TESOURONACIONAL

REVISTA
CADERNOS DE FINANÇAS PÚBLICAS

03 | 2022

Apoio:

BID
Banco Interamericano de Desenvolvimento

EXTRAORDINARY PERFORMANCE IN THE PUBLIC SECURITIES MARKET - THE EXPERIENCE OF THE BRAZILIAN NATIONAL TREASURY

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Abstract

This article analyzes the adoption of extraordinary actions in the public securities market carried out by the Brazilian National Treasury, encompassing aspects related to the country's macroeconomic, financial, and institutional structure. It sought to understand the main elements, tools, contexts, and underlying factors that have been present over time. Using a probit model and principal component analysis, it was found that the National Treasury performs extraordinary actions based on important financial market volatility indicators and seeks to minimize this type of action, privileging market adjustments.

Keywords: Debt Management, Extraordinary Actions, Liquidity Reserve, Liability Operations.

JEL: H630, C530.

SUMMARY

Introduction

The global financial and sovereign debt crises observed in recent years, as well as the mutual influence between various markets, have brought about important changes in the conduct of economic policy in several countries. The need to guarantee the functionality of the financial system and, simultaneously, to respond to macroeconomic adversities has increased the interaction between fiscal, monetary, and debt management policies. In the face of this environment, even considering the advances made in Brazilian public debt management[1], at times the National Treasury has had to carry out extraordinary actions in the public securities market, with the objective of reestablishing normalization of operations.

The diagnostic characterization of these moments is complex, involves intense monitoring of the economic-financial conditions and the use of appropriate instruments. The evaluation of the level of uncertainty, market volatility and liquidity reserve volume[2], as well as the need for assertive communication with investors, are examples of important elements. Therefore, with the objective of understanding the main vectors related to the extraordinary actions of the National Treasury in the domestic public securities market in more recent years, an analysis was made of the debt management framework, as well as the particularities of the Brazilian case, such as the increase in uncertainties over the last decade, the difficulties in implementing an economic reform agenda, official credit policy and the institutional arrangement of the relationship between the National Treasury and the Central Bank of Brazil (BCB).

These idiosyncrasies have contributed to create atypical conditions that have allowed the country to live with a comfortable situation of available resources to meet its obligations, even in the face of an environment of fiscal deterioration. In other words, the National Treasury was able to maintain a positive condition from the point of view of solvency[3] and efficiency of the public securities market, despite having to deal with the adversities resulting from the challenging perspectives for debt sustainability. However, at specific moments in time, unfavorable conditions (including the weakening of fiscal results) increased uncertainties and had direct repercussions on the public securities market.

Against this backdrop, this article analyzes the use of extraordinary actions by the National Treasury, covering aspects related to the country's macroeconomic, financial and institutional structure. It sought to understand the main elements, tools, contexts, and underlying factors that have

1 Since the early 2000s, the National Treasury has managed to significantly change the profile of the Federal Public Debt (DPF). The joint share of debt with remuneration tied to exchange and interest rate variations was significantly reduced. This period also witnessed a smoothing of the maturity structure and a deepening of the public securities market.

2 The liquidity reserve corresponds to the amount of funds deposited in the Single Account of the National Treasury with free availability to be used in expenses related to the debt budget.

3 The concept of solvency refers to the government's ability to honor its obligations. Under normal conditions, the government collects resources from society, usually through taxation or debt issuance, to meet its obligations. The concept of sustainability, on the other hand, is concerned with the ability to pay the debt in the future. A country may present good solvency conditions, but face restrictions to remain sustainable. On the other hand, a government may have good economic prospects, but find it difficult to honor its short-term obligations.

been present over time. Using a probit model and principal component analysis, it was verified that the National Treasury carries out extraordinary actions based on important financial market volatility indicators and seeks to minimize this type of action, privileging market adjustments.

The following sections present aspects that help the reader understand the structure of public debt management in Brazil, such as the interaction between fiscal and monetary policies, liability management operations, and the importance of the liquidity reserve. In the next section the reader has a brief description of the extraordinary actions of the National Treasury from a historical perspective. Then, an econometric model is estimated that provides evidence of the main financial variables for extraordinary actions, an evaluation that is complemented through principal component analysis. Finally, final considerations are presented.

Public Debt Management

The purpose of this section is to briefly describe the processes related to public debt management. At the macroeconomic level, the interaction between the public debt, fiscal policy and monetary policy is highlighted, as well as the importance of coordinating these fronts for the efficiency of the economic-financial system. In the specific scope of debt management, the instruments available to achieve the objectives related to the financing process are explored. In this sense, we highlight the activities of improvement of the public securities portfolio and management of the liquidity reserve, focusing on the institutional arrangement, indexer composition, maturity structure and, mainly, risk mitigation. Finally, emphasis is given to the main extraordinary action tools available to the National Treasury.

Liability Management Operations

Liability management is the process by which changes are sought in the existing stock of public debt with the objective of improving the debt profile, given previously defined guidelines. These operations are generally not aimed at providing additional short-term financing capacity, with the highlight being repurchase and exchange operations with the focus on risk management. However, despite the strategic nature, liability management operations have been increasingly used for different purposes, such as support in situations of market stress, cost reductions and diversification of the investor base [BM (2015)].

Faced with the spectrum of risk assessment, it is important to dimension which of the risks inherent in the public financing process can hinder the achievement of the debt manager's objectives. The literature usually groups these risks mainly in the following categories (a) market risk, related to movements in economic and financial indicators such as interest and exchange rates; (b) rollover/ refinancing risk, which refers to the ability to renew a particular debt exposure upon maturity; (c)

liquidity risk, which refers to the availability of sufficient demand for a specific debt instrument without generating price distortions; (d) credit risk, which is associated with the ability to meet obligations; and (e) operational risk, which includes technological aspects and settlement procedures [IMF and WB (2014)].

The public debt manager usually has a range of instruments available to mitigate these risks, and consideration of the economic scenario is very relevant in defining the liability management actions that will be adopted. In normal situations the traditional instruments available to achieve the specific debt management objectives, especially repurchases and exchanges of securities, stand out. In crisis cases, on the other hand, a broad spectrum of actions may be necessary, including extraordinary actions with repurchases and exchanges of public securities, simultaneous purchase and sale auctions, cancellation of auctions or, at the limit, debt restructuring. Papaioannou (2014) highlighted, for example, the use of repurchase or bond exchange operations as tools to deal with high levels and inadequate public debt structures, as well as to reduce related vulnerabilities.

The process of implementing actions to reach the debt manager's objectives generally allows for the distinction between planning activities[4] and operational management[5] which, despite being integrated, emphasize different time perspectives for the actions. In the set of planning activities, the analysis of the structural conditions of the economy gains relevance, and it is worth mentioning the tools that emphasize the medium and long term time frame, which tend to be applied with the following purposes: to reduce the refinancing risk associated to the debt maturity structure, to accelerate the process of improving the debt composition, to reduce the cost of financing, as well as the projection of cash flow.

Within the scope of operational management activities, in turn, activities related to short-term actions tend to gain relevance, such as the monitoring of the market conjuncture, the evaluation of price formation, the fine-tuning of the debt strategy and the timely diagnosis of exceptional situations. In this case, the activities designed to contribute towards stimulating liquidity and correcting distortions in the secondary public bond market[6] should be highlighted. The actions directed at stabilizing the market and reestablishing transparency in the formation of prices tend to be adopted during periods of stress.

Considering this broad spectrum, the public debt planning framework developed by the National Treasury highlights the importance of intertemporal programming capable of providing transparency, predictability, and timeliness. In fact, the objective, guidelines, and optimal composition formalize the desired cost and risk structure for the public debt over the long term. The transition

4 Activities associated with determining the overall objectives and guidelines.

5 Activities associated with day-to-day operations with government bonds, related to the market and business.

6 The ability to withdraw undervalued securities from the market and to refinance high coupon bonds, for example, allows market distortions to be corrected and also helps to ease the government's budget constraint.

strategy between the present moment and the long term, called medium-term planning, emphasizes the macroeconomic scenarios and the degree of development of the debt market to determine the speed of transition. Short-term operations, in turn, are guided by the Annual Borrowing Plan (PAF) and monthly tactical management by the Public Debt Management Committee (COGED)[7], with emphasis on the analysis of current market conditions and their implications on the borrowing process.

Despite the potential benefits of liability management operations, the execution of the financing process prioritizes traditional actions through public offerings with competitive auctions, and predictability is an important attribute promoted, for example, through the disclosure of an issuance calendar. Therefore, liability management tools tend to be used in a complementary manner, as potential catalysts towards the optimal debt composition in moments of favorable economic conditions or as buffers when unfavorable market conditions are observed.

Despite this consideration, the use of liability management tools has been increasingly frequent. Blommestein et al. (2012) report that, among OECD countries[8], repurchase transactions are more frequent than swap transactions, being used by more than 80% of the debt managers consulted. In addition, almost 30% of managers stated that they use buybacks regularly[9]. The authors also identified that, after the 2008/09 financial crisis, many debt managers started to increase liquidity reserves, issuing above the funding need to expand equity flexibility and reduce the risks associated with refinancing capacity and possible adverse shocks.

Therefore, extraordinary actions should be treated as being of an auxiliary nature. The possibility of holding extraordinary auctions may bring greater stability and security to the public bond market, if it does not jeopardize the regularity of the ordinary issuing process. It is still appropriate to point out that the use of these tools tends to depend on the degree of development, particularities of each economy, sophistication of the public bond market and specialization of the debt managers.

The Liquidity Reserve

Regardless of the size and development of local government bond markets, maintaining a liquidity reserve has been a common practice among debt managers. The stated objective of liquidity reserve management is generally directed at maintaining timely resources to ensure that obligations can be met in an efficient manner. Of course, the measures to ensure the availability of resources and the options exercised to invest or retain surplus resources have risk and cost implications, so

7 The National Treasury Ordinance No. 426, dated June 25, 2019, establishes the COGED's actions.

8 Organization for Economic Cooperation and Development (OECD).

9 The form of action may differ among the thirty-three countries surveyed. The French government conducts operations in the secondary and primary market (reverse auction), while the German government operates buybacks in the secondary market on a daily basis, without warning the market and without disclosing statistics of the operations. The Japanese government, on the other hand, conducts monthly auctions. There are also those countries that prefer to adopt an ad hoc methodology for carrying out buyback operations, such as Italy, which carries out extraordinary auctions using resources from eventual fiscal surpluses and extraordinary revenues.

that inappropriate practices and dysfunctional institutional arrangements can undermine the implementation of government policies.

The main approaches used for liquidity reserve management are the traditional and the modern. The first emphasizes the need to maintain a considerable reserve of resources to ensure that payments are honored in a timely manner, and is characterized by prudence, a passive attitude, and a low emphasis on opportunity costs. The modern view, on the other hand, seeks to guarantee the government's obligations by minimizing the resources retained. In this case, the notion of efficiency is present due to the restriction of opportunity costs associated with maintaining the liquidity reserve.

Cruz and Koc (2018) conducted a survey with debt managers from OECD countries and identified that for them the liquidity reserve has the capacity to assist in the fulfillment of obligations, to mitigate refinancing risk, to increase market confidence, to allow dealing with eventual volatilities in demand at bond auctions or with the occurrence of temporary loss of market access. The authors pointed out some stylized facts among the countries researched: i) the main mechanisms for accumulating resources are issues in volumes greater than maturities and positive primary fiscal results; ii) the reference for a liquidity reserve is defined in number of months of debt service coverage; iii) the need for a liquidity reserve is heterogeneous among countries, oscillating between one week and one year; iv) the most common practice is to maintain a level of reserve sufficient to cover budget expenses (including debt redemptions) for one month[10].

In the Brazilian case, the National Treasury has a debt management organizational structure that divides its attributions between back office (registration, control, payment, and accounting activities), middle office (medium and long-term strategy activities) and front office (short-term strategy activities and operationalization of security issues). From this perspective, the mandate of the Brazilian debt manager involves activities related to the process of indebtedness and cash flow for payment of the debt, characterizing a double mandate, which has in the liquidity reserve an important management instrument.

However, part of the liquidity reserve of the Brazilian debt in more recent years did not necessarily result from the deliberation of using traditional tools for accumulating resources, but from the relationship structure between the National Treasury and the BCB[11] and the partial reversal of the Federal Government's credit policy, especially the early liquidations of credit operations with the BNDES[12]. This notion should be considered because the country began to live with relevant primary

10 Interestingly, in the case of Portugal, the reference value of the liquidity reserve was determined by analyzing the debt redemption profile and expectations of deviations based on revenue and expenditure. The indicative level in 2018 was 40% of the gross funneling requirement in the following 12 months. The Turkish government, in turn, defines the liquidity reserve as the level of cash and other credit allocations readily available to support severe liquidity strains for shorter periods. However, the actual reference level and currency composition of the liquidity reserve is kept confidential, considering that the disclosure of its level may compromise the efficient functioning of operations.

11 See Bacha, E. The Brazilian Fiscal and Monetary Crisis. Rio de Janeiro: Civilização Brasileira, 1st ed.

12 National Bank for Economic and Social Development.

deficits since 2014 but did not present difficulties in honoring its obligations even in the most critical situations.

The policy of accumulating international reserves, established with the main objective of mitigating the vulnerability of the external sector, began to have an increasing impact on the results of the monetary authority from the end of the decade of 2000. A distortion resulting from this new condition was the contamination of the BCB's results by exchange rate volatility. In moments of increased uncertainty, in particular, the depreciation of the exchange rate contributed to the positive results of the BCB balance sheet due to the mark-to-market of the international reserves, which obliged the monetary authority, due to legal requirements, to pass on the profits in cash to the National Treasury. In other words, a mechanism was established whereby the liquidity reserve tended to have an extra source of supply in adverse situations.

In addition, it should be considered that the funds deposited in the Single National Treasury Account receive the average yield of the federal government bonds held in the BCB's portfolio. Although the destination of this revenue is free, with no specific link to debt payments, it is a source that helps to mitigate the need for new issues or primary resources to finance the Federal Government's Budget. In other words, a high volume of funds in the Single Account increases financial revenues for the National Treasury, ceteris paribus.

Thus, the institutional arrangement of the fiscal and monetary authorities contributed to create a condition of decoupling between solvency capacity and the need for primary fiscal results, the latter being fundamental to guarantee debt sustainability. The adverse implications of this construction led to a change in the legal bases that define the relationship between the National Treasury and the BCB.

Despite the impact that the existing institutional arrangement has had on other dimensions of public finances, the Single Account resources allocated to the liquidity reserve have shown an upward trend over the years, with the volumes reaching a capacity to honor more than three months in domestic and foreign currency, a level that the National Treasury considers important to anticipate periods of greater concentration of maturities, to mitigate risks and to avoid pressuring the cost of the debt.

Extraordinary Performances

The dimensions of cost and risk are clearly observed in the definition of the objective function of debt management in most countries[13]. In the case of DPF management, the objective disclosed in the planning is

> "efficiently supply the Federal Government's financing needs, at the lowest cost in the long term, while respecting the maintenance of prudent risk levels and, additionally, seeking to

13 See the Appendix Table.

contribute to the proper functioning of the Brazilian public securities market" (STN, 2018, emphasis added).

This is the initial framework for the definition and analysis of the National Treasury's financing actions. The consideration of a contribution to the proper functioning of the bond market is an important attention. By placing the government bond market within its objective function, the manager of the public debt must have instruments available that will help the market towards an efficient path.

It is from this perspective that extraordinary debt operations should be interpreted, when the dysfunctionalities of the public securities market become apparent. These moments are usually marked by expressive price volatility, losses in reference rates, a significant decrease in the number of daily trades, an opening in the spreads between buying and selling, etc. Under these conditions, the public debt authority may evaluate in a discretionary manner the relevance of acting to reestablish market fundamentals and efficiency.

From a legal point of view, the regulation that defines the attributions of COGED[14] assures the possibility of extraordinary meetings so that the Committee can deliberate on matters within its competence in a timely manner, which brings flexibility to the process.

However, from a practical point of view, one of the greatest challenges for the debt manager is to effectively characterize the market conditions. Broadly speaking, two situations may be classified: i) market repricing - when there is a permanent increase in the yield curve to a new level; and ii) loss of reference - moments in which the yield curve temporarily gains level and/or inclination but returns to levels compatible with the historical average or those previously registered. It is difficult for the debt manager to establish ex-ante which of the two situations the market is in. However, in both situations, the presence of the debt authority can help in determining market equilibrium, whether by safeguarding investors or helping to minimize the asymmetry of information between investors and savers in the price formation process, or by making use of reputation and/or signaling to give direction to the market.

A precise diagnosis helps define the instruments and intensities of the actions available to the debt manager. Table 1 lists the main tools that can be used by the National Treasury for action:

14 National Treasury Ordinance No. 426, dated June 25, 2019, which defines COGED's attributions, points out in Art. 7 that the COGED president may call extraordinary meetings to deal with matters within the Committee's competence, such as defining the annual financing strategy for the DPF and limits for its indicators, auction schedules, establishing the monthly strategy for the DPF, and deliberating on other matters related to DPF management.

Table 1 - Extraordinary Actions by the Debt Manager

Shares	Description
Reduction of Lots from Scheduled Auctions	A change in the level of issues in relation to historical or programmed levels can help reduce the pressure on the yield curve or on the premiums of pre-fixed securities. This type of action tends not to put significant pressure on the level of liquidity reserve.
Auction Cancellation	The cancellation of scheduled auctions due to risk aversion or the need for a more precise diagnosis of the economic fundamentals can avoid the endorsement of distortions in the price formation process. The existence of a reasonable liquidity reserve is a necessary condition for this type of action.
Issuance of Floating Bonds	The characteristics of domestic demand favor the issuance of these securities, which help to increase the liquidity reserve and the debt maturity, in addition to mitigating pressure on the yield curves. However, at times when interest rates are excessively low, the attractiveness of these papers may decline. This type of action helps the management of market assets and liabilities, raising the interest rate risk of the public debt, with the benefit of reducing the refinancing risk of the debt.
Short-Term Issuance	The characteristics of domestic demand favor the issuance of these securities, which benefit the increase in the liquidity reserve in the short term. Although they favor the management of market assets and liabilities, they maintain pressure on market and debt refinancing risks.
Procurement	They can be useful in acute liquidity constraints, helping to provide liquidity to the holder of the security and mitigate adverse impacts on the financial market. Holding a considerable amount of liquidity reserve is a necessary condition for this action.
Simultaneous Purchasing and Sales	They can be useful in moments of liquidity restriction in the secondary market of government bonds, helping to establish a price reference for the market. An adequate level of liquidity reserve is a necessary condition for this type of operation.
Exchanges	They can help match investors' portfolios to market conditions. Swapping different securities, either in terms of maturity or indexers, can mitigate pressures on the government bond market. They do not put pressure on the level of liquidity reserve.

Source: authors.

Caution in the use of these market intervention tools is a desirable attribute. International practice does not recommend extraordinary actions to achieve short-term public debt cost objectives. Opportunistic use for this purpose can weaken the credibility of the debt manager and harm the integrity of the financing process, even hindering the development of the market and raising long-term costs. Attention to the participants' incentives is also relevant, since they can take advantage of the presence of the debt manager to avoid market solutions. Therefore, despite the potential benefits of having some flexibility for extraordinary actions, there is the possibility of generating inappropriate incentives for some investors and harming the overall smooth functioning of the government bond market.

In addition, a preventive attitude is desirable to have this instrument available, especially considering that a significant volume of liquidity reserve is a necessary condition for many forms of extraordinary performance and that there are non-negligible uncertainties in determining scenarios, especially for longer terms. In the Brazilian case, even though fiscal difficulties have not weakened cash management throughout the 2010s, the change in legislation of the existing relationship between the National Treasury and the BCB, as well as the anticipation of a large part of BNDES returns, should impose a new dynamic for the liquidity reserve, making its management more challenging in the coming years. In this sense, recovering the capacity to realize primary surpluses is a fundamental condition.

It is also worth pointing out that the Brazilian public bond market does not have an automatic safeguard system as observed in the stock and futures markets by means of the circuit break, which establishes a temporary price limit. When these markets fall below the limit value, trading is interrupted for a predetermined period of time. One of the reasons for using circuit brakers is credit risk and loss of financial confidence. The arguments in favor of this mechanism are based on the premise that significant changes in market prices may not be consistent with economic fundamentals or market efficiency. However, circuit breakers can interfere with the price formation process and inhibit the hedging strategy of portfolios, thus reducing liquidity in other markets.

Historical Analysis of Extraordinary Actions

This section is designed to evaluate historically which factors were important for the diagnosis of extraordinary actions in Brazil, with special attention to the COVID-19 shock. The National Treasury monitors general market conditions with the objective of maintaining appropriate references for the operation of the public securities market and having a precise diagnosis of its dynamics. Although the decision process for extraordinary actions by the debt manager is discretionary in nature, the analysis of different economic-financial variables (such as information on volatility, liquidity, price references, risk sentiment and asset repricing) makes it possible to characterize the elements that involved past actions.

From a historical perspective it is possible to evaluate some conditioning factors, both internal and external, and several challenges that have been faced by the debt manager over time. For example, at the end of the 1990's the increase in risk aversion in relation to emerging markets (which culminated in the Russian crisis) reached the Brazilian economy and generated a significant reduction in liquidity for the country, in a context of a high current transactions deficit, with obvious external restrictions. At that moment the economic policy conduction structure that guaranteed the stabilization started to show clear signs of exhaustion in face of the challenges imposed by the external environment. Thus, after an intense capital outflow and a significant reduction in international reserves, the country faced difficulties in debt management.

According to Carvalho et al. (2009), the crises at the end of the 1990s slowed down the process of changing the public debt profile. The hostile environment made it difficult to increase the share of fixed-rate securities, and there was also a growing concentration of short-term debt. In this way, the National Treasury sought to reduce refinancing risk and increase the share of securities pegged to interest rates. Difficulties were also observed in the early 2000s, notably during the period when governments changed hands. However, as support for obtaining robust fiscal surpluses consolidated, uncertainties regarding the adjustments required in the economy were reduced, making it possible to build a beneficial cycle for debt management, despite some of the adversities faced.

Even in the face of gradually more favorable conditions, Pereira et al. (2009) report that, because of the impacts of international market adversities, in 2004 the National Treasury held two simultaneous purchase and sale auctions of short-term fixed rate securities (LTN[15]) in the month of May. Similar operations were also carried out with floating-rate Selic indexed securities (LFT) with the purpose of providing transparency and price parameters for the secondary market. The authors also pointed out that later, in May 2006, the uncertainties concerning the conduct of monetary policy in the USA restricted liquidity in the Brazilian market, with a worsening in government bond prices. With this, non-resident investors holding longer-term price-indexed securities (NTN-B) were unable to find buyers on the secondary market, leading the National Treasury to conduct purchase and sale auctions to minimize market imbalance. According to the authors, this action reduced the stress initially verified in the NTN-B market, which was contaminating the other markets.

In the following years, debt management continued to advance in several dimensions, such as composition and average maturity. In 2008, Brazil's long-term external debt, for example, was rated investment grade by two of the main rating agencies - Standard and Poor's (S&P) and Fitch Rating -, a reflection of the capacity to honor debt obligations, which helped achieve better financing conditions by reducing funding costs and additional demand for government bonds by institutional investors that had regulatory restrictions for investments in countries without this sovereign rating reference.

15 The LTN or National Treasury Bills are securities with simple payment flow, which means that the investor makes the purchase and receives the yield in a single installment, on the maturity date of the security, along with the principal amount. Their remuneration is prefixed, i.e., defined at the time of purchase, and equivalent to the difference between the purchase price of the bond and its face value at maturity.

The NTN-F or National Treasury Notes - Series F are securities with semiannual interest coupon payments, whose prefixed profitability is determined by the internal rate of return (IRR) of the payment flow of these coupons and by the premium or discount applied on its face value.

The NTN-B or National Treasury Notes - Series B are post-fixed securities, with semi-annual interest coupon payment flows to the investor. Their profitability is composed of a rate agreed upon at the time of purchase, plus the variation of the Amplified Consumer Price Index (IPCA).

The LFT or Financial Treasury Bills are securities with a simple payment flow, whose post-fixed remuneration is determined by the variation of the Selic rate between the settlement date of the purchase and the maturity date of the security, plus, if any, a premium or discount at the time of purchase.

However, the outbreak of the economic-financial crisis in September 2008 brought excessive volatility to the markets and caused a retraction in global activity. In this period, the National Treasury held four simultaneous purchase and sale auctions of long-term fixed rate securities (NTN-F). These auctions aimed at assuring investors of price parameters, as well as avoiding the opening of premiums. The BCB, in turn, based on a diagnosis of the lack of liquidity in the foreign exchange market, opted to provide liquidity by means of different instruments in foreign currency. The coordinated actions contributed to the reduction of interest rates and allowed some investors to change positions without pressuring those interested in maintaining their positions. This action involved a low financial volume in relation to the stock and was based on the objective of helping the secondary public bond market to function well.

After the initial shock of the Subprime crisis, perceptions regarding Brazil's performance evolved into a view of consistent recovery. This change in mood was accompanied by an improvement in the external environment and had direct repercussions on the reduction of financial volatility benefiting public debt management. Then, in the early 2010s, there was a deceleration in the level of domestic activity even with several stimulus measures, which did not prove effective. As of 2013, some adverse economic aspects became acute (repression of administered prices, increased public spending, reduced transparency of fiscal policy and a complex external environment) and began to reverberate negatively on the domestic securities market, imposing difficulties to improve the public debt profile.

Due to the increase in risk aversion in 2013, when interest rates on public securities became excessively volatile with the prospect of an early withdrawal of US monetary stimulus, the National Treasury resumed its activities by means of extraordinary auctions for the purchase and sale of fixed-rate and price-indexed securities in June and August. Still with a view to reducing global liquidity, the National Treasury held two extraordinary repurchase auctions in February 2014, based on the diagnosis of distortion in the demand for fixed-rate securities.

In 2015, on the other hand, the negative aspects related to the political environment accumulated, so that there was an interruption in the search for a debt composition with a lower proportion of floating-rate securities vis-à-vis a greater share of fixed-rate and price-index instruments, interrupting a long trend of advances in this direction. Furthermore, the DPF/GDP trajectory began to rise, revealing the fiscal difficulties the country was facing. A striking fact of that year was the submission to the National Congress of an Annual Budget Bill containing a primary deficit of R$ 30 billion in 2016, indicating the fiscal difficulties and political articulation, which induced the loss of the investment grade rating of the S&P agency.

The deteriorating economic conditions led the National Treasury to act between late September and early October 2016 by canceling auctions for the sale of fixed-rate securities and the exchange of price-indexed securities, followed by the announcement of simultaneous one-off auctions for the

purchase and sale of fixed-rate and price-indexed securities, as well as an extraordinary auction for the sale of LFT. The sequence of actions adopted was possible thanks to the flexibility brought about by the liquidity reserve.

Political difficulties entered the 2016 agenda, but there were prospects for overcoming the deep crisis in which the country found itself, marked by an intense recession in economic activity. Part of the favorable outlook came from the progress in the fiscal agenda, especially with the approval of Constitutional Amendment No. 95 (Expenditure Ceiling). However, the last quarter of the year was marked by a resumption in risk aversion, given the frustration with domestic data, the results of the US elections and the uncertainties of the European and Chinese economies. In view of these adversities, in November 2016, the National Treasury announced a program of extraordinary auctions for the purchase of NTN-F, as well as the cancellation of an auction for the sale of LTN and NTN-F. At the time, the objective was to remove interest rate variation risk from the market to attenuate excessive volatility in fixed-rate markets.

In 2017, concerns about the structural adjustments needed for the Brazilian economy, such as the delay in the approval of the Social Security reform, in addition to the uncertainties related to political support for the reformist agenda of the executive branch pressured the market from the beginning of the year, and the month of May was marked by a significant deterioration in the political environment and financial conditions. Faced with this unfavorable scenario, the National Treasury cancelled two auctions of LTN, LFT and NTN-F, in addition to holding extraordinary auctions for the purchase and sale of LTN, NTN-F and NTN-B (resulting in total net redemptions of approximately R$ 2.1 billion). On that occasion, the National Treasury sought not to alter the asset repricing trend, but rather to avoid acute short-term fluctuations that could hinder the smooth operation of the securities market and other related markets.

The year 2018 brought the expectation of volatility due to the pressing political issues of the election year. The domestic financial market was hit by greater uncertainties as of May. The combination of internal elements (the truck drivers' movement, elections, political difficulties, deadlock in the reform agenda, etc.) and external elements (international trade tensions, the United Kingdom's exit from the European Union, the economic fragility of some countries in the Euro Zone and emerging countries, etc.) put pressure on the return rates of the yield curve in the medium and long term vertices, with an increase in risk premiums. To a lesser extent, short-term rates also rose in anticipation of a more restrictive monetary policy, mainly due to the exchange rate depreciation.

In this context, the National Treasury held extraordinary auctions and cancelled auctions that were foreseen in the annual schedule, with the objective of taking pressure off the supply of securities and ensuring the functionality of the public securities market, mitigating the impacts of excessive volatility. Between the end of May and the beginning of July 2018, extraordinary auctions of NTN-F, NTN-B and LTN were held. Additionally, the following traditional auctions were cancelled: i) two of

NTN-B, LTN and NTN-F, scheduled for May; ii) all of June, except for one LFT auction; and iii) of NTN-F scheduled for early July. In all, seventeen extraordinary auctions were held, resulting in a net repurchase of approximately R$ 24.3 billion. This was the largest extraordinary action carried out by the National Treasury. On this occasion, there was an increase in the share of floating-rate security issuances to the detriment of fixed-rate securities. National Treasury actions were aimed at reducing risk (DV01 level).

The BCB acted in a coordinated manner in this episode. Investors' demand for shorter securities led the monetary authority to carry out an extraordinary repurchase operation with a maturity of 9 months; usually the repo terms offered were between 3 and 6 months. The BCB also acted in the foreign exchange market by means of currency swaps, which correspond to the sale of dollars in the futures market. The coordinated actions did not have the objective of altering the repricing trend of assets, but to avoid excessive fluctuations that could harm the functioning of the financial market.

Pandemic Adverse Shock from COVID-19

The year 2020 was marked by an unprecedented adverse shock to the Brazilian economy, arising from the COVID-19 pandemic. The impacts of the virus dissemination were observed in several segments, with health, social and economic repercussions that resulted in the decree of a state of public calamity throughout 2020. The intensity of the crisis impacted the financial markets and brought uncertainty and volatility. In this context, the National Treasury acted in an extraordinary way in the public securities market with the objective of mitigating adverse risks on financing needs and the financial system.

Between March 12 and 26, 2020 extraordinary auctions were held for the purchase and sale of NTN-F, NTN-B and LTN. Additionally, the following traditional auctions were cancelled: i) NTN-B, LTN, NTN-F and LFT, scheduled for March 12, 17, 19 and 26; and ii) NTN-F scheduled for April 2, 9 and 16. All these auctions were scheduled in the annual calendar. In total, the net repurchase was approximately R$ 35.6 billion. In addition, on March 25 it was defined that the LFT auctions would have two legs: a long leg, maturing on 03/01/2026, and a short leg, maturing on 09/01/2022. Later, on April 1, it was decided to hold weekly LFT auctions instead of every two weeks.

Given the dimension of the crisis, the National Congress approved Constitutional Amendment 106/2020 to support some economic policy actions while the situation of public calamity persists. Within the scope of public debt management, of note is the authorization granted to the BCB to negotiate in the secondary market for public and private securities. This provision eliminated the legal uncertainty for the monetary authority to operate in the public bond market. This instrument was not used, but this provision brought a new element to debt management, since historically extraordinary actions in the public bond market were carried out by the National Treasury.

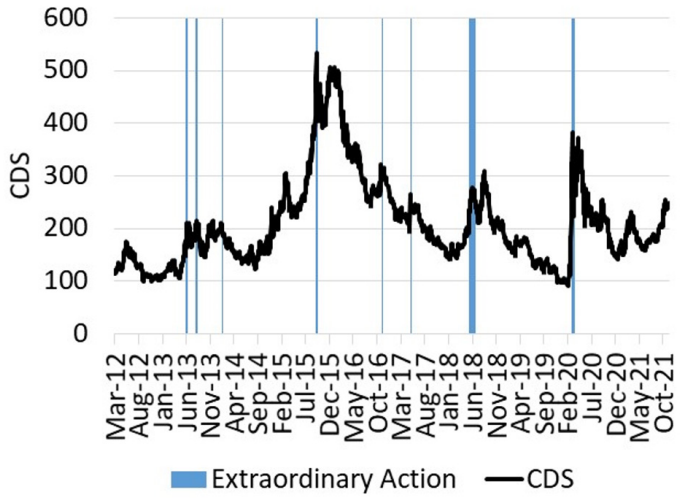
One of the challenges for debt management in the crisis was the increase in the Federal Government's funding needs at a time of great uncertainty and risk aversion on the part of investors, which increased the precautionary demand for liquidity. Thus, funds migrated from government bonds to repo operations, which have shorter maturities and virtually no price volatility.

During this period, liquidity reserves helped the National Treasury to have the flexibility to adjust issues in accordance with market conditions and increase security issuances on a timely basis. As the need for financing increased, the financial volume raised through public bond issues reached historic records. While the average monthly financial volume in 2019 was R$ 58 billion, in the second half of 2020 it reached R$ 126.7 billion. Amid a scenario of uncertainties, risk aversion and a steep yield curve, the average debt issue term declined, implying a shortening of the public debt maturity structure.

In 2020, the National Treasury made adjustments to its funding plan to meet the sudden increase in funding needs and to adapt the plan to changing market conditions. The addition of some on-the-run securities throughout 2020 was a key factor in the success of the funding strategy, as it also provided flexibility in debt management. With market demand concentrated on short-term securities, in particular 6- and 12-month LTN, and considering the steeper yield curve, the National Treasury increased the list of available securities. With this measure, debt management intended to respond to the sudden increase in funding needs imposed by the pandemic, minimizing the consequences for very short-term refinancing risk. The financial volume raised with the issuance of DPMFi bonds in 2020 was R$ 1,298.6 billion, approximately 71.5% above the average of the previous four years.

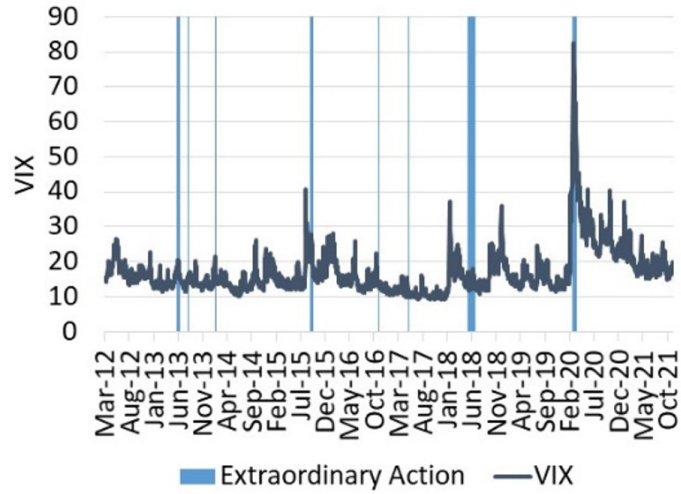
The crisis caused by the COVID-19 pandemic has imposed unprecedented challenges on global economies and markets. In Brazil, the reaction has provoked a temporary increase in government spending. However, the timing and magnitude of the measures succeeded in mitigating the negative impacts on the main macroeconomic variables. In this context, DPF management has fulfilled its role in meeting the federal government's borrowing requirements and guaranteeing the smooth operation of the federal public securities market. Aspects of DPF management, such as maintenance of the liquidity reserve, the composition of the debt, especially domestic, and a developed and organized public securities market, have proved to be important mechanisms for mitigating the effects of the crisis.

Chart 1 - 5 Year CDS - Brazil



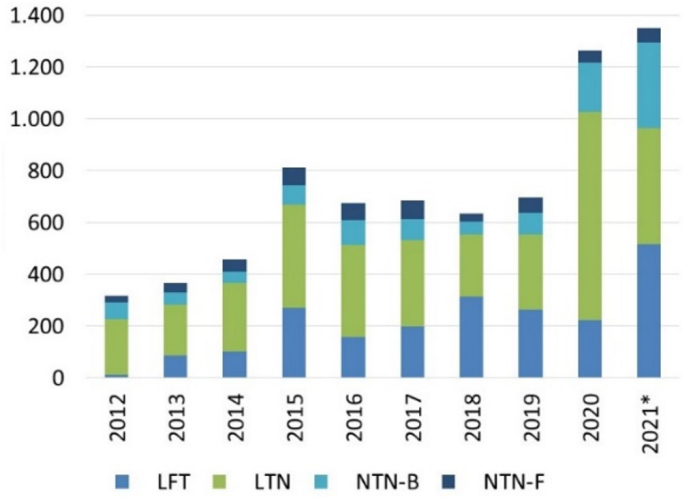
Source: Bloomberg and STN.

Chart 2 - VIX



Source: Bloomberg and STN.

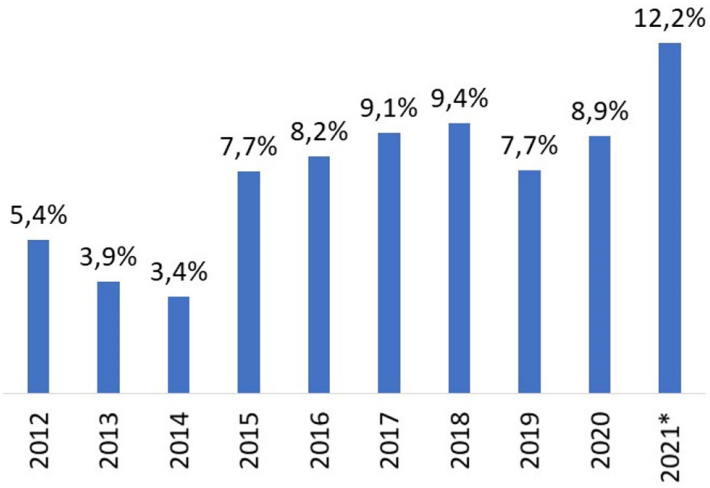
Chart 3 - DPMFi Issuances (R$ - Bi)



*Accumulated until June.

Source: STN.

Chart 4 - Liquidity Reserve/GDP



*Accumulated until June.

Source: STN.

This historical analysis indicates that the extraordinary actions of the National Treasury in the public bond market were associated with moments of risk aversion. It is also important to note that, although the peaks in National Treasury actions are related to moments of stress, the action taken by the economic authorities can mitigate sudden movements in asset prices, be they public securities or foreign currency. In other words, despite the difficulty in establishing a counterfactual for what happened, an event of extreme volatility may not have occurred because of the actions of the economic authorities, despite the construction of an adverse scenario.

Quantitative Analysis

The objective of this section is to develop statistical tools that allow the evaluation of the conditions of extraordinary actions of the National Treasury. For this purpose, two methods were used: i) an econometric model, which allows us to evaluate how, and which financial indicators were important for the performance; and ii) the other metric used was principal component analysis, which allows us to evaluate in aggregate form how financial volatility behaved at the moments of performance.

To evaluate the need for intervention by the National Treasury in the public bond market, the following research strategy was adopted: i) a survey of the moments when extraordinary actions are required; ii) definition of the market variables that may give rise to extraordinary actions; iii) econometric analysis using extraordinary actions as the dependent variable and market indicators as independent variables; iv) definition of a volatility index based on the indicators and on an ad hoc

metric that can suggest moments of high volatility in the financial market, an environment that may give rise to extraordinary actions.

To evaluate the actions of the National Treasury, the binary models[16] was chosen. These models are frequently used in studies that evaluate excluding agent choices and are appropriate for situations in which the agent defines between two alternatives. In the case in question, between acting or not in the public bond market. Additionally, based on the Principal Component Analysis (PCA)[17] of the indicator series, a financial volatility series was built based on the 10 indicators evaluated and it was defined as a rule that results above the 95th percentile would be characterized as an extreme measure of risk.

The variables used in the evaluation are divided into 5 distinct categories, which demonstrate both domestic and foreign market conditions, namely: i) level of volatility; ii) lack of liquidity; iii) lack of price reference; iv) risk sentiment; and v) asset repricing. A total of 10 variables were analyzed - these are described in Appendix I[18]. The analysis period chosen comprised the interval between 08/01/2013 and 11/22/2021, with data on a daily basis. Econometric estimation by Probit or Logit model requires that the series be stationary[19], a procedure that was verified for the variables used (Appendix I). The results of the econometric estimation are shown in Table 2.

The estimates for the coefficients[20] of the independent variables presented the expected signs and were statistically significant up to the 10% level in all models. Regarding the statistics, in general, the Log-Verosimilitude, Akaike and Schwarz signaled a marginally superior fit of the Probit in relation to the Logit model. The Ordinary Least Squares (OLS) model was estimated for comparison purposes only. It should be noted that Table 2 only reports the model with the best test statistics.

16 As per the methodological description in Annex II.

17 Principal Component Analysis (PCA) is a method used to reduce the dimensionality of multivariate data, that is, it allows to express the available information in few variables. The principal components can extract the variability of the original variables, allowing the data analysis to be simplified.

18 Such as yield curve slope, VIX (Volatility Index), NTN-F bid-ask spread, exchange rate, spread between Fed Funds and the US risk-free rate, etc.

19 A time series is said to be stationary when it develops in time randomly around constant mean and variance, reflecting some form of stable equilibrium.

20 The estimated coefficients of binary models should be interpreted with care. Rather than measuring the slope of change in Y (dependent variable) as X changes (as in traditional MQO regression), the slope coefficient is interpreted as the rate of change in the "log odds" when X changes. This explanation is not very intuitive, and in practice, the concern was focused on the direct or indirect relationship and the level of significance of the coefficients

Table 2 - Estimation Results

	PROBIT	LOGIT	MQO
C	-2,81***	-5,71***	-0,00*
	0,12	0,32	0,00
RECOMPRA(-1)	3,14***	6,19***	0,75***
	0,22	0,47	0,05
AMPLITUDE_DI(-3)	11,47***	21,84***	0,71***
	3,38	6,49	0,22
CDS_BRAZIL(-3)	5,32**	12,52	0,37**
	2,38	4,22	0,17
Akaike info criterion	0,09	0,09	-1,79
Schwarz criterion	0,1	0,1	-1,78
Log likelihood	-101,2	-101,6	2085
Obs with Dep=0	2260	2260	
Obs with Dep=1	62	62	
Obs Total	2322	2322	2322

Notes: standard deviations are in parentheses. Akaike and Schwarz indicate the model fit information criteria. LL represents the log likelihood ratio. H-L Statistic evaluating goodness of fit for binary specification. The p-value of the t-statistic is given by: * if p < 0, 10, ** if p < 0, 05 and *** if p < 0, 01.

Source: authors.

The fit of binary choice models is usually evaluated in the form of a comparison between predicted and realized values. Wooldridge (2010) suggests that the fraction of success/success of the full sample as a threshold or cut-off point is the most appropriate way to evaluate the correctly predicted percentage of the model. That is, if the total of extraordinary performances corresponded to 2.7%, every time the model indicates a probability higher than 2.7% there will be an indication of an extraordinary performance. In this perspective, the total forecast accuracy (actuation and non-actuation) was 97.8% = (2,220+50)/2,322. The Type II Error[21] (not predicting a performance and it occurs) was 1.8% = 40/2,220. The estimated series considered 90 actuations[22] by the National Treasury, of which the model predicted 50, or 55.6%.

21 Denomination used in the finance literature to define the occurrence of the event that was not predicted by the model, i.e., the occurrence of acting on the securities market without being indicated by the model. Type I Error occurs when the model indicates the action but it does not occur.

22 In two days of National Treasury actions there were no data records for one of the regressors, for this reason the estimated model considered 42 actions, instead of a total of 44 records.

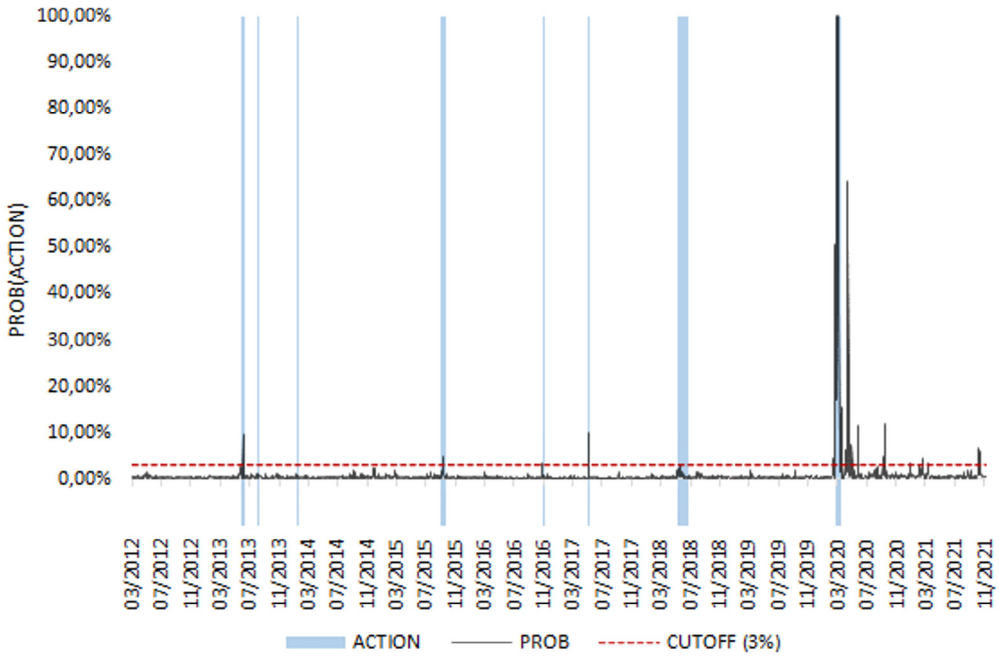
Table 3 - Selected Model (2.7% cut-off)

		Observed		
		0	**1**	**Total**
Expected	**0**	2220	12	2232
	1	40	50	90
	Total	2260	62	2322

		Observed (%)		
		0	**1**	**Total**
Expected (%)	**0**	95,6	0,5	96,1
	1	1,7	2,2	3,9
	Total	97,3	2,7	100,0

The chart below shows the probability of action of the National Treasury (black line), as well as the dates of operations (blue bar) and the historical cutoff (red dashed line). In a simple reading, whenever the probability of action indicator exceeds the historical cutoff, there is a relevant probability that the National Treasury will take extraordinary actions. As can be seen in the visual analysis, most actions coincide with the estimated indications.

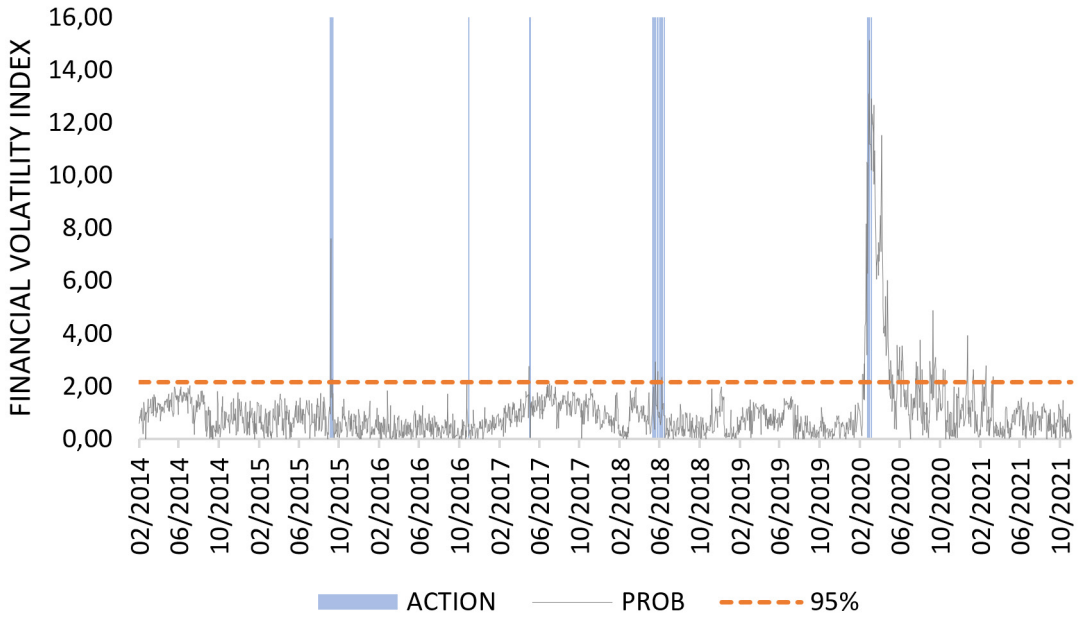
Chart 5 - Probability of Extraordinary Actions



Source: authors.

The second method we used also considers the set of 10 variables whose common behavior corresponds to financial market conditions, in this case the extraction of the principal components was considered to build a financial volatility index. With this, it was possible to propose a metric for evaluating stressful situations in the financial market. Adopting variations above two standard deviations (95% percentile) as an ad hoc criterion of high volatility. In this period, the extraordinary actions, with the exception of those that occurred in 2014, were located at least in the same week of the financial volatility index stress indication, ratifying the same perception of the econometric model.

Chart 6 - Financial Volatility Index



Source: authors.

Obtaining indications that the actions of the National Treasury were within moments of volatility was an expected result. However, these indications are insufficient to determine the form of action, whether in instruments, time or intensity. In other words, the tool is capable of indicating only one vector of the set of information that involves an attitude from the debt manager. On the other hand, given the indications of the results, it is possible to perceive that the National Treasury sought to minimize extraordinary actions, favoring autonomous market adjustment.

Concluding Remarks

The approach to the extraordinary actions of the public debt manager must involve aspects from those intrinsic to debt management to those related to the macroeconomics, public finances and institutional structure of the country. In this sense, some tools have been consolidated as strategic among debt managers, with liability management operations being used for several purposes, such as supporting the government bond market in stress situations.

In Brazil this perception is present, and the National Treasury has acted over the last few years with the purpose of contributing to the functioning of the public securities market. Therefore, we sought to understand the tools and contexts that gave rise to the extraordinary actions of the National Treasury, as well as the underlying factors. In this sense, we have sought to highlight the role played over recent years by official credit policy and the institutional arrangement of the relationship between the National Treasury and the BCB as a source of funding for the Single Account and the Liquidity Reserve.

The results of the quantitative studies showed that important financial market volatility indicators are relevant for predicting National Treasury operations in the public securities market. The models tested showed high predictive capacity for National Treasury actions and were robust to different sets of independent variables and statistical tests.

Furthermore, the principal component analysis ratifies the perception that moments of financial volatility were important for the actions of the public debt authority. The construction of an ad hoc metric of extreme moments of volatility based on the financial volatility index also confirms the debt manager's systematic actions.

Therefore, the results suggest a National Treasury action associated with volatility peaks over time, based on criteria and indicators that reflect the financial situation of the public securities market. Another important result aspect is that, given model indications, the National Treasury sought to minimize extraordinary actions, favoring autonomous market adjustment. Furthermore, the results indicate that the model selected, and the financial volatility index can be used to monitor the government bond market and to support the formulation of strategic actions aimed at improving the functionality of the government bond market.

However, it is important to emphasize that the use of mechanical indicators or metrics represents only one dimension of the broad spectrum related to the actions of the National Treasury in the financing process. The relations between debt management and fiscal, exchange and monetary policy, as well as the interaction with different markets, are essential conditions for decision making, in such a way that financial indicators should not be analyzed in isolation. The advancement in the understanding of metrics that help in the diagnosis of market conditions of government bonds and that may assist the debt manager in the decision-making process must be a constant exercise.

In the case of extraordinary actions, the interaction between analytical techniques and the experience of the debt manager, as well as the institutional and idiosyncratic knowledge of each country, is fundamental for debt management. Therefore, the technical tools and the experience of the manager are complementary and not substitutive.

Paraphrasing Bolder and Deelei (2011), one could say that economic-financial indicators are available tools that should be used in conjunction with (not as a substitute for) the manager's judgment. In this way, indicators are necessary because one cannot fully rely on intuition. However, intuition is necessary because indicators cannot be fully trusted. It is the controlled interaction between these two elements that contributes to a good debt management policy.

Finally, it should be emphasized that the actions of the National Treasury should be focused primarily on the development and preservation of a competitive and efficient government bond market. It is necessary to maintain the reputation of the debt manager to decide whether or not to act in moments of uncertainty or asymmetric information, since his actions have the potential to alter the behavior of the participants in this market and, consequently, the price formation process of government bonds.

Annex I - Debt Management Objectives

Table 4 - Debt Management Objectives by Country

	Cost and Risk Minimization in the Long Term	Cash Flow Optimization	Secondary Market Efficiency	Diversification of the Investor Base	Economic Coordination
Brazil	X		**X**		
Colombia	X				
Denmark	X		**X**		
Finland	X				
Ireland	X				
Jamaica	X				
Japan	X				
Mexico	X		**X**	**X**	
New Zealand	X			**X**	
Poland	X				
Portugal	X		**X**		
United Kingdom	X	X			
Turkey	X		**X**		**X**

Source: authors

Annex II - Description of Indicators

The indicators to be analyzed to support decision making regarding the execution of extraordinary auctions of public debt securities in this National Treasury Secretariat were grouped into 5 categories, as follows:

1. Volatility indicators: The occurrence of volatility at abnormal levels, which are not explained by structural factors.
2. Indicators of absence of liquidity: The absence of liquidity in the markets makes it impossible to close positions and increases the risk of the agents.
3. Indicators of Lack of price references: They make it impossible to carry out negotiations in the secondary market.
4. Risk Sentiment Indicators: Aims to highlight an atypical detachment between the nominal and real yield curves.
5. Asset repricing indicators: seek to identify whether the market is going through a period of transitory volatility or if the price of assets is undergoing a process of leveling off.

Below is a brief description of the indicators.

1) Volatility Indicators

Moments of uncertainty and/or risk aversion in the markets tend to be accompanied by an increase in the volatility of asset prices, which in turn can impact the proper functioning of the markets and even generate problems for the management of the public debt. The indicators selected to indicate financial market volatility are:

1.1 Amplitude of DI

The DI amplitude indicator is calculated from the maximum and minimum rates of DI contracts trading throughout the day and measures the percentage of the rate variation of such contracts in basis points in relation to the average of the maximum and minimum rates. The trading data are registered by the Stock Exchange - B3 and obtained from the Bloomberg platform.

1.2 VIX

The VIX volatility indicator was created by the Chicago Board Options Exchange (CBOE) and is an indicator of the volatility of stock options traded on the Standard & Poor's 500 index (S&P 500), the main stock market index in the United States, composed of five hundred assets listed on the New York Stock Exchange (NYSE) or the NASDAQ. The VIX represents the market's expectation for stock

price volatility over the next 30 days, and can be a good gauge of the level of global market stress, as in times of crisis stock price volatility tends to increase.

1.3 Implied volatility of currency options

The FX option implied volatility (FX vol) indicator prospectively measures the uncertainty of the future exchange rate that is embedded in the trading of dollar options, which are traded on the BM&F. Implied volatility is an indeterminate variable in the Black-Scholes option pricing model and because it cannot be observed, it must be calculated using the other inputs of the model. The FX vol index is published daily in the BM&F's daily bulletin, taking as reference the options trading that occurred in the trading session immediately preceding the publication date. Its historical series can be obtained from the Bloomberg platform.

2) Indicators of Lack of Liquidity

The absence of liquidity is another good metric to verify moments of great risk aversion in the financial market, since the lack of price reference, caused by great volatility, can make agents feel insecure about doing business, taking away market liquidity. The indicators selected to verify market liquidity are:

2.1 Daily Contract Volume of the Reference ID

The daily volume indicator of DI reference contracts is built from the sum of the total intraday volume of a specific DI contract maturity. Trading data for DI contracts are registered by the Stock Exchange - B3 and obtained from the Bloomberg platform.

2.2 Total Daily Volume of Government Securities

The indicator total daily volume of public securities seeks to have an overview of liquidity in the secondary public securities market and follows the aggregate volume of daily trading of each category of public security (Treasury Financial Bills - LFT, National Treasury Bills - LTN, National Treasury Notes series B - NTN-B and National Treasury Notes series F - NTN-F). NTN-F were further subdivided into two categories, the first encompassing the volume of the NTN-F market as a whole and the second the volume of the maturities 01/2025, 01/2027 and 01/2029. The government bond trading data are registered in the Special System for Settlement and Custody - SELIC, and obtained from the Bloomberg platform.

3) Indicators of Lack of Price Reference

During times of turbulence, it is very common for markets to lose their relative price reference for financial assets, either due to a drop in the liquidity of these assets or to other factors, which can

generate a vicious cycle, further decreasing market liquidity and making it difficult to return to a situation of equilibrium. In moments like this, an action by the STN offering extraordinary auctions, and acting on the buying and selling ends of selected securities, can help the market to return to its normal functioning by providing the different players with a fair buying and selling spread. The indicator selected to check for the absence of a price benchmark is:

3.1 Government Bond Spread (Buy rate - Sell rate)

The government bond spread indicator measures the relation between the spread and the reference rate for buying and selling the bond. The reference rates for buying and selling are calculated through research conducted daily by Anbima with the main financial institutions.

4) Risk Sentiment Indicators

The risk sentiment indicators bring aggregate market data that may indicate moments of great stress in the global or local financial market. Thus, the risk spread charged to the private sector, the risk spread of Brazil against selected countries, among other data, are analyzed. The indicators selected for the verification of market risk sentiment are:

4.1 TED Spread

The TED Spread measures the spread between 3-month US government Treasuries and the 3-month international market interbank rate (Libor) in US dollars, and aims to measure the difference in the cost of short-term US funding and the Libor rate. This indicator is taken from Bloomberg data.

4.2 Libor OIS

The Libor OIS measures the spread between the international market interbank rate (Libor) and the Overnight Indexed Swap (OIS) rate, which measures the cost of exchanging a pre-fixed flow for a post-fixed flow of the same term in the US market. Thus, the Libor OIS spread measures the difference between the cost of interbank loans in the international market, which have solvency risk, and the risk-free interest rate in the US market. This indicator is extracted from Bloomberg data.

4.3 CDS Brazil

The Credit Default Swap - CDS is the premium charged to the investor by the protection seller to guarantee the payment of the security of a given issuer, i.e. it works as a kind of insurance, guaranteeing that the investor receives the amount owed to him by the issuer. The CDS works as a measure of the issuer's credit risk.

5) Asset repricing indicators

5.1 Exchange Rate Regression x DXY

The U.S. Dollar Index or DXY is a measure of the strength of the U.S. dollar against a predefined basket of foreign currencies. The index rises when the dollar appreciates or "gains" strength against other currencies, and falls when the dollar depreciates or "loses" strength. Its linear regression against the Brazilian real can show whether the real goes through a devaluation/appreciation process that is not explained by the gain/loss of dollar strength.

5.2 Exchange rate regression x DI

The regression of exchange rate x DI interest rate is used to know if variations in the exchange rate can be explained by changes in the interest rate level. Initially, the 10 year DI rate was chosen as reference interest rate because it is less affected by short term changes in the SELIC rate.

Appendix III - Stationarity Tests

Table 5 - Stationarity Test

SERIES	CONSTANT	CONST. and TREND	NONE	STATUS
AMPLITUDE_DI*	0,000	0,000	**0,000**	**Stationary**
BRL_USD	0,000	0,000	**0,000**	**Stationary**
CDS_BRASIL*	0,000	0,000	**0,000**	**Stationary**
LOIS	0,000	0,000	**0,000**	**Stationary**
REG_CAMBIO	0,000	0,000	**0,000**	**Stationary**
SPREAD NTN-F	0,000	0,000	**0,039**	**Stationary**
TED SPREAD	0,000	0,000	**0,010**	**Stationary**
VIX	0,000	0,000	**0,050**	**Stationary**
VOL. IMPLIED EXCHANGE	0,002	0,006	**0,310**	**Stationary**
VOLUME_DI	0,000	0,000	**0,000**	**Stationary**
INCLINATION_CURVE	**0,800**	**0,840**	**0,630**	**Non-Stationary**

*The AMPLITUDE_DI and CDS_BRASIL series used in the regression were constructed from non-stationary data. See Appendix II for more details.

Source: Bloomberg and authors.

Table 6 - Stationarity Test - 1st difference

SERIES	CONSTANT	CONST. and TREND	NONE	STATUS
INCLINATION_CURVE	0,000	0,000	**0,000**	**Stationary**

Source: Bloomberg and authors.

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