving the overall level of debt unaffected, only changing the composition of public debt from debt held directly by the public to debt held by the public through *compromissadas*.

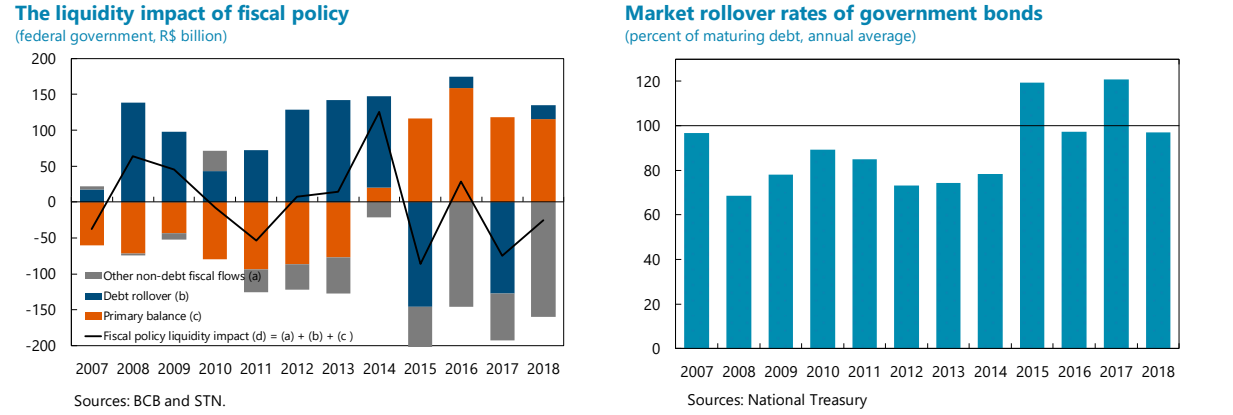
- **Monetary policy**. Positive variations in base money cause, ceteris paribus, a contraction of the same magnitude in the liquidity as banks exchange holdings of reverse repos for some component of the monetary base. For instance, a sharp increase in reserve requirements in 2010 caused a sizeable contraction in liquidity. Monetary policy also affects liquidity indirectly

[4] The primary and overall budget balance have the same qualitative effect on liquidity. However, here the focus is on the primary balance as it directly relates to fiscal policy, whereas interest expenditure is also influenced by monetary and exchange rate policies.

because the repos' interest rate payments are key drivers of structural liquidity (see above), and are linked to the policy rate.

- **Exchange rate policy**. From 2006 to 2012, international reserves increased by US$310 billion and boosted liquidity, prompting the BCB to sterilize the inflow via reverse repos. From 2012 onwards, the exchange rate impact on liquidity was much smaller, and mainly driven by FX swaps results.

Figure 5. Brazil: Liquidity Impact of Fiscal Policy and Debt Rollover Rates



C. A Solid Framework with Unforeseen Consequences

17. The institutional framework has helped Brazil overcome macroeconomic instability. Borne out of the stabilization programs of the 1990s and helped by IMF-supported programs, the macroeconomic tripod of a floating exchange rate, inflation targeting, and fiscal primary surpluses was underpinned by an institutional setup designed to prevent the repetition of past policy missteps: Specifically, the TSA was moved from a public bank (*Banco do Brasil*) to the BCB in the 1980s, the central bank was barred from financing the Treasury under the 1988 Constitution, and the Fiscal Responsibility Law (FRL), enacted in 2001, prohibited that any public financial institution provided financing to their controlling entities.

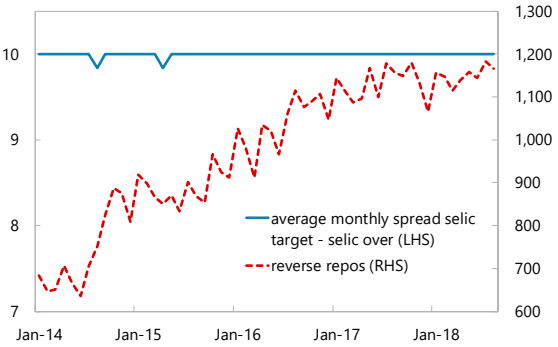
18. As domestic and international economic conditions evolved, the institutional setup remained the same until mid-2019. The previous section identified very large balance sheet positions that have accumulated as a result of the interplay of the institutional setup with economic conditions at home and abroad. This section discusses if these features have had, or could have, unforeseen consequences. Specifically, the section discusses the impacts of the setup on monetary policy execution, the public debt trajectory and profile, and fiscal operations.

Monetary Policy Execution

19. Monetary policy execution, liquidity and interest rates. The BCB executes monetary policy by maintaining the market interest rate (*SELIC over*) close to the monetary policy rate (*SELIC*

target), targeting a difference of 10 bps. To achieve this convergence, the central bank conducts reverse repo operations to control the liquidity surplus. The level of liquidity in the financial system is directly related to the pricing of the *SELIC over*. In clearing surplus liquidity, the *SELIC over* also impacts directly the overnight inter-banking interest rate (DI), which in turn is the benchmark for several fixed income products. Based on this mechanism, liquidity management is the key process that allows the BCB to control inflation and inflation expectations.[5]

Selic spread and liquidity surplus
(bps and R$ million)



Sources: BCB.

20. *Compromissadas* and SELIC. The market interest rate *SELIC over* is calculated as an average of overnight repo market transactions. To control liquidity, the BCB uses different maturities: 1 day (overnight), 45 days (between COPOM meetings), 3 months and 6 months. The overnight operations affect the SELIC's pricing directly. The longer maturities play an important secondary role: their volume is set by BCB, so if the monetary authority chooses not to roll over longer maturities, all markets players will lend money to the BCB through overnight repos, putting downward pressure on the *SELIC over*. Barbosa et al (2018) argue that a CB pursues monetary policy implementation by minimizing the difference between the market interest rate (*SELIC over*) and policy targeted rate (*SELIC target*); a deviation in the rates would lead to a social loss caused by deflation or inflation.

21. High structural liquidity does not seem to have had an adverse effect on monetary policy execution. The current *SELIC over* rate has not been affected by the increasing structural liquidity (text chart). The BCB has effectively controlled the price (SELIC spread) of daily reverse repos as the spread has remained constant throughout periods of large OMO accumulation.

Central Bank Profit Accounting and FX Volatility

22. The setup under the old framework had generated substantial financial flows between the BCB and the Treasury. The accounting of profit and losses from the BCB differed from international practice (Box 1). Until the recent changes, the financial flows between the institutions consisted of two items separated by law; losses in one could not be offset by gains in the other (Figure 6).

[5] See IMF (2018a) for a technical discussion of Brazil's Liquidity Management Framework.

Box 1. Central Bank Operations: International Experience

Central Bank solvency. Reis (2015) argues that if a central bank is financially supported by the Treasury, for example via a dividend rule which also covers losses, then, regardless of any discretionary transfers from the fiscal authority, the central bank can never be insolvent. Therefore, an institutional setup between the central bank and the Treasury that follows a clear and automatic profit and loss distribution rule is desirable. Stela (1997) points out that a central bank should have an appropriate level of capital to preserves its financial independence from the Treasury in normal times.

General principles for central bank profit distribution. Brunea, Karakitsos, Merriman and Studener (2016) acknowledge that no optimal rule for central profit distribution will be suitable for all cases. An appropriate framework should resolve the conflicting needs of the government's expectations for central bank profits, have a neutral impact on monetary policy and the business cycle, and ensure an appropriate (non-negative) level of capital for the central bank. To this end, the authors point out the following principles: (i) rules should be clear and transparent, (ii) the profit distribution rules should be based on pre-defined criteria, (iii) profit distribution frameworks should be stable over time, (iv) amendments to the profit distribution framework should be subject to consultation with the central bank, (v) profits are distributed only in the absence of accumulated past losses, and (vi) unrealized gains are excluded from distribution.

The distribution of unrealized profits from FX valuation gains varies. A BIS survey[1] confirms heterogeneity in the treatment of unrealized gains, as some countries mark their assets at face value and others at market value while transferring unrealized profits/losses to distribution or to equity. The case of Israel is an important illustration of potential consequences. In 1998, the Bank of Israel earned substantial unrealized gains from the sudden depreciation of the local currency. Due to the distribution rules, the central bank distributed a profit of roughly 10 percent of its assets to the treasury. However, in February 1999, the profits turned into a significant loss, which negatively impacted the bank's equity. The greater the unrealized gains and its volatility, the greater the corrosive effect of the asymmetry. Moreover, for countries with large foreign exchange exposure as a percentage of its assets, the result of asset revaluation, which is composed mainly by the exchange rate, tends to account for a significant part of the central bank profits and losses. After the stress episode in 1999, Israel changed its institutional setup, channeling unrealized gains to a specific revaluation account. On the other hand, unrealized losses are booked as expenses that reduce this buffer.

Minimizing the distribution of unrealized profits is critical to building a robust institutional framework. Best practices call for a rule-based distribution of realized gains. This can be achieved in different ways. In Canada, for instance, there is a restriction of non-negativity of the revaluation accounts which include the FX revaluation. Thus, the unrealized gains/losses are forwarded to a revaluation account in the central bank's equity, which cannot be negative. If a loss were to turn this item negative, the loss is taken to the operating result. The European Central Bank (ECB) directs the unrealized profit for revaluation to a specific account within equity, while the loss is deducted from the account. If the accounts balance is not sufficient to absorb the loss, it is taken to the operating results of the ECB.

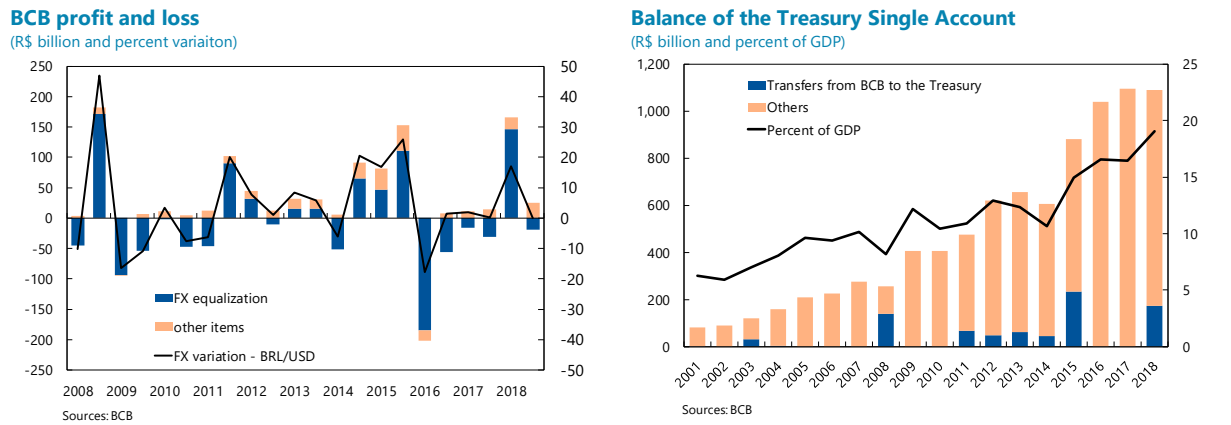
[1] For a detailed explanation, see Archer and Moser-Boehm (2013).

- The first part was the so called "FX equalization" (*equalização cambial*), which singled out the net profit/loss of the international reserves holdings and FX swaps. It comprised of (i) the exchange rate effect on international reserves (valuation gains/losses), (ii) the gains/losses from the foreign exchange derivative transactions carried out in the domestic market (FX swaps), and (iii) the opportunity cost of carrying the reserves.

- The second item refered to the operations of the BCB that are not related to FX operations, such as gains/losses on the the portfolio of government securities, monetary base and repo operations.

- Gains/losses in each of the two items were assessed seminaually, losses are compensated through debt issuances, while gains were transferred to the TSA. From 2008 to mid 2018, the transfers from BCB to Treasury amounted to a large 14.3 percent of 2018 GDP, with 72 percent corresponding to FX equalization. In the same period, the Treasury transferred bonds equivalent to 9.7 percent of 2018 GDP to the BCB, primarily to cover FX equalization losses (97 percent).

Figure 6. Brazil: BCB Results and Transfers to the TSA



Impact on Fiscal Operations

23. The BCB's large balance sheet positions accumulated over the past decade impacted fiscal operations. The financial relations between the BCB and the National Treasury are detailed in different public reports. The 2017 Fiscal Transparency Evaluation (FTE) concluded that the accounting and statistical treatment of the relationship between the BCB and the Treasury could be strengthened to improve transparency (IMF, 2017).

24. BCB profits have been used to refinance public debt. Since 2014, refinancing of debt (both held by the market and the BCB) through new debt issuance represented, on average, just 80 percent of maturing debt (principal and interest). The remainder was financed by various sources, including extrabudgetary financial revenue, which included the BCB's valuation gains (Figure 7). The government accumulated a financial surplus from fiscal operations rather than pay down debt. This helped limit the growth of structural liquidity because net treasury debt repayments would have increased liquidity, necessitating a compensating OMO. On the other hand, this strategy increases the—already large—cash buffer further.

25. Interest revenue on TSA balances has played an increasingly important role. TSA balances, including those originating from valuation gains, generate sizeable interest revenue. This source of revenue, which is not earmarked, has become a relevant factor in fiscal operations. Until 2014, the treasury used TSA interest revenue to repay debt, helping the government to comply with

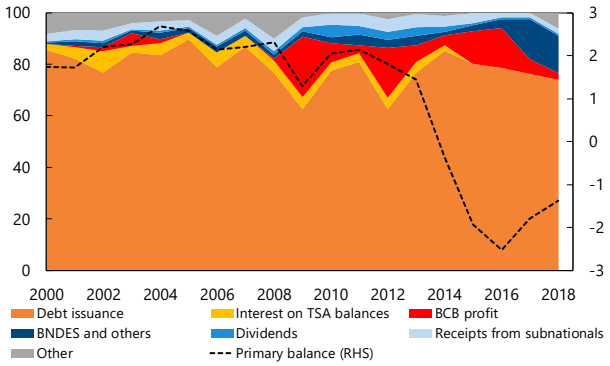
the golden rule. From 2015 onwards, interest revenue from high TSA balances, is also being used to finance primary expenditures (Figure 7).

Figure 7. Brazil: Impact of BCB Profits on Fiscal Operations

BCB profits and interest earned on TSA balances have been used to pay for primary expenditure

How did the Treasury repay public debt?

(Sources of debt re-financing: percent of total, primary balance: percent of GDP)

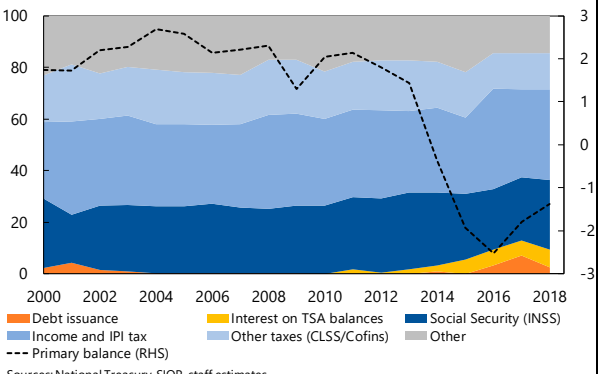


Sources: National Treasury: SIOP, staff estimates.

Interest on TSA balances has been used to finance primary expenditures

How did the Treasury finance primary expenditure?

(Sources of financing: percent of primary balance, primary balance: percent of GDP)

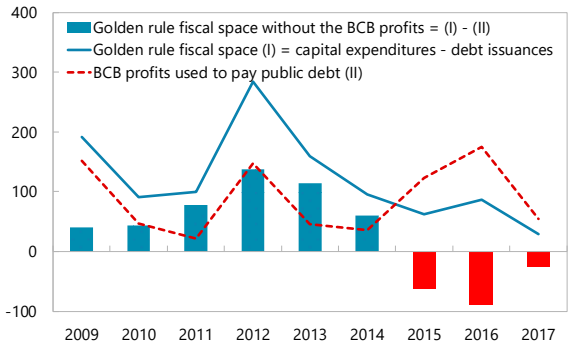


Sources: National Treasury, SIOP, staff estimates.

26. As such, the BCB profits have helped achieve the golden rule. The Constitution prohibits the government from using more proceeds from debt operations to finance the budget than there are capital expenditures, in any given year. In the legal definition, capital expenditures include investments, financial investments, and public debt amortization. The main goal of the rule is to prevent current spending (mainly wages, pensions, health, education) from being debt-financed at a cost for future generations. As a consequence of the institutional setup and specific legal definitions, the space provided by the golden rule has been increased by the BCB's profits; valuation gains credited to the TSA reduce rollover needs. Disregarding the contribution of BCB profits to the government's financial revenue, all else being equal, the golden rule would have become a binding constraint, at least since 2015 (text chart).

Golden rule and central bank profits

(R$ billion)



Sources: National Treasury and SIOPE.

27. Foreign exchange operations have impacted fiscal results. Table 1 summarizes the impact of BCB's foreign exchange operations on different debt perimeters and the golden rule under the old and new framework. The BCB's debt definition does not change with bond issuance to cover valuation losses on international reserves, because these transactions cause a change in debt composition, reducing *compromissadas'* share in gross debt. Valuation gains reduce debt measures if the proceeds are used to reduce debt held by the BCB or the public. The BCB's gross debt definition responds to purchases (and sales) of international reserves and FX swaps gains (and losses), because both operations affect the monetary base and, consequently, reverse repos. The

difference between the BCB's and IMF's concepts is the BCB's FS portfolio, which is affected by valuation losses of international reserves. As long as the FS portfolio is large enough to back the issuance of reverse repos to mop up the monetization caused by a purchase of international reserves or a FX swap loss, the IMF gross debt measure will not be affected by these operations.[6] The *net* debt, in turn, is affected by net changes in the non-financial public sector assets, narrowing the concept sensibility to valuation and FX swaps operations. The new framework (see Section IV) corrected the distortions of international reserves valuation gains/losses on public debt and its side effect on the golden rule.

Table 1. Brazil: Impact of BCB's Foreign Exchange Operations on Fiscal Operations

Operation 1/	Impact on			
	BCB Gross Debt	**IMF Gross Debt**	**Net Debt**	**Golden Rule Fiscal Space**
Valuation **gains / losses** of international reserves				
Old framework				
Valuation **gains** used to reduce BCB-held or market debt	unchanged	decrease	decrease	increase
Valuation **losses** compensated by bonds issued to BCB	unchanged	increase	increase	unchanged
New framework				
Valuation **gains** transferred to reserve account	unchanged	unchanged	unchanged	unchanged
Valuation **losses** compensated by reserve account	unchanged	unchanged	unchanged	unchanged
Acquisition of international reserves	increase	unchanged	unchanged	unchanged
Sale of international reserves	decrease	unchanged	unchanged	unchanged
FX swaps gains	decrease	unchanged	decrease	unchanged
FX swaps losses	increase	unchanged	increase	unchanged

Source: Author's elaboration.
1/ Assumes that the FS portfolio is greater than zero in all scenarios.

High TSA Balances

28. Debt rollover risks call for a cash cushion for debt operations. The government may want to keep a buffer for precautionary purposes to deal with periods in which a large volume of debt is coming due to reduce refinancing risks. This aims to mitigate two types of risk, (i) the need for the government to tap the markets when the issuance cost rises significantly and (ii) temporarily enable payment of debt service in extreme cases where the treasury is exposed to excessively high rates.

29. The opportunity cost of holding large TSA balances is substantial. From a consolidated public sector point of view, government cash buffers have opportunity cost, as reflected in the cost of debt. Debt falling due during a period of high volatility can help determine the upper-bound for the optimal precautionary cash buffer. In the case of Brazil, such a cost/benefit analysis presents a series of particularities which are explored further in Annex 1. An ex-ante analytical toolkit for an optimal buffer for precautionary purposes could enhance the debt management framework.

[6] In a dynamic context, any replenishment of the FS portfolio will affect the IMF's gross debt measure.

30. TSA balances appear to be above the optimal level for precautionary purposes (Appendix 1). The TSA stood at R$ 1.3 trillion (19 percent of GDP) as of December 2018. About half of the balance (9.5 percent of GDP) can be used to repay debt (National Treasury Secretariat, 2019b). Estimates indicate that the TSA's debt cushion could finance debt held by the market coming due in the next 12 months and beyond, well above the 3 months level established as a lower bound by the National Treasury. Using the non-debt-cushion part of the TSA to service debt is possible, but requires legal and accounting changes.

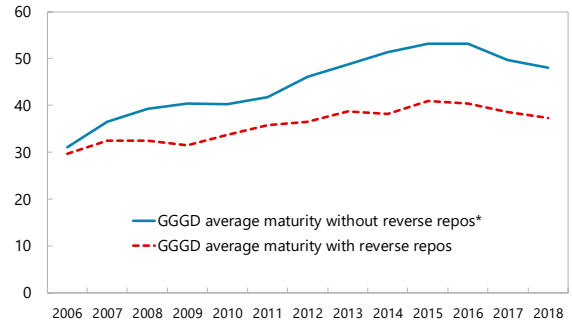
31. The impact on liquidity and market risk perceptions are other factors beyond the precautionary cash buffer that play a role in determining the optimal level of cash balances. Opportunity costs of high TSA balances go beyond financial costs. For example, a reduction in TSA balances through debt redemption would trigger compensating liquidity operations, leaving overall levels of debt unchanged but shifting its composition further to short term debt (see below). The risk aversion of debt managers, broader debt market developments, and risk perception by agents also influence the decision on the size of TSA balances.

Compromissadas and Public Debt

32. *Compromissadas* offer investment opportunities for investors, and as such can be regarded as sovereign debt. The question of the appropriate debt perimeter for Brazil's public debt should not only be viewed from a legal point of view, but also from an investor's perspective. In as much as there are economic reasons to consolidate intra-public sector holdings of government debt—that is, net out the central banks holding of public debt, there are also reasons to consider open market operations as public sector debt, not least because of its large size, very high liquidity, and book value valuation. In fact, investors, domestic and foreign, often see *compromissadas* as opportunities to invest short-term, and Brazil's fund industry has developed financial market products that make monetary policy operations accessible to investors.

33. Including OMOs in the analysis of debt sustainability is thus important to properly and fully assess risks. A key factor is that OMOs effectively transform longer dated debt instruments into short-term collateral debt operations. In other words, longer dated bonds issued to the BCB are used for collateralized OMOs in overnight OMOs. Accounting for this shortens the effective debt maturity profile of public debt significantly (text chart). The OMO investor base is different from the traditional treasury bond investors. Thus, including the short-term investment opportunities offered by OMOs changes the risk profile of public debt. Extreme risk tail events—domestic or foreign—could lead investors to withdraw from participation in OMOs, with significant impacts on liquidity, interest rates, and sovereign re-financing decisions.

Brazil: Average debt maturity
(months)



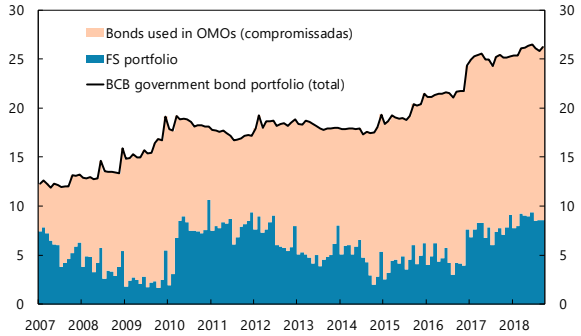
Sources: BCB and IMF staff estimaets.
* Computed using the maturity of domestic public debt as a proxy for public debt

D. International Experience and the 2019 Reform

Institutional Incentives and International Experience

34. Under the old framework, the incentives of the Central Bank and the Treasury were not fully aligned. Bond issuances to the BCB are costly for the Treasury, because they pay interest and, in addition, their issuance does not generate any cashflow.[7] The central bank, in turn, has an incentive to hold a large portfolio of free securities (FS), to ensure it has sufficient firepower to manage liquidity.[8] As a result, an equilibrium emerged in which the Treasury needs to finance the debt service of the Free Securities portfolio, increasing its own rollover needs, while the BCB's monetary policy action was subject to a not legally enforceable action by the Treasury.

Liquidity Management
(percent of GDP)



Sources: BCB

35. Aligning incentives—and with it, debt and liquidity management tools—could help bring about a better equilibrium. A setup in which the BCB's holding of government debt is set automatically to match the necessary stock of reverse repos, for example, would eliminate the FS portfolio, lower costs, and increase efficiency. The treasury's interest rate payments would be lower without constraining the BCB's capacity to execute monetary policy. Further, the difference between the analytical debt perimeters would be eliminated, improving communication with investors.

36. International evidence points to a diverse set of liquidity management frameworks. Table 2 summarizes the institutional setup for various countries. Three conclusions can be drawn from international experience. First, there is no single or predominant instrument for liquidity management; most Central Banks use a combination of different instruments. Second, the use of government bonds to sterilize liquidity is not unusual. Finally, several central banks do not rely on automatic capitalizations from the Treasury, meaning that potential losses are covered by Central Bank's buffers or future profits.

[7] When receiving direct issuances, the BCB obtains a securities portfolio of its choice at prevailing market rates. The BCB does not participate in debt auctions, thus avoiding any price influence.

[8] Under the old framework, the supply of securities to the BCB was based on an ordinance from the Minister of Finance (241/2009) which set the lower bound for the free security portfolio to R$ 20bn. Given its low legal hierarchy, the ordinance lacked enforcement options.

Table 2. Liquidity Management: International Experience				
Country	**Structural liquidity (percent of GDP, 2018)**	**OMO instruments**	**CB uses central government bonds for liquidity management**	**CB can draw on exogenous resources to cover losses**
Brazil	15.8	reverse repos	yes	Yes
Chile	6.3	time deposits and CB bonds	no	No. Losses are accommodated by buffers and / or future profits
Denmark	6.6	certificates of deposits	no	No. Losses are accommodated by buffers and / or future profits
Iceland	7.6	Time deposits	no	No. Losses are accommodated by buffers and / or future profits
Israel	17.1	time deposits and CB bonds	no	No. Losses are accommodated by buffers and / or future profits
Korea	4.7	reverse repos, time deposits and CB bonds	yes	Yes
Mexico	0.4	Treasury and CB bonds	yes	No. Losses are accommodated by buffers and / or future profits
Peru	8.5	Time deposits and certificates of deposits	no	Yes
Philippines	1.8	reverse repos and time deposits	yes	No. Losses are accommodated by buffers and / or future profits
Poland	2.3	CB bonds	no	No. Losses are accommodated by buffers and / or future profits
Sweden	7.3	certificates of deposits	no	No. Losses are accommodated by buffers and / or future profits
Thailand	20.4	reverse repos and CB bonds	no	No. Losses are accommodated by buffers and / or future profits
Uruguay	13.6	CB bonds	no	Yes

Sources: CB financial statements and BIS Central Bank Finances (2013).

37. The optimal choice of liquidity management instruments depends on a variety of factors. The institutional setup should not constrain the Central Bank's ability to execute OMOs. This is especially critical for Central Banks that rely only on government bonds for liquidity management. Using a range of instruments can be useful for central banks to accommodate different market preferences and liquidity conditions.[9] Regarding the cost of monetary policy, macroeconomic conditions and the level of the policy rate will primarily determine the cost of liquidity management operations, while the choice of instrument plays a secondary role. Nyawata (2012) highlights that the

[9] The IMF's 2018 Financial System Stability Assessment recommended BCB issued securities as an alternative structural sterilization instrument. Remunerated term deposits are an alternative tool to sterilize liquidity, but they may not fully align within asset managers' investment mandates (IMF, 2018b).

use of treasury bills could be the first best option to mop up surplus liquidity, when the CB has operational independence, financial markets are developed, and monetary policy transmission channels work properly.

38. Commitment of the fiscal authority to back the central bank's losses is critical in a structural liquidity surplus environment. OMOs to drain structural liquidity are costly due to the underlying interest rate expenditures. Depending on the dynamics of other items of balance sheet, this cost may offset *seignorage* income, jeopardizing the Central Bank solvency over time.

The 2019 Reform

39. The 2019 reform redesigns the relationship between the Treasury and the BCB. In summary,[10] the new framework (i) changes the rules of profit and loss distribution, (ii) enhances monetary policy execution and (iii) improves public debt management. The modifications better align incentives of the Central Bank and the Treasury, secure the Treasury's backing of BCB's losses, and allow to significantly reduce the costly FS portfolio.

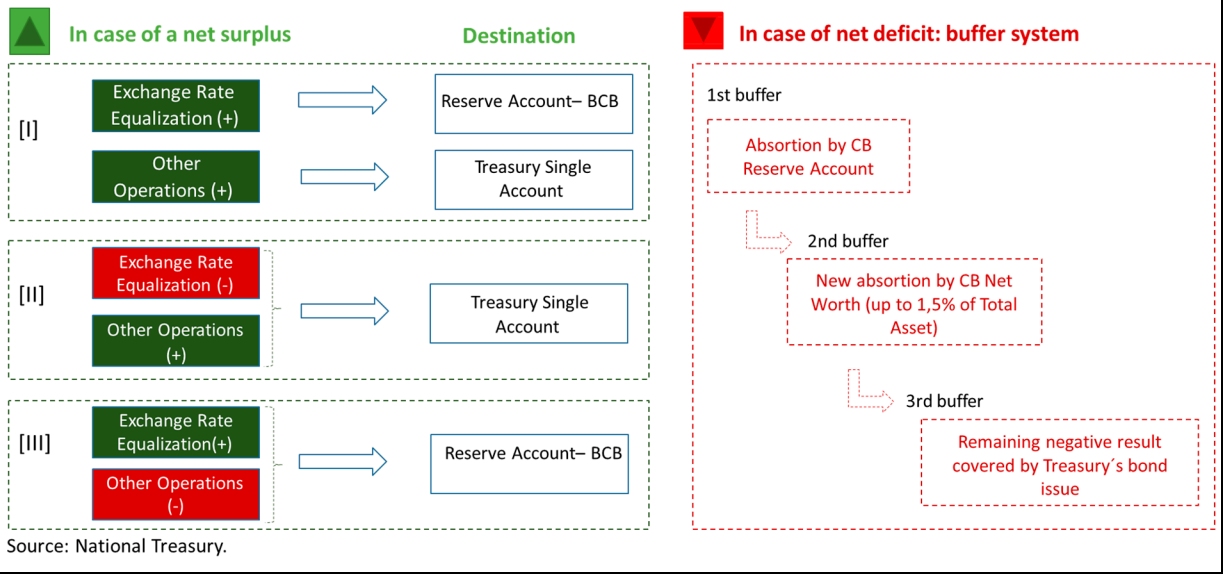
40. Unrealized gains will no longer be credited to the TSA. (Figure 8). Profits from FX holdings will now flow into an accounting reserve in the balance sheet of the BCB. This reserve will be used to cover future losses. In case the reserve is insufficient in a given year, the remainder will be covered by BCB's net worth, until this reaches 1.5 percent of its assets. If this mechanism still leaves a loss to be covered, the Treasury will automatically issue securities to the BCB.

41. The new profit distribution scheme will thus make the Golden Rule more effective. More generally, the changes will reduce the frequency and magnitude of transfers between the Treasury and BCB, eliminating the possibility of indirect coverage of primary expenses with funds derived from the BCB's FX results. The distribution of unrealized FX valuation gains has been a relevant source of revenue for achieving the golden rule in the past. The golden rule is set to regain economic significance even in its current form.

42. Monetary policy execution and Central Bank solvency will be placed on a firmer footing. After the reform, when the FS portfolio reaches a lower bound of 4 percent of total BCB's bond portfolio, the Treasury will automatically issue new securities so that the FS portfolio reaches 5 percent of the total BCB's bond portfolio. In addition, should the reserve account buffers be insufficient to accommodate a BCB loss, the treasury will have a legal obligation to cover any remaining losses, guaranteeing the BCB's solvency. The mandatory nature of these mechanisms is critical to eliminate discretionary actions, thereby strengthening the monetary framework.

[10] See National Treasury Secretariat (2019a).

Figure 8. Brazil: BCB Profit Distribution under the New Framework



Source: National Treasury.

43. The reform stops the ratchet effect of FX volatility on public debt and paves the way to reduce the FS portfolio to the minimum necessary. The BCB's securities portfolio will no longer grow due to the coverage of losses arising from FX operations. Furthermore, the reform paves a way to cancel a portion of the FS with BCB's net worth, which jumped from 0.04 percent of GDP in end-2007 to 1.9 percent of GDP in end-2017. As a result, the level difference between the BCB's and IMF's debt perimeter definition can be reduced.

E. Conclusion

44. How was the structural liquidity surplus built up over time? The growth of BCB's reverse repos is mainly explained by four factors: (i) the effect of FX reserve accumulation, (ii) an expansionary fiscal policy (in particular from 2015 onwards) (iii) debt rollover rate less than 100 percent, and (iv) the compounding effect of high interest payments on the existing stock of reverse repos.

45. The old framework facilitated compliance with fiscal rules, impacted debt management, and provided indirect coverage of expenditure with funds derived from the BCB's FX results. The TSAs balance has regularly been boosted with unrealized FX valuations, which reduced the Treasury's debt rollover needs, and as a result, also helped the government to comply with the Golden Rule. BCB profits and interest on TSA balances have been used to refinance debt and finance primary expenditure, respectively.

46. The setup has entangled monetary, exchange rate, and fiscal policies. Exchange rate policies (NIR accumulation, FX swaps) have a bearing on the fiscal deficit and public debt trajectory, while high interest rates perpetuate liquidity, triggering more OMOs, which in turn increase public debt. As the stock of OMOs has increased and debt rollover rates have fallen, investors have increased their exposure to short-term liquidity management instruments as an alternative to short term treasury bills.

47. The 2019 reform will reduce financial flows between the two institutions, but they do not address the high stock of TSA balances, NIR, and OMO. Holding unrealized FX valuation gains within the BCB's balance sheet reduces the flows between the Treasury and the BCB. The reforms are therefore important to contain the continued growth of the imbalances. Over time, this will reduce the size of the BCB's balance sheet relative to GDP. Addressing the stock problems could be subject to further research.

48. The size of the government's cash buffer should be reviewed. In international comparison, Brazil's TSA stands out, mostly due to the idiosyncrasies of the current institutional framework and the earmarking of TSA's sub-accounts to serve specific budget needs. But holding a large cash buffer has a high opportunity cost. Therefore, within a new operational framework, a portion of the TSA could be used to repay the free securities FS portfolio, improving public debt dynamics and closing the gap between the BCB's and IMF's debt perimeter.

49. The role of the Treasury, and fiscal policy more generally, to curb the structural liquidity surplus could be strengthened. The Treasury could contribute to controlling structural liquidity not only by speeding up the fiscal consolidation, but also by envisaging higher rollover rates of its securities. Blommestein and Turner (2012) argued that public debt managers should move from micro portfolio mandate towards one that incorporates macroeconomic considerations to enhance the coordination of public debt operations with monetary policy. In this sense, consideration could be given to mandate that the Treasury operations have at least a neutral impact on liquidity, in normal times.

50. Full central bank independence and the expansion of the liquidity management toolkit are key milestones to be achieved. The new institutional setup ensures the BCB's solvency and provides a legal basis for the Treasury to issue bonds to back monetary policy execution. Looking ahead, it remains desirable to grant the central bank full *de jure* independence, and expand its toolkit to include additional instruments to manage liquidity, in line with the experience of other Central Banks.

Annex I. An Optimal Cash Buffer for the Government

Determining the Benefit Calculation Formula

1. To calculate the benefit for the government of holding cash at the CB, we assume that this benefit derives from the ability of using such cushion to stay out of the market when financial conditions are abnormally tight. Such benefit arises to the extent that the rise in interest rates on government securities is temporary. In the case of permanent or prolonged elevations, the benefit is depleted because, once the fund for rainy days has been used up, the Treasury has to re-access the market and face the same rates it sought to avoid. The benefit is therefore defined as:

$$B = [(1 + \Delta ACI)^M - 1] * d \qquad (1)$$

ΔACI is the change in the average cost of issuance during the period of high volatility;
M is the average maturity of debt issuance; and
d is debt coming due during the period of high volatility.

2. This definition assumes that there was a moment of volatility in the market where the cost of financing rose. During this period, the Treasury cut off its issuances and ceased to refinance a debt volume of *d*. After that period, the cost of financing declines and the Treasury resumes its issues. By interrupting its issuances, the Treasury ceased to issue volume d, with an increase ΔACI in its issuance cost. This potential additional cost, which was no longer incurred, would obviously not be limited to the period of volatility but would extend over a period equivalent to the average issuance maturity.

3. Equation (1), however, is incomplete from the point of view of the consolidated public sector, which includes the CB. The matured volume *d* that is no longer refinanced increases market liquidity and must be sterilized by the CB. To this end, the CB uses open market operations because they are of short duration, and they have an approximate cost of the policy rate. Thus, the complete formula of the consolidated public-sector benefit obtained by the existence of a buffer becomes:

$$B = \left[(1 + \Delta ACI)^M - (1 + PR - ACI)^{M'}\right] * d \qquad (2)$$

M' is the duration of the period of high volatility; and
PR is the policy rate.

4. Equation (2) builds on simplifying assumptions. It assumes that debt maturing in the period of volatility would be fully refinanced. It also considers that, once the period of volatility is over, the Treasury will be able to recompose the TSA immediately. Despite these shortcomings, it is a good approximation for preliminary analyses on the benefits of holding a cash cushion.

Determining the formula for calculating costs

5. In the cash management of private companies, the treasurer is aware of the opportunity cost of keeping the company's financial resources in the form of cash. If the money is not going to be used right away, it should be invested to maximize profits. In this case the opportunity cost would

be the profitability that the treasurer would achieve by applying the surplus of net financial resources in the company's investment or in financial markets. However, the cash management of a government is more complex. Consequently, the calculation of the opportunity costs is more intricate and depends on the relationship between the Treasury and the CB, as well as the impact of treasury operations on money market liquidity, especially from the viewpoint of the consolidated public sector.

6. The opportunity cost of central government of holding a buffer for rainy days (*b*) is the Average Cost of its debt (AC). However, consistent with the best practices,[1] the CB should remunerate this buffer according to the Market Rate (MR). Hence, we can represent the cost incurred by the Treasury as:

$$C_T = [(1 + AC)^M - 1] * b - [(1 + MR)^M - 1] * b \qquad (3)$$

7. The CB, in turn, suffers the cost of remuneration paid to the Treasury due to *b*. Moreover, we assume that b was built up via public debt issuance. However, if the Treasury decides to maintain its cash buffer instead of spending it, the monetary authority has an implicit return, as the CB will not have to wipe out liquidity at the cost of PR. Thus, the effective cost of the CB can be represented by:

$$C_{CB} = [(1 + MR)^M - 1] * b - [(1 + PR)^M - 1] * b \qquad (4)$$

8. Considering an institutional arrangement that establishes that the CB's profit/loss must be backed by the central government, the underlying cost of holding a fund for rainy days should cover the costs incurred by both the Treasury and the CB. Equation (5) shows that the cost can vary a lot, depending on the evolution of the average cost and policy rate, in such way that it can turn negative if the average cost of debt is lower than the policy rate.

$$C = C_T + C_{CB}$$
$$C = [(1 + AC)^M - (1 + PR)^M] * b \qquad (5)$$

9. We can analyze the net benefit (NB) of holding a buffer through a simple maximization exercise, in which *b* is the control variable and the other ones are exogenous parameters.

$$NB = B - C = \left[(1 + \Delta ACI)^M - (1 + PR - ACI)^{M'}\right] * d - [(1 + AC)^M - (1 + PR)^M] * b$$

benefit factor = $\left[(1 + \Delta ACI)^M - (1 + PR - ACI)^{M'}\right]$

cost factor = $[(1 + AC)^M - (1 + PR)^M]$

$$\max_b \left[(1 + \Delta ACI)^M - (1 + PR - ACI)^{M'}\right] * d - [(1 + AC)^M - (1 + PR)^M] * b \qquad (6)$$

[1] See Yaker and Pattanayak (2010). In Brazil, the cash of the debt is deposited in the single account that is remunerated by the Central Bank at a rate equivalent to the intrinsic income of the Treasury bonds in the Central Bank's portfolio.

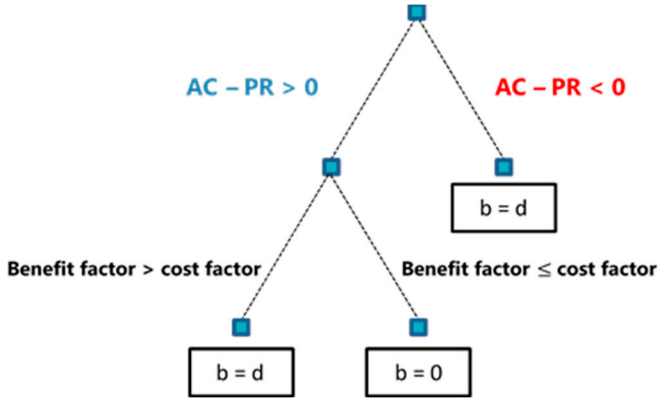
10. As equation (6) represents a linear maximization, it is enough to study the determinants of the signals to find their inclination (positive or negative), aiming to estimate the optimal buffer.

11. In this way, we can find three cases in response to the maximization problem. The first case appears when the spread (AC - PR) is positive. Consequently, the objective function of the maximization exercise becomes negatively sloped. In this situation, the initial response would be that the optimum cushion equals zero. However, a more careful examination, analyzing a neighborhood in which $d \cong b$, reveals two different outcomes.

12. First, if the benefit factor is greater than the cost factor, the optimum buffer is equal to the volume that would be refinanced during the period of volatility (*b*). The economic interpretation of this result speaks to the microeconomic theory of insurance. In this sense, the insurance's fair value is equal to the expected loss (i.e., the debt coming due). Second, if the benefit factor is lower than the cost factor, then *b* does not act as a fair insurance. As a result, equation (6) becomes negatively sloped and, consequently, the optimum buffer equals zero.

13. The third case occurs when the spread (AC - PR) is negative. Thus, it is easy to see that equation (6) becomes positive sloped, and therefore, *b* goes to infinity. However, this situation is temporary because AC typically lags PR in monetary cycle. Considering a debt manager is averse to risk, it is reasonable to include a constraint in (6) that $b \leq d$. Therefore, the best response is to hold a buffer that equals *d*.

Figure 1. Optimal Buffer for Precautionary Purposes



Source: Authors' elaboration.

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