

The Predictive Value of Government Accounting Information and the Secondary Brazilian Bond Market

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Abstract

The international literature highlights evidence on the predictive ability of government accounting information in relation to bond markets, especially for sub-national governments' bonds. However, there is little evidence in the literature about the role of accounting information from national governments. Having observed this gap, we aimed to identify how strongly the government accounting information affects the pricing of the government bonds issued by the Brazilian Federal Government and traded in the secondary market. In this research, we analyzed the transactions carried out without the direct participation of the federal government. The predictive ability of the accounting information of the Brazilian federal government was verified for the period from 2003 to 2012 on a monthly basis. Following the value relevance approach, we developed price and return models for the bond National Treasury Bills, Single Series. After analyzing the presence of unit roots in the price and return series, we estimated regressions using the ordinary least squares method. We showed that the accounting information of the Brazilian federal government has predictive ability regarding the pricing of bonds traded in the secondary market. However, this does not mean that the government accounting information is fully and directly used by investors, but rather that such information is intended as a proxy for information reviewed by investors when negotiating such bonds, these investors being considered as limited rational agents.

Keywords: governmental accounting, public debt, accounting information, predictive value

1. Introduction

At the end of fiscal year 2012, to approach the target for the fiscal surplus, the Brazilian federal government undertook a series of transactions that was widely publicized by the government and the media. Using resources of the Brazilian Sovereign Fund (*Fundo Soberano*, in Portuguese) and state-owned enterprises, the Federal Government increased the fiscal surplus by around R\$19 billion (D'Amorim & Schreiber, 2013a).

The operations carried out by the federal government were not welcomed by banks and consulting firms, which adjusted the released government numbers in their reports to investors (D'Amorim & Schreiber, 2013b). The adjustments indicated a reduction in the credibility of the government's implemented policies and the disclosed information. Internationally, reducing the credibility of the information disclosed by the Brazilian federal government, too, was the tone of the news of the end of the year (Mance, 2012).

The situation described above indicates that government financial statements, among other information released by the government, are considered useful for some user groups. The criticized procedures adopted by the federal government show that the market is probably concerned with the process leading to information and the ability to reflect the economic events taking place in the country.

In a few years, regardless of the entity's industry, the academic literature has demonstrated that accounting information plays an important role in decision-making processes for a range of users. Among the probable users of financial information are the following: (a) investors, (b) analysts, (c) creditors, (d) regulators, (e) auditors, (f) workers, and (g) the government.

To analyze the relevance of accounting information to certain decision-making processes, it is necessary to identify the group of users of such information. The main group of users chosen both by researchers and by regulators is investors (Barth, Beaver, & Landsman, 2001). Investors use accounting information when buying, selling, or holding securities and contracts.

In relation to the accounting information generated and evidenced by private entities, studies on the relevance of such information have mainly followed the value relevance approach. From the perspective of this approach, Barth, Beaver, and Landsman (2001) described accounting information as being deemed relevant to a market when it has information content that is able to influence that market's prices.

In private sector entities, the tests on the relevance of accounting information for investors can be performed considering, in addition to accounting information, the data obtained in the capital markets and bond markets. In the capital markets, primarily equity securities are traded that allow entities' participation in the capital. In bond markets, securities are traded in which two or more economic agents combine the exchange of financial flows, on agreed terms and conditions between the parties involved in the transaction.

With the exception of state-owned enterprises, public authorities cannot trade equity securities, because, due to the risk of losing sovereignty, public equity is indivisible. Thus, most public bodies can only issue bonds. Studies on the relevance of accounting information in the public sector, using data from government bond markets, can also be performed from the perspective of value relevance.

From the perspective of value relevance, studies have investigated the behavior of municipal bond markets using models with the price or the return of bonds as the dependent variable and have concentrated on North American markets (Copeland & Ingram, 1983; Apostolou, Reeve, & Giroux, 1984; Soybel, 1992, Marquette & Wilson, 1992; Kim, 2001; Summers, 2003; Reck & Wilson, 2006; Plummer, Hutchison, & Patton, 2007).

In the Brazilian context, the main issuer of bonds is the federal government. With the permission of the Brazilian Senate, subnational governments (states, federal districts, and municipalities) can only issue bonds to refinance the principal (Senado Federal, 2001). Such a limitation shall remain in force until the end of 2020 according to the legislation currently in force, aiming to reduce the public debt of governments, and subnational governments are forbidden to issue bonds while owing the federal government.

In September 2012, the operations of Brazilian federal government bonds in the secondary market moved an amount of approximately R\$618 billion (Secretaria do Tesouro Nacional, 2013). We can observe that the secondary market for government bonds accounts for a significant volume of transactions. Economic agents operating in their market dispense information to support choices about investments or divestments.

In the Brazilian context, it is possible that government accounting information is considered helpful by economic agents operating in the secondary market for bonds issued by the federal government. However, this relationship has not yet been studied either in the Brazilian literature or in the foreign literature. In Brazil, the relevance of accounting information to the bond market is so far unknown.

Resulting from the detection of this gap, the main objective of this research is to investigate the following question: To what extent does government accounting information affect the pricing of bonds of the Brazilian federal government traded in the secondary market?

2. Literature Review

2.1 Brazilian Federal Government Bonds

The debt of a public entity comprises its obligations set with third parties. Public debt has several origins, being mainly related to the financing of capital expenditures and the occurrence of budget deficits.

From the perspective of public finances, according to Silva and Medeiros (2009), the most common segregation of public debt is into (a) gross debt and (b) net debt. Gross debt only considers the financial liabilities of a public entity, while net debt represents the difference between financial liabilities and assets.

Also according to Silva and Medeiros (2009), gross debt can be classified according to:

- Origin: (a) internal – debts denominated in the currency of the country – and (b) external – debts in foreign currencies;
- Scope: (a) central government – in Brazil, involving the National Treasury (Secretaria do Tesouro Nacional – STN, in Portuguese), the National Social Security Institute (Instituto Nacional de Seguridade Social – INSS, in Portuguese), and the Central Bank, (b) federal government – involving the STN and the INSS; (c) general government – represented by the federal government and subnational governments, (d) subnational governments – made up of the state, district, and governments, and (e) state enterprises – including federal, state, and municipal enterprises; and
- Nature: (a) contractual – originated from a contract – and (b) securities – caused by the issuance of bonds.

Bonds can be divided into internal or external, depending on which there is an offer of instruments, respectively, in the domestic or the international market. Bonds may be issued by public offering in the form of auctions or directly due to legal contracts and devices. Bonds may be negotiable or not and may be held in the Bank's portfolio or issued to the

public (Silva & Medeiros, 2009).

According to the Central Bank of Brazil (Banco Central do Brasil, 2008), the federal debt comprises only some of the bonds issued by the central government. The securities coming from the privatization certificates, overdue and renegotiated debt, and agrarian debt are classified as securitized debt and do not enter into the calculation of the federal debt.

In the table below, the main characteristics of the bonds issued by the Brazilian federal government and traded on the domestic market over the past ten years are summarized. Only government securities relating to the federal debt are included.

Table 1. Main characteristics of Brazilian government bonds

Issuer	Bond	Series/ Subseries	Term	Negotia- ble	Update	Rate	Interest Payment	
National Treasury	National Treasury Bonus	Single	Up to 25 years		Dollar variation (a)	6% p.a.	Semester	
	Treasury Financial Letters	Single	Defined in emission					
		Series A	Up to 15 years		Without	SELIC	Redemption	
	National Treasury Bills	Series B						
		Single	Defined in emission	Yes		Rate discount (b)		
		Subseries A1	Up to 16 years			6% p.a.		
		Subseries A2	Up to 4 years			Six-month LIBOR		
	National Treasury Notes	Subseries A3	Up to 27 years			Dollar variation	5.25 to 6% p.a.	
		Subseries A6	Up to 17 years				4.5% to 8% p.a.	
		Subseries A10	Up to 9 years	No		Six-month LIBOR	Half-year	
Series B					IPCA			
National Treasury Notes	Series C				IGP-M			
	Series D	Defined in emission	Yes		Dollar variation	Defined in emission		
	Series F				Without			
	Series H				Reference rate	Without		
	Series I		Yes (c)			Defined in emission		
	Series M	15 years			Dollar variation	Six-month LIBOR	Half-year	
Central Bank of Brazil	Central Bank of Brazil Bonus	Series P	Minimum 15 years	No	Reference rate	6% p.a.	Redemption	
		Subseries R2	10 years		Dollar variation	12% p.a.	Monthly	
	Central Bank of Brazil Financial Letters	Series S	7 days/21 days (d)			Without	Rate discount/SELIC	Redemption
		Series U	Up to 15 years			TJLP	6.53% p.a.	Monthly
		Series A	7 days/21 days (d)	Yes			Rate discount/SELIC	
	Central Bank of Brazil Notes	Single	Maximum 30 months			Without	Mean rate	Redemption
		Series A	1 month / 2 months (d)				6% p.a./SELIC	
		Special	Defined in emission			Dollar variation	Defined in emission	Half-year
		Floating	Minimum 3 months				6% p.a.	

Note: (a) It is also possible to choose the restatement; (b) The bond is sold at a discount rate; (c) It became negotiable on 05/01/1997; (d) There are two periods with minimum terms each.

Source: Central Bank of Brazil (Banco Central do Brasil, 2012) and Brazil (Brasil, 2001).

To control the government bond market operations undertaken by the federal government in the domestic market, the Central Bank uses the Sistema Especial de Liquidação e de Custódia (SELIC), an information system that operates with

those bonds that are registered and settled. According to the Central Bank of Brazil (Banco Central do Brasil, 2013), the implementation of the SELIC took place in 1979, and today the system has about 500 participants and 10,000 individual customers. In the system, 450 types of securities are recorded, which represent approximately 99% of the portfolio of government bonds.

In the structure of the Brazilian federal government, two organs are responsible for the bonds. They are: (a) the National Treasury (STN) and (b) the Central Bank. Currently, only the STN is responsible for issuing bonds, leaving the control and monitoring to both organs.

The issuing of bonds held by the Central Bank continued until May 2002, that is, two years after the enactment of Supplementary Law No. 101/2000. Law No. 101 (Brasil, 2000) withdrew the ability to issue bonds from the Central Bank and limited the operations involving their titles.

The STN is responsible for issuing the following bonds: (a) National Treasury Bonuses (Bônus do Tesouro Nacional – BTNs, in Portuguese), (b) Treasury Financial Letters (Letra Financeira do Tesouro – LFTs, in Portuguese), (c) National Treasury Bills (Letra do Tesouro Nacional – LTNs, in Portuguese), and (d) National Treasury Notes (Notas do Tesouro Nacional – NTNs, in Portuguese). With the exception of NTNs – Series S, all such securities will mature in the medium to long term. Only NTNs – Series/Subseries A10, M, and P are not negotiable and must be retained by the buyer to their redemption.

Most bonds issued by the STN update the nominal value linked to the variation of the US dollar. To update the nominal value of the bonds, the following indicators are used: (a) IGP-M (General Market Price Index, in Portuguese: Índice Geral de Preços do Mercado), (b) IPCA (National Index of Consumer Price, in Portuguese: Índice Nacional de Preços ao Consumidor Amplo), (c) TR (reference rate, in Portuguese: Taxa Referencial), and (d) TJLP (long-term interest rate, in Portuguese: Taxa de Juros de Longo Prazo).

BTNs and LTNs are intended to cover the budget deficit and the anticipated budget revenues from operations. LFTs are meant to fulfill the contract assumption by the Union of Responsibility for Debts of the States and the Federal District and the reduction of the presence of state public entities in the financial sector. NTNs were used in the restructuring of the Brazilian foreign debt (Brasil, 1989, 2001).

The bonds that were issued by the Central Bank had short-term maturity and could be traded in the secondary market. The bonds are: (a) Central Bank of Brazil Bonuses (Bônus do Banco Central – BCBs, in Portuguese), (b) Central Bank of Brazil Bills (Letras do Banco Central – LBCs, in Portuguese), and (c) Central Bank of Brazil Notes (Notas do Banco Central – NBCs, in Portuguese). These bonds were used as monetary policy instruments (Banco Central do Brasil, 2008).

According to the data analyzed in the study, the last security issued by the Central Bank of Brazil and traded in the SELIC was an NBC – Special Series issued in 2000 and traded on November 1, 2006, fifteen days before its maturity.

Amante, Araujo, and Jeanneau (2007) reported that the domestic market for government bonds has expanded very rapidly since the mid-1990s to become the largest market in Latin America. The authors also emphasized that the Brazilian federal government changed the short-term debt profile and variable rates for long-term debt and fixed rates.

Silva, Garrido, and Carvalho (2009) pointed out that in 2008, according to the Bank of International Settlement, Brazil was the world's eighth-largest bond market, behind only: (a) Japan, (b) the United States, (c) Italy, (d) France, (e) Germany, (f) China, and (g) the United Kingdom. The authors added that the Brazilian market was "one of the most liquid among emerging economies."

We can observe that the market for bonds issued by the federal government is complex and involves a diversity of bonds. In the current context, the federal government essentially seeks the balance of the cash flow by maintaining the budget balance and the renegotiation of the Brazilian public debt.

2.2 Studies Focusing on Government Bond Markets and the Role of Government Accounting Information

The first studies that sought to investigate the efficiency of financial markets, according to Sewell (2011), dated from the nineteenth century and studied the behavior of prices in the capital markets. Research on the behavior of bond markets emerged only in the twentieth century, for example the works published by Fisher (1959) and Robson (1960).

Ingram, Brooks, and Copeland (1983) analyzed whether the changes in the credit risk rating made by the rating agencies affected the bond prices of 127 US cities. The classification changes made by Standard & Poor's were analyzed in the period between August 1976 and February 1979. The authors found that the change in the classification affected the yield of a municipal bond during the month in which the change occurred.

Adopting as their theme the influence of accounting regulation in municipal debt costs, Benson, Marks, and Raman (1984) studied the behavior of bonds issued by 66 US cities during the period from October 1976 to May 1979. The

authors showed that stricter accounting regulation is associated with lower costs of government debt. According to Benson, Marks, and Raman (1984), economic agents operating in a bond market interpret tighter regulation as generating higher-quality accounting information.

Allen (1994) initially divided five hundred and thirteen municipalities of the United States into two groups: (a) the first was composed of the municipalities that were audited by one of the eight largest firms and (b) the second contained other municipalities. Then, the author examined whether the municipal accounting information could be used to predict the credit risk ratings issued by Moody's during the period between January 1978 and March 1986.

According to the author, only the financial statements audited by the eight largest firms demonstrated predictive power in relation to risk ratings. Allen (1994) stated that the economic agents possibly understand that the work of the eight largest audit firms assigns quality to the government financial information of the respective municipalities.

Gore (2004) studied the effects of the incentives caused by the regulation for municipal accounting disclosure, as well as the effects of the disclosure in relation to the bond market. The author analyzed the financial statements of 88 municipalities located in Michigan (for which there was a specific regulation) and 87 municipalities in Pennsylvania (unregulated) for the year 1995. Controlling for other incentives for disclosure, the results indicated that the accounting regulation induced voluntary disclosure in municipalities with low levels of debt; however, they did not show the same effect in those with high levels of debt (Gore, 2004).

Gore (2004) reached two conclusions: (a) in all the municipalities, the disclosure level was considered significant in relation to the prices of bonds, and (b) in municipalities with specific regulations, only those that had a low level of debt had a high level of disclosure.

Schuknecht, Hagen, and Wolswijk (2009) analyzed the risk perceived by market participants in relation to public entity issuers of bonds. The authors evaluated 283 bonds issued by national governments and 272 bonds issued by subnational governments in the European Community and Canada during the period between 1991 and 2005. The survey results indicated that, for the national governments, the increased risk was positively associated with increasing debt and the occurrence of deficits. In the case of sub-national governments, which are subject to the same conditions as national governments, the increased risk is also associated with increased financial assistance received from their national governments.

Aside from Schuknecht, Hagen, and Wolswijk's paper, other studies reviewed bonds issued by subnational governments. These studies showed that the public bond markets reflect the information available and thus are effective to some degree. However, these studies did not analyze the behavior of the variables price of the bonds and return from the bonds. The level of regulation and the risk were the variables analyzed in this research.

According to these works, it is apparent that government accounting information has the capacity to influence agents' decisions. In relation to national governments, though, there is little evidence on the influence of accounting information on prices and returns. In this research, we seek to evaluate the role of government accounting information in the Brazilian federal government bond market.

In the following text, we discuss the value relevance approach, considering the context of the public sector.

2.3 The Value Relevance Approach Applied in Studies Involving the Public Sector

During the literature review, we identified eight studies involving the public sector that used the value relevance approach. All the analyzed studies dealt with accounting information from North American municipalities (or municipal school districts). They sought to analyze essentially the risk associated with such bonds. Aside from Marquette and Wilson's and Reck and Wilson's papers, the studies used models of government bonds returns.

The earlier works found no evidence that financial information exerts an influence on the pricing of bonds (Copeland & Ingram, 1983; Apostolou et al., 1984; Soybel, 1992). A common finding of these three studies was the low quality of government financial statements due to the lack of or scarce existing regulation in the United States in the 1970s and 1980s.

However, the more recent papers (Marquette & Wilson, 1992; Kim, 2001; Summers, 2003; Reck & Wilson, 2006; Plummer et al., 2007) identified the influence of government accounting information on the prices of government bonds. This finding is related to the evolution of the regulation of governmental accounting in the United States. Roybark, Coffman, and Previts (2012) emphasized that the Governmental Accounting Standards Board (GASB), the regulatory body of governmental accounting in USA, was created only in April 1984. The regulatory bodies prior to the GASB were not independent and had financial constraints.

Copeland and Ingram (1983) analyzed the relevance of accounting information from the municipal pension funds to bonds. Due to the absence of an influence of accounting information, the authors stated that the deficiencies in the

practices used reduced the reliability of the information generated at the end of the 1970s in the United States. Financial information was shown to have low predictive power with respect to the classification of risks and returns (Copeland & Ingram, 1983). The authors added that the low level of reliability affected the level of relevance of accounting information in 62 municipalities in the United States during the year 1977.

Using a sample of 531 bonds issued by municipalities in Minnesota, Apostolou et al. (1984) tested the association between the result (surplus/deficit) of those municipalities and the risks of their underlying securities. Considering the period between July 1977 and June 1980 and bonds with a minimum maturity of five years, the authors showed that the result was not correlated with the bonds' risk. Apostolou et al. (1984) also attributed such evidence to the low quality of municipal financial information.

Soybel (1992) investigated the relationship between the government financial statements and the returns of the securities issued by New York City during the period between 1961 and 1975. The author identified that the originally highlighted information had no association with the returns on bonds and mentioned that the accounting practices adopted at the time by New York City did not incorporate information about: (a) revenues transferred by the state and federal governments, (b) taxes on property and improvements, (c) the advance in the recognition of revenue, (d) stabilization reserve revenue, (e) capitalization of current expenditure, (f) deferral of current expenses, (g) pensions, and (h) long-term debt. After adjusting the original information through the implementation of the practices cited above, Soybel (1992) found that the information set showed an association with the returns of bonds issued by New York City.

Marquette and Wilson (1992) analyzed the relationship between the bonds' price and the accounting information for a sample of 358 bonds during the period 1961 to 1975. The authors found that the analyzed market could be considered efficient in the semi-strong form in incorporating the publicly available information, including that on government accounting. A critical feature of the sample analyzed by Marquette and Wilson (1992) refers to the regulation exerted by the Securities and Exchange Commission (SEC). As the authors wrote, the SEC had no authority to regulate subnational governments; however, it imposed standards on financial intermediaries (dealers, underwriters, and others). The SEC rules improved the quality of government disclosures, which would explain their behavior in relation to the government bonds.

In their study, Kim (2001) aimed to determine whether market factors, municipality-specific factors, and accounting information would be able to explain the variations in bond returns issued by 103 US cities. The study period comprised the years 1983–1992.

Kim (2001) showed that the following items significantly affected the return on bonds according to the survey results: (a) the risk of the public securities market (market factor), (b) the public entity risk (specific factor), and (c) the total revenue, tax revenue, transfer revenue, total expenditure, and long-term debt (accounting information).

Summers (2003) and Plummer et al. (2007) studied the securities issued by school districts in the periods 1995 to 1999 and 1995 to 2002, respectively. Summers (2003) sought to understand whether the quality of government accounting information would affect the return on bonds, while Plummer et al. (2007) aimed to assess how the financial information generated by different accounting regimes affects the risks of government bonds. Using a sample containing 209 school districts, Summers (2003) found little influence of the quality of financial reporting on the return on government bonds.

The sample analyzed by Plummer et al. (2007) contained 530 school districts. Whereas the standard GASB 34 required the use of modified accrual basis accounting relative to government funds and the accrual basis for consolidated information, the authors showed that the information derived from the modified accrual basis was more significant in explaining the risk of default of the analyzed districts.

Reck and Wilson (2006) worked with three samples composed of US municipalities considering the following periods: (a) from 1996 to 1998 for the first two samples and (b) from 1978 to 1989 for the third sample. The authors sought to examine the relationship between the bond prices and the municipal accounting information.

3. Methodology

Transactions in the secondary market for bonds issued by the Brazilian federal government are controlled by the Central Bank in the SELIC system. Data on these transactions are available from the Central Bank's website (www.bcb.gov.br) and informed the operations carried out from January 2003.

Among the bonds issued by the Brazilian federal government and traded in the secondary market between January 2003 and December 2012, the National Treasury Bills (LTNs) were the bonds chosen for analysis, by virtue of being those with the highest trading volume.

The dependent variables in the study are related to the pricing of government bonds from the federal government. We

selected two variables: (a) price and (b) return. The price refers to the traded value in the secondary market, considering each transaction. The average monthly price was used. The average price unit of measurement is the Brazilian currency, the real. The return includes the percentage change between two prices of a certain bond during two different periods. To calculate the return, we employed the average monthly prices. The return of the unit of measurement is the percentage.

The financial information of the Brazilian federal government provided the explanatory variables used in the research. This information is disclosed by the STN on its website (www.stn.gov.br) on a monthly basis and covers the period between December 2002 and December 2012. The numbers are shown in thousands of reals.

From the accounting information obtained from the Brazilian federal government, indicators were calculated for use as explanatory variables. The indicators can be segregated into three types: (a) revenue generation capacity, (b) payment capacity, and (c) debt level.

The indicators relating to the revenue generation capacity focused on demonstrating the public entity's ability to obtain an adequate revenue to meet its obligations. We used three indicators:

$$rec_1 = \text{tax revenue} / \text{total revenue} \quad (1)$$

$$rec_2 = \text{net income} / \text{total expenditure} \quad (2)$$

$$rec_3 = \text{net income} / \text{total revenue} \quad (3)$$

The indicators relating to the payment capacity represent the current public entity's ability to honor the commitments already made. We used two indicators:

$$pag_1 = \text{personnel expenses} / \text{total expenditure} \quad (4)$$

$$pag_2 = \text{total expenditure} / \text{total revenue} \quad (5)$$

The debt-level indicators seek to demonstrate the amount to be paid by the public entity for its current debts. We used four indicators:

$$end_1 = \text{bonds debt} / \text{total revenue} \quad (6)$$

$$end_2 = \text{internal debt} / \text{total revenue} \quad (7)$$

$$end_3 = \text{external debt} / \text{total revenue} \quad (8)$$

$$end_4 = \text{bonds debt} / \text{tax revenue} \quad (9)$$

The variables arising from the above indicators are in percentages.

In an attempt to reduce the interference from other variables that may affect the pricing of the Brazilian federal government bonds with the aim of capturing the likely influence of government accounting information more accurately, we used five control variables: (a) maturity; (b) country risk; (c) overnight SELIC interest rate; (d) exchange rate, and (e) inflation.

Whereas the dependent variables are in a time-series format, the intervention variables were chosen as a way to solve the problem of outlying observations. They allow isolated effects that are not related to the explanatory and control variables. The observations, which were standardized residuals greater than two standard deviations, were considered outliers.

After collecting and organizing the information mentioned above, tests were performed to detect the stationarity of the time series formed. To check whether the series in question were stationary, the following tests were performed: (a) for the identification of two unit roots, the Dickey–Pantula test, and (b) to identify a unitary root, the Dickey–Fuller Generalized Least Squares (DF-GLS) and Kwiatkowski–Phillips–Schmidt–Shin (KPSS) tests.

The technique chosen depends on the stationarity of the series of the dependent variables. If it is stationary, it is possible to use the classical econometric techniques. The technique chosen was the multiple linear regression with ordinary least squares estimator. Otherwise, the use of a specific technique for time series would be selected, such as the autoregressive integrated moving average (ARIMA) and autoregressive conditionally heteroscedastic (ARCH) models.

4. Analysis of the Results

The next table presents the results of the Dickey and Pantula tests. As stated in the description given in the methodology, such tests are designed to identify the presence of two unit roots.

Table 2. Results of the Dickey and Pantula tests

Variable	Increased terms	Trend		Constant		Statistic \hat{f}	Result
		Individual	Set	Individual	Set		
		\hat{f}_{bt} (a)	\hat{F}_3 (b)	\hat{f}_{am} (c)	\hat{F}_1 (d)		
p_{LTN}	5	0.059	4.50×10^{-4}	0.091	0.001	-3.401 (e)	Negative
r_{LTN}	4	-0.133	0.003	0.063	0.001	-10.499 (e)	Negative

Notes: (a) Critical value of 2.79. (b) Critical value of 6.49. (c) Critical value of 2.54. (d) Critical value of 4.71. (e) Critical value of -1.94. (a), (b), (c), and (d) Values calculated by Dickey and Fuller (1981) for a series of 100 observations at the 5% significance level. (e) Values calculated by MacKinnon (1996) considering a series of 100 observations at the 5% significance level.

Considering the statistics of the individual and set tests, it was found that the model without deterministic terms was feasible for the variables. As a complement, that of the correlogram residuals was analyzed for the determination of increased terms, and the residuals showed that it is autocorrelated.

For both variables, the test statistics were lower than the critical values calculated by MacKinnon (1996) for series with 100 observations at the 5% significance level. These results led to the conclusion that none of the variables had two unit roots. The fact that the variables do not have two unit roots minimizes the errors in the DF-GLS and KPSS tests, the results of which are shown next.

Table 3. Results of the DF-GLS and KPSS tests

Variable	Model	DF-GLS			KPSS			Conclusion
		Increased terms	Statistic	Result	Bandwidth	Statistic	Result	
p_{LTN}	1	11	-1.688 (a)	Positive	8	0.095 (c)	Negative	Negative
	2	11	-2.553 (b)	Positive	8	0.098 (d)	Negative	Negative
r_{LTN}	1	10	-0.537 (a)	Positive	3	0.086 (c)	Negative	Negative
	2	10	-1.384 (b)	Positive	3	0.054 (d)	Negative	Negative

Notes: Models: 1 – with constant and 2 – with constant and trend. (a) Critical value of -2.89. (b) Critical value of -3.45. (c) Critical value of 0.463. (d) Critical value of 0.146. (a) and (b) Values calculated by MacKinnon (1996) considering a series of 100 observations at the 5% significance level. (c) and (d) Values calculated by Kwiatkowski, Phillips, Schmidt, and Schin (1992) considering the significance level of 5%.

By analyzing the results of the DF-GLS and KPSS tests together, it was found that the two variables were considered stationary in both models (with a steady and constant trend).

In the following table, the results of the analysis of the predictive value of accounting information for the variable price of LTNs are displayed.

Table 4. Results of the regressions with the price-dependent variable (p_{LTN})

Regressor	Models				
	A01	A02	A03	A04	A05
Constant	762.981***	564.812***	604.325***	600.823***	536.498***
$rec_{1,t-1}$	-2.015	-0.048	-	-	-
$rec_{2,t-1}$	-0.201	-	-0.123**	-	-
$rec_{3,t-1}$	-0.030	-	-	-0.172**	-
$pag_{1,t-1}$	0.273	-	-	-	0.318*
$pag_{2,t-1}$	-32.637	-	-	-	-
$end_{1,t-1}$	0.047*	-	-	-	-
$end_{2,t-1}$	-0.010	-	-	-	-
$end_{3,t-1}$	-0.022	-	-	-	-
$end_{4,t-1}$	-0.025	-	-	-	-
$mat_{LTN,t}$	-0.127***	-0.107***	-0.114***	-0.113***	-0.099***
ris_t	-0.006	0.005	0.008	0.008	0.003
sov_t	-42.381***	-42.272***	-44.586***	-44.449***	-42.567***
cam_t	12.945**	8.010**	7.567**	7.604**	8.183**
inf_t	-4.539	-8.058**	-7.395**	-7.460**	-7.886**
$p_{LTN,t-1}$	0.374***	0.445***	0.405***	0.408***	0.461***
Observations	119	119	119	119	119
Adjusted R ²	0.903	0.887	0.891	0.891	0.890
F	58.57***	84.98***	88.97***	88.41***	87.41***
Akaike Criterion	838.953	850.205	845.297	845.969	847.184
Normality	Yes	Yes	Yes	Yes	Yes
Heteroscedasticity	No	No	No	No	No
Serial autocorrelation	No	No	No	No	No
Multicollinearity	Yes	No	No	No	No
Intervention variables	Yes	Yes	Yes	Yes	Yes

Regressor	Models				
	A06	A07	A08	A09	A10
Constant	574.645***	578.523***	537.369***	563.553***	600.487***
$rec_{1,t-1}$	-	-	-	-	-
$rec_{2,t-1}$	-	-	-	-	-
$rec_{3,t-1}$	-	-	-	-	-
$pag_{1,t-1}$	-	-	-	-	-
$pag_{2,t-1}$	9.794	-	-	-	-
$end_{1,t-1}$	-	0.008***	-	-	-
$end_{2,t-1}$	-	-	0.015**	-	-
$end_{3,t-1}$	-	-	-	0.007	-
$end_{4,t-1}$	-	-	-	-	0.005***
$mat_{LTN,t}$	-0.110***	-0.115***	-0.107***	-0.104***	-0.119***
ris_t	0.008	-0.002	0.003	0.005	-0.003
sov_t	-43.588***	-44.148***	-39.670***	-44.192***	-43.537***

cam_t	7.536**	8.512**	13.366***	5.916	10.152***
inf_t	-7.912**	-5.086	-5.285	-8.207**	-5.673*
$P_{LTN,t-1}$	0.426***	0.405***	0.441***	0.447***	0.379***
Observations	119	119	119	119	119
Adjusted R ²	0.888	0.900	0.893	0.887	0.899
F	85.72***	97.55***	90.55***	85.19***	96.92***
Akaike Criterion	849.276	835.371	843.402	849.939	836.070
Normality	Yes	Yes	Yes	Yes	Yes
Heteroscedasticity	No	No	No	No	No
Serial autocorrelation	No	No	No	No	No
Multicollinearity	No	No	No	Yes	No
Intervention variables	Yes	Yes	Yes	Yes	Yes

Notes: *** Significant at 1%. ** Significant at 5%. * Significant at 10%.

Model A01 was composed of all the accounting indicators used as explanatory variables beyond the control and intervention variables. However, this model showed multicollinearity problems. Aside from the A09 model, in which the variable end_3 was present, the other models presented no multicollinearity problems. Thus, models A01 and A09 were excluded from the analysis.

The other regression models were normally distributed, homocedastic, and not autocorrelated. According to the Akaike criterion, the most adjusted models were A07 and A10.

With regard to the indicators relating to the ability to generate revenues, only the rec_1 variable parameter was not significant and the other parameters were negative and significant at the 5% level. For the indicators of the ability to pay, only the parameter of the variable pag_1 was significant and positive at the 10% level. Except for the variable end_3 , the model presented multicollinearity problems; the remaining debt level indicators were positive and significant at the level of 1%.

From these results, we could note that accounting information has predictive value in relation to the pricing of LTN bonds. The debt-level indicators were those with greater predictive power in relation to the others. The higher the level of debt and the lower the capacity to generate income, the higher the price assigned to bonds traded in the secondary market. Such situations may arise from investors' increased perception of risk.

Regarding the control variables, with the exception of the country risk variable, they were significant in most of the other models. The parameters of the maturity and the SELIC rate were negative and significant at the 1% level. The parameter of the exchange rate was significant and positive at the levels of 1% (A08 and A10 models) and 5% (other models). Aside from the A07 and A08 models, the estimated coefficient of inflation was negative and significant at the levels of 10% (A10 model) and 5% (other models).

It appears that the lower the maturity, the SELIC rate, or inflation and the higher the exchange rate, the higher the price of LTN bonds, according to the estimated models. The autoregressive behavior of the p_{LTN} variable was also confirmed.

In the next table, we present the regression results for the verification of the use of the predictive value of accounting information relating to LTN returns.

Table 5. Results of the regressions with the dependent variable return (r_{LTN})

Regressor	Models				
	B01	B02	B03	B04	B05
Constant	9.072	-0.164	1.205	1.186	-1.281
$rec_{1,t-1}$	-0.056	0.024	-	-	-
$rec_{2,t-1}$	-0.052	-	-0.005	-	-
$rec_{3,t-1}$	-0.011	-	-	-0.006	-
$pag_{1,t-1}$	0.050	-	-	-	0.079***
$pag_{2,t-1}$	-9.995***	-	-	-	-
$end_{1,t-1}$	0.002	-	-	-	-
$end_{2,t-1}$	-0.001	-	-	-	-
$end_{3,t-1}$	-0.003	-	-	-	-
$end_{4,t-1}$	-0.001	-	-	-	-
$mat_{LTN,t}$	-0.002	-0.001	-0.001	-0.001	2.92×10^{-4}
ris_t	-0.002*	-0.001	-0.001	-0.001	-0.001
sov_t	0.030	-0.611	-0.435	-0.440	-0.760
cam_t	1.292*	0.198	0.302	0.304	0.425
inf_t	-1.024**	-1.368***	-1.403***	-1.405***	-1.413***
$r_{LTN,t-1}$	-0.279***	-0.187**	-0.225***	-0.219***	-0.205***
Observations	118	118	118	118	118
Adjusted R ²	0.468	0.399	0.394	0.393	0.441
F	5.90***	6.96***	6.84***	6.82***	8.10***
Akaike Criterion	372.241	380.201	381.181	381.319	371.606
Normality	Yes	Yes	Yes	Yes	Yes
Heteroscedasticity	No	No	No	No	No
Serial autocorrelation	Yes	Yes	Yes	Yes	No
Multicollinearity	Yes	No	No	No	No
Intervention variables	Yes	Yes	Yes	Yes	Yes

Regressor	Models				
	B06	B07	B08	B09	B10
Constant	2.325	-0.948	-3.443*	0.956	-0.232
$rec_{1,t-1}$	-	-	-	-	-
$rec_{2,t-1}$	-	-	-	-	-
$rec_{3,t-1}$	-	-	-	-	-
$pag_{1,t-1}$	-	-	-	-	-
$pag_{2,t-1}$	-1.582	-	-	-	-
$end_{1,t-1}$	-	0.001**	-	-	-
$end_{2,t-1}$	-	-	0.002***	-	-
$end_{3,t-1}$	-	-	-	-4.48×10^{-4}	-
$end_{4,t-1}$	-	-	-	-	2.44×10^{-4}
$mat_{LTN,t}$	-0.001	-0.001	-0.001	-0.001	-0.001
ris_t	-0.001	-0.002	-0.001	-0.001	-0.002
sov_t	-0.506	-0.352	0.010	-0.349	-0.282

cam_t	0.358	0.360	1.243**	0.431	0.416
inf_t	-1.395***	-1.176**	-1.015**	-1.399***	-1.314***
$r_{LTN,t-1}$	-0.164**	-0.246***	-0.278***	-0.200***	-0.233***
Observations	118	118	118	118	118
Adjusted R ²	0.398	0.417	0.429	0.392	0.400
F	6.96***	7.43***	7.76***	6.80***	7.00***
Akaike Criterion	380.227	376.603	374.054	381.490	379.957
Normality	Yes	Yes	Yes	Yes	Yes
Heteroscedasticity	No	No	No	No	No
Serial autocorrelation	No	No	Yes	Yes	No
Multicollinearity	No	No	No	Yes	No
Intervention variables	Yes	Yes	Yes	Yes	Yes

Notes: *** Significant at 1%. ** Significant at 5%. * Significant at 10%.

Six of the regressive models, in which the dependent variable was the return of LTN bonds, used to evaluate the predictive value of the financial information presented problems and therefore were excluded from the analyses. They are: (a) models B01 and B09, with problems of serial autocorrelation and multicollinearity, and (b) models B02, B03, B04, and B08 with autocorrelation problems. The other models were normal, homoscedastic, and had no autocorrelated residuals.

The autoregressive behavior of the dependent variable was confirmed. Considering the Akaike criterion, the B05 and B07 models were the most adjusted.

The relationship between the personnel expenditure and the total expenditure, an indicator of payment capacity, had a positive and significant coefficient at the 1% level. The relationship between the bond debt and the total revenue, an indicator of the debt level, exhibited a positive and significant coefficient at the 5% level. This means that the higher the values of the variables pag_t and end_t , the greater the LTN returns. These indicators were the ones that showed evidence of the predictive value of governmental financial information.

Inflation was the only significant control variable. It showed a negative parameter, indicating that an increase in inflation is associated with a reduction in the LTN returns. The inflation parameter was significant at the 5% level in the B07 model and at the 1% level in the other models.

For models A01 to A10, four intervention variables were required for the months of: (a) February 2005, (b) May 2006, (c) July 2006, and (d) July 2011. Of the models B01 to B10, six were selected to use intervention variables for the following periods: (a) April 2003, (b) September 2003, (c) June 2004, (d) July 2009, (e) January 2011, and (f) July 2011.

It is noteworthy that the intervention variables related to the months of the years 2003 and 2011 are directly related to moments of contraction of the Brazilian economy, according to the analysis of the variation of the monthly gross domestic product estimated by the Central Bank of Brazil. The other intervention variables probably resulted from specific movements of the secondary bond market; however, they were not clearly identified.

In all the regressive models from A01 to B10, the residuals were stationary according to the DF-GLS and KPSS tests.

5. Conclusions

According to the evidence found during the research, we can state that the accounting information of the Brazilian federal government has predictive value in relation to the price and return of LTNs in the secondary market. However, this is not to say that the behavior of government financial information was constant in relation to the price and return. Some evidence was found that some of the indicators related to the ability to generate revenue were significant only for the price of LTNs. Regarding other indicators, there is significant evidence for both price and return.

Regarding the control variables, the country risk was the only one with non-significant parameters in the regressions in which the dependent variable was the price. In turn, only inflation was found to have significant parameters in relation to the regressions in which the dependent variable was the return.

The research's evidence is quite similar to that shown by the international literature consulted. Regarding the price, the accounting information of the Brazilian federal government showed reasonable predictive capabilities. Similar results were highlighted by Marquette and Wilson (1992) and Reck and Wilson (2006).

Concerning the return, Copeland and Ingram (1977), Summers (2003), and Plummer et al. (2007) demonstrated that government accounting information had little or reasonable predictive power. In this research, it was evident that the accounting information had little predictive power in relation to the returns on debt securities issued by the Brazilian federal government.

We showed that there is an association between the government accounting information and the prices and returns of LTNs in the period between 2003 and 2012. According to the evidence, accounting information can be considered relevant following the assumptions of the value relevance approach. Thus, this association can be explained from two viewpoints. From the first, a more restricted view, the accounting information is part of the information set used by investors. Thus, the financial statements are able to explain a portion of the variations in the prices and returns of a governmental bond. The second view comes from the relaxation of the assumptions made in the first vision. It would be reasonable to think that specific factors of securities (maturity, values adjustment rates, existence of periodic coupons, etc.), specific factors of the issuer (financial and legal restrictions, default risk, geographical location, etc.), and macroeconomic factors (inflation, exchange rate, similar investment returns, etc.) could be used by investors. The accounting information represents proxies of some of the information used by investors.

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