Public debt management and disagreement on public debt expectations

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Abstract

In public sector economics, an important issue is public debt. Uncertainty regarding future public debt may lead to uncertainty in economic decisions. This paper aims to answer the following question: does the management of public debt securities affect the dispersion of market expectations regarding public debt in Brazil? The Brazilian case is of interest because it presents problems of deterioration in public accounts in recent years. Estimates show that the strategy adopted by the National Treasury as of 1999 for the management of public debt securities, based on the recommendations of Calvo and Guidotti (1990), reduces the disagreements of public debt expectations. Another result of interest is that the coefficient of determination decreases as the time horizon increases. That is, the model explains the variance of the dispersion of expectations better at shorter maturities than at longer maturities. These findings are important since disagreements in expectations can be considered measures of economic uncertainty.

Keywords: Disagreement on Expectations, Public Debt, Uncertainty, Taxes.

Resumo

Na economia do setor público, uma questão importante é a dívida pública. A incerteza quanto à dívida pública futura pode levar à incerteza nas decisões econômicas. Este trabalho visa responder à seguinte questão: a gestão de títulos da dívida pública afeta a dispersão das expectativas do mercado em relação à dívida pública no Brasil? O caso brasileiro é interessante porque apresenta problemas de deterioração das contas públicas nos últimos anos. As estimativas mostram que a estratégia adotada pelo Tesouro Nacional a partir de 1999 para a gestão dos títulos da dívida pública, baseada nas recomendações de Calvo e Guidotti (1990), reduz os desacordos das expectativas da dívida pública. Outro resultado de interesse é que o coeficiente de determinação diminui à medida que o horizonte de tempo aumenta. Ou seja, o modelo explica melhor a variância da dispersão das expectativas em prazos mais curtos do que em prazos mais longos. Esses achados são importantes, pois divergências nas expectativas podem ser consideradas medidas de incerteza econômica.

Palavras-chave: Desacordo de Expectativas, Dívida Pública, Incerteza, Impostos.

JEL: H0 H2 H30 H60

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Introduction

According to Dornbusch and Draghi (1990), the macroeconomic context observed in some countries in the 1980s, with high debt/GDP ratios, highlights several issues related to fiscal equilibrium. When public debt is high, the question is: is there a theoretical model that provides guidance on the appropriate maturities or on the appropriate indexation of public debt? In response, several theoretical models on public debt management have been developed. Broadly speaking, there are five models that consider the issue: (i) Calvo and Guidotti (1990); (ii) Giavazzi and Pagano (1990); (iii) Missale et al. (2002); (iv) Barro (2003); and (v) Giavazzi and Missale (2004).

In late 1999, the Brazilian National Treasury, based on Giavazzi and Pagano (1990) and Calvo and Guidotti (1990), announced a new strategy for managing public debt securities: (i) extend the maturities of federal securities and, (ii) seek a composition of public liabilities to increase the proportion of fixed-rate and price-indexed government securities, and decrease the proportion of floating-rate and exchange-indexed securities.

This paper reports the empirical results of a study on the impacts of the management of public debt securities from the new strategy of the National Treasury on the disagreements of expectations of net public sector debt (DEDLP) for the case of Brazil. The time horizons of expectations are for 12, 24, 36 and 48 months, i.e., short and medium term, based on the period from December 2001 to August 2019. The justification for choosing the time interval is due to the complete availability of the statistical series by the Central Bank of Brazil. In addition, the period of analysis is relevant, given that it starts soon after the adoption of the inflation targeting regime, comprising periods of political instability in Brazil, such as the election of President Lula in 2002, the subprime crisis, the change in economic policy guidelines, known as the "New Economic Matrix," as well as the problems of creative accounting and the impeachment of President Dilma Russef.

The present study has relevance since there is empirical evidence of the impact of DEDLP on the inflation risk premium in Brazil (Montes and Curi, 2017), and on the disagreement of exchange rate expectations (Luna and Montes, 2020). Moreover, according to Montes et al. (2019), it is important to understand the variables that lead to uncertainties in the process of forming public debt expectations, and what kind of practice policymakers could take to mitigate such uncertainties.

This study is aligned considering the topic on disagreement in expectations on fiscal variables, and the central question to be answered is: is better management of government debt securities able to contribute to anchoring government debt expectations, reducing DEDLP? The findings in this study indicate that yes.

Uncertainty plays a crucial role in the expectations formation process: agents may differ and therefore disagree about the future behavior of different economic variables (Montes and Acar, 2018). Since expectations perform an important role in the decision-making process (Mankiw, 2003), several studies debate the process of expectations formation and seek to understand the impacts of expectations on the economy (de Mendonça and Machado, 2013, de Mendonça and Auel, 2015, Backer et al., 2016, Montes and Curi, 2017). In addition, Montes and Luna (2018) emphasize that disagreements in expectations can be substantial and vary over time according to the evolution of uncertainties around the behavior of certain variables.

Studies on disagreement on expectations are recent (Montes and Acar, 2018). According to Montes and Luna (2018), a little explored field in the literature on disagreement on expectations is the one related to disagreement on expectations on fiscal variables. To date, the only studies that address the impact of disagreement in expectations on fiscal variables, considering Brazil as a case study, are Montes and Curi (2017), Montes and Luna (2018), Montes et al. (2019), Montes and Sousa (2019), Luna and Montes (2020), and Montes and Acar (2020).

To the best of our knowledge, no study has sought to verify whether the management of public debt securities, based on the recommendations of Calvo and Guidotti (1990), can impact the process of formation of expectations for the public debt. Thus, this study is innovative in

empirically verifying the impact of the management of public debt securities and the average maturity of the public debt on the DEDLP for the case of Brazil.

Therefore, given the objective of this study, its contribution is relevant, since it is the first work that seeks empirical evidence for this relationship, concluding that better management of public debt securities, based on the recommendations of Calvo and Guidotti (1990), leads to a reduction in uncertainty regarding public debt expectations for the case of Brazil. The results serve as a recommendation to public managers on how to conduct an action plan in the management of public securities.

The remainder of this article is organized as follows: 1. literature review on evidence for public debt management; 2. description of data and estimation methodology; 3. presentation of results and Conclusion with findings and implications for policy.

1. Data and Methodology

To estimate the effect of the management of public debt securities on the disagreement of the public debt, the study contemplates data in the period from December 2001 to August 2019, totaling 213 monthly observations. The justification for choosing the time interval is due to the complete availability of the statistical series by the Central Bank of Brazil. In addition, the period of the analysis is relevant, given that it starts soon after the adoption of the inflation targeting regime, comprising periods of political instability in Brazil, such as the election of President Luiz Inácio Lula da Silva in 2002, the subprime crisis, the change of economic policy guidelines, known as the "New Economic Matrix", as well as the problems of creative accounting and the impeachment of President Dilma Russef.

1.1. Description of the data

1.1.1. Dependent Variables in each estimation

(i) Public debt disagreements (DES_DIV): The disagreement series consider the time horizons of 12, 24, 36 and 48 months, in addition to the variable DES_DIV_PCA, constructed using the principal components technique. Based on Montes and Curi (2017), Montes and Luna (2018), Montes and Acar (2019) and Montes and Lima (2021), the series for the DES_DIV are constructed based on data from the "Focus Bulletin" of the BACEN[1]. In order to better understand the construction of DES_DIV series, it is important to present the following notation: *t* is the instant of time when the expectation is formed[2], *i* identifies the agent making the projections ($i \in$ I, where I is the set of agents[3]), X is the variable of interest of the disagreement, and a is the year for which expectations are formed. Then, $E_t X^{a+j}$ represents the expectation formed by the agent at time t about the value that the net debt will have at the end of the year $a + j$[4]. Then, $E_t^{min} X^{a+j} = \min(E_{i,t} X^{a+j}, i \in I)$ denotes the minimum value of the distribution, while $E_t^{max} X^{a+j} = \max(E_{i,t} X^{a+j}, i \in I)$ denotes the maximum value. The measure of disagreement used in this paper is $Desac\_X^{a+j}$, which is calculated according to equation (1):

$$(1) \qquad Desac\_X^{a+j} = E_t^{max} X^{a+j} - E_t^{min} X^{a+j}$$

[1] BACEN provides the daily maximum, minimum, median, mean, coefficient of variation and standard deviation statistics of the net debt in fixed event for the end of the current year and 4 years ahead.

[2] The instant of time is characterized by a specific date, that is, a day d, a month m, and a year a.

[3] The number of agents in I is *I*.

[4] J = 0: current year; j = 1: year immediately after the current year; j = 2: 2 years after the current year; j = 3: 3 years after current year; j = 4: 4 years after current year.

Forecasts such as $E_t X^{a+j}$ are known as fixed events because the expected horizon varies with the passage of time. In fact, the period of expectations formed in t about the value that variable X will have at the end of the year $a + j$ decreases as t approaches a.

This pattern of decreasing forecast horizon as t progresses throughout the year, leads to seasonal behavior in disagreement measures based on fixed event expectations, precisely because the dispersion of expectations tends to decrease as the forecast horizon shortens[5].

In order to avoid this seasonal behavior, several studies resort to the fixed horizon, in which the forecast horizon does not vary with the passage of time (e.g., Mankiw et al., 2003; Montes et al., 2016; Oliveira and Curi, 2016; Montes and Curi, 2017). According to Dovern et al. (2012), the conversion from fixed event to fixed horizon is done using the equation (2):

$$(2) \qquad E_t X^{12(j+1)} = \frac{12-(m-1)}{12} E_t X^{a+j} + \frac{m-1}{12} E_t X^{a+j+1} \text{ , j = 0,1,2,3...}$$

Where m represents the month in which the expectation is formed and $E_t X^{12(j+1)}$ denotes the average of agents expectations about the value that variable X (net debt) will have at the end of next 12 (j + 1) months. The same formula is used to interpolate minimum and maximum projections in order to calculate the disagreement of expectations (as well as the average expectations). At the end of the process, a term structure of debt expectations disagreement is derived: DES_DIV_12m, DES_DIV_24m, DES_DIV_36m and DES_DIV_48m. As the BACEN releases forecasts for the current and the next 4 years, the above formula can be applied by taking j = 0, 1, 2, 3 e 4. Therefore, you could always interpolate forecasts for fixed time horizons of 12, 24, 36 and 48 months ahead.

The described procedure is performed daily, allowing the study of the term structure of the disagreement for each working day. The time series composed of daily observations are converted to monthly frequency by means of monthly averages.

Principal component analysis is conducted by fitting a linear combination of observed variables with optimal weights. Several principal components can be conducted, but for the analysis performed in this study, only the first principal component (PCA) is created. Before generating the PCA series, it is necessary to perform the Bartlett, Levene, and Kaiser-Meyer-Olkin (KMS) tests, whose results are reported in table A.2 and A.3 in the appendix at the end of the paper. Based on the test results, it is possible to extract the PCA.

The fixed horizon event forecast conversion, monthly frequency and PCA extraction techniques are applied to calculate the DEDLP variables.

1.1.2. Explanatory variables of main interest

(ii) Relative indexation index (IIR): the following series are used for IIR construction: pre-fixed public debt - National Treasury Bills (LTN) and National Treasury Notes (NTN-F), series no. 4178 from the Central Bank of Brazil's time series manager system (SGS); public debt indexed to the broad consumer price index (IPCA), series no. 12001 - SGS; public debt indexed to the general market price index (IGP-M), series no. 4175 - SGS; public debt indexed to the general price index - domestic availability (IGP-DI), series no. 4176 - SGS; public debt indexed to the over SELIC interest rate, series no. 4177 - SGS; and public debt indexed to the Exchange rate, series no. 4173 - SGS. The IIR is obtained from the sum of the fixed-rate debt with the debt indexed by the IPCA, IPG-M and IGP-DI, divided by the sum of the debt indexed to SELIC and Exchange. The higher the index, the better the quality of the indexing profile, as pointed out in de Mendonça and Auel (2015); (iii) Average Federal Debt Term (PMDP): average maturity of the public debt, series no. 10618 - SGS. This variable is linked to refinancing risk. According to de Mendonça and Machado (2013), a

[5] An example could help clarify this problem. Suppose that an agent, in March 2005, calculates his expectation about the value of the net debt at the end of 2005. In this case we can say that the time horizon of the forecast is 10 months, because the first 2 months of 2005 have already passed and the budget balance figures for January and February are known. By the same line of reasoning, when this agent calculates his net debt expectation in September 2005 over the value of the budget balance at the end of 2005, the horizon of his forecast shrinks to 4 months.

longer maturity period is one of the factors that reduces the amount of securities that need to be exercised in a crisis period;

1.1.3. Control variables

(iv) Variation of the tax burden (VAR_TRIB): this series seeks to capture the beneficial effects of a softening of the tax burden according to Barro's theory (1979)[6]. For this purpose, the variable is constructed according to equation 3 below:

$$(3) \qquad \text{VAR\_TRIB}_t = \left\{\left[\left(\frac{R}{Y^*}\right)\cdot 100\right]_t - \left[\left(\frac{R}{Y^*}\right)\cdot 100\right]_{t-1}\right\}^2$$

Where R is the tax revenue in current values obtained by the government and Y* is the monthly GDP in current values[7]. The series were obtained from BACEN, where R is series number 7639 - SGS and Y* is series number 4380 - SGS.

An increase in VAR_TRIB is expected to lead to an increase in the costs of distortions in resource allocation, which increases agents' uncertainty, which may lead to higher DEDLP;

(v) Political and economic uncertainty index for Brazil (EPU_BRA): this variable measures the index of movements in economic uncertainty, following Baker *et al*. (2016) policy-related in Brazil, assessing the perception of Brazil's ability to maintain political and economic stability [8]. EPU_BRA is built from texts from the newspaper Folha de São Paulo that have in their content terms like "uncertain", "uncertainty", "economic" and "economy";

(vi) Fiscal Impulse (FI): this series represents the fiscal impulse indicator, which tends to obtain discretionary fiscal policy actions. Thus, the methodology used in the works of Fatás and Mihov (2003), Ciro and de Mendonça (2017), Montes and Luna (2018) and Montes and Lima (2021) was applied, and the same indicator used by the aforementioned authors was chosen, which seeks to acquire the arbitrary conduct of the government in relation to fiscal policy.

As described in the paper by Montes and Luna (2018), according to Fatás and Mihov (2003), it is beneficial to ponder that fiscal policy consists of three strands: (i) automatic stabilizers, (ii) fiscal policy that reacts to the state of the economy, and (iii) discretionary policy that is implemented for reasons other than macroeconomic conditions. Following the literature, and what was applied in the paper by Montes and Lima (2021), this paper will focus on the third item of fiscal policy. As described in Montes and Luna (2018), Fatás and Mihov (2003) argued that there is no understanding in the literature about the convenient methodology for constructing a measure of discretionary fiscal policy.

In line with the works of Montes and Luna (2018), Montes and Curi (2017b), Montes and Lima (2021), authors Fatás and Mihov (2003) focus only on government spending in denial of the budget deficit. The authors' preference is caused both by theoretical arguments that the political process in most countries does not allow for urgency changes in discretionary spending, as well as by empirical evidence that exposes that spending does not respond much to the cycle. Fatás and Mihov (2003) estimate an equation for government spending and use the error term of this equation to calculate its volatility, where they interpret the volatility of the error term as a quantitative estimate of discretionary policy. Thus, they calculate the volatility of the error term, and this variable can be interpreted as the typical size of a discretionary change in fiscal policy.

The construction of the fiscal impulse indicator follows the articles by Fatás and Mihov (2003) and the methodology presented by Ciro and de Mendonça (2017) and Montes and Luna (2018). Thus, the indicator (FI) was constructed, which assimilates the arbitrary change in fiscal policy.

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[6] Barro (1979) considers the use of public debt to regulate the tax burden over time, to minimize the effects of tax collection distortion on resource allocation.

[7] In assembling the VAR_TRIB series it was used the seasonal adjustment by the *Ratio to moving average – Multiplicative*.

[8] Series obtained from the *site*: https://www.policyuncertainty.com/all_country_data.html.

According to the study by Montes and Lima (2021), to compose the fiscal impulse indicator, one must estimate the elasticities of government spending in relation to the main macroeconomic variables through equation 4. Based on this equation, it is feasible to separate the influence of the economic situation from the indicator, allowing only the term related to the discretionary behavior of the government (Ciro and de Mendonça, 2017; Montes and Luna, 2018). Equation 4 is defined as:

$$(4) \qquad G_t = \alpha_0 + \alpha_1 G_{t-1} + \alpha_2 r_{t-1} + \alpha_3 Y_{t-1} + \alpha_4 INF_{t-1} + \varepsilon_t$$

Where G_t is government spending, G_{t-1} is fiscal policy persistence, r is the short-term real interest rate, *Y* is the log of seasonally adjusted real GDP, INF is the inflation rate and ε_t is the random error term.[9] The variables *Y*, *INF* and *r* capture the response of fiscal policy to the state of the economy.[10] Discretionary fiscal policy is captured through the residual, and therefore does not represent a reaction to economic conditions.

After estimating equation 4, the residual is used to observe changes in discretionary fiscal policy. Thus, based on Ciro and de Mendonça (2017) and Montes and Luna (2018), equation 5 generates the fiscal impulse indicator (FI)[11]:

$$(5) \qquad FI_t = \varepsilon_t - \varepsilon_{t-12}$$

(vii) Public debt (DIV_LIQ): net public sector debt, as a percentage of GDP, consolidated public sector (series no. 4513 - SGS). The larger the stock of public debt, the greater is the government's sacrifice in meeting its commitments. This series was used in the works of de Mendonça and Machado (2013) and de Mendonça and Auel (2015);
(viii) Inflation (INF): is the inflation measured by the IPCA (series no. 13522 - SGS). This variable can reveal whether the government is monetizing the public debt. Furthermore, a drop in inflation due to a restrictive monetary policy (interest rate increase) can imply an increase in public debt, as pointed out in de Mendonça and Machado (2013).
(ix) Subprime dummy (DUMMY_SUBPRIME): is a dummy that captures the effect of the subprime crisis. This dummy assumes values of 1 for the period November 2009 to April 2010, and zero for the remaining periods.
(x) Fiscal Dummy (DUMMY_FISCAL): is a dummy that captures the effect in relation to the fiscal crisis of the Dilma government, comprising the period from January 2015 to February 2017, receiving the value of 1 for this period and 0 for the other periods. The justification for using this dummy is that in the period there was a considerable increase in public debt disagreements due to the use of the so-called creative accounting.

Descriptive statistics for the variables used in the analyses are presented in table A.4 in the appendix.

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[9] The government expenditure series (G) was obtained from the BACEN - serial number 7547 (Central Government Primary Result - Total Expenditure). The real interest rate is obtained through the difference between the nominal interest rate (Selic) obtained from BACEN (nº series 4189) and the inflation rate is obtained from the Broad Consumer Price Index - IPCA (nº series 13522). The real GDP was obtained from the accumulated GDP series in the last 12 months, current prices (R$ million), made available by BACEN (nº series 4382), deflated by the Extended Consumer Price Index - IPCA (nº series 13522) and seasonally adjusted.

[10] Both economic growth (captured through the log of seasonally adjusted real GDP) and inflation determine the adoption of stabilization policies, and the real interest rate affects the decision to invest in public infrastructure. In short, these variables define the procyclicality or counter-cyclicality of fiscal policy. Unlike Ciro and de Mendonça (2017), in this paper the inflation rate is used instead of oil prices. Since the Brazilian case is studied here, and Brazil has experienced several episodes of high inflation, inflation was included to ensure that the results are not driven by inflationary episodes. Including the inflation rate in this type of equation was also adopted by Fatás and Mihov (2003), Montes and Luna (2018), and Montes and Lima (2021).

[11] Like Ciro and de Mendonça (2017), we use a 12-month lag because it is long enough to measure important changes in fiscal policy.

1.2. Metodology

To estimate the impact of risk management on DEDLP, the empirical analysis was conducted using the ordinary least squares method (OLS), the generalized method of moments (GMM) and two-stage generalized method of moments (GMM-2s). The estimates obtained by OLS and GMM use the Newey-West covariance matrix (Newey and West, 1987), while GMM-2 uses the Windmeijer matrix for finite samples (Windmeijer, 2005).

The ordinary least squares (OLS) method is one of the most common methods for regression analysis.

According to Wooldridge (2006), the model requires some basic assumptions: linearity in the parameters, no perfect linear relationship among the explanatory variables, no model specification bias, uncorrelated error terms with zero mean, homoscedasticity, and normal distribution.

According to de Mendonça and Tostes (2015), although the OLS estimator is useful for our purposes, it is well known that the estimated coefficients are not reliable in the presence of serial autocorrelation, heteroscedasticity, or nonlinearity (GREENE, 1993).

Furthermore, the OLS estimator is susceptible in the regressors to simultaneity and endogeneity problems, while the GMM provides consistent estimates (Wooldridge, 2001; Hall, 2015) allowing to verify that the results with OLS are preserved.

In a GMM context, the selection of instruments follows Johnston (1984), that is, when using instruments that are the same variables used in the model, these are lagged in one or more periods relative to the period used in the estimation, in order to ensure exogeneity.

However, when there are more moment conditions than parameters to be estimated, a test can be used to check overidentification constraints.

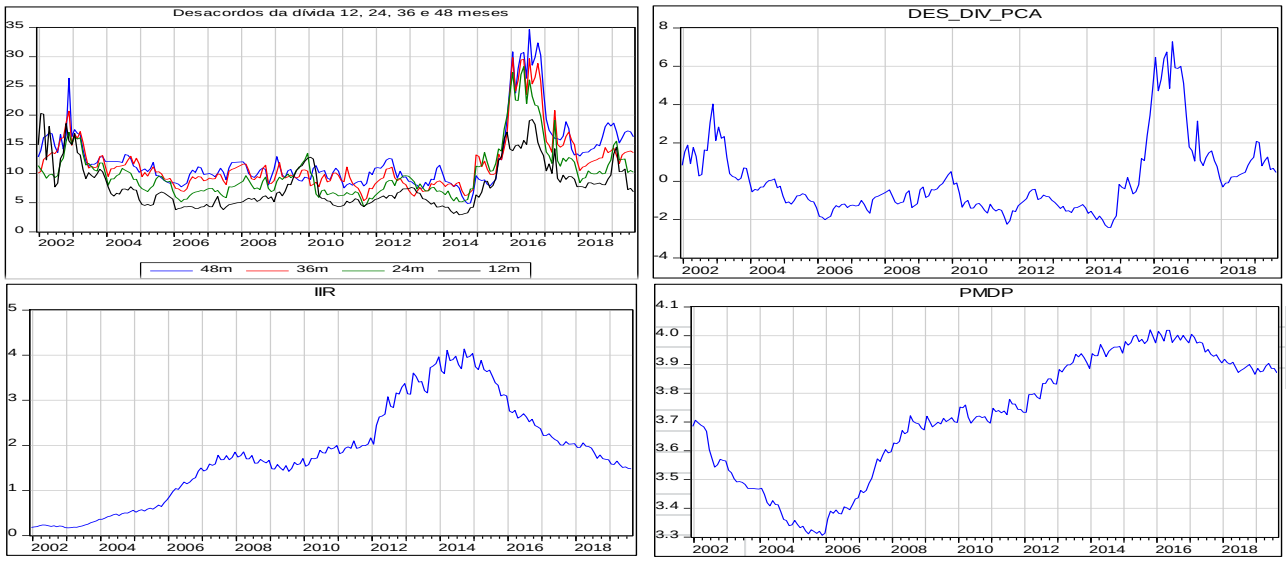
Therefore, the standard J-test was performed and reported to indicate whether the orthogonality condition is satisfied. In addition, the Durbin-Wu-Hausman test for endogeneity is applied.

Given, then, the variables that will be used in the study, a first condition to be analyzed, before applying the estimation methods, is to verify if the series are stationary. The stationarity or non-stationarity of a series can strongly influence its behavior and properties. For example, the persistence of shocks in nonstationary series will always be infinite. Also, the use of nonstationary data can lead to spurious regressions, since if the variables are trending over time, a regression could present a high R2, even if the variables are independent. In view of this, the Augmented Dickey-Fuller (ADF), Phillips Perron (PP) and Kwiatkowski -Phillips-Schmidt-Shin (KPSS) tests were applied to verify the presence of unit root in the series, reported in table A.1 of the appendix.

According to the results, it was found that the variables IIR, PMDP and DIV_LIQ are I(1). For the I(1) series, in the estimations, these enter differentiated, thus using Δ as the first difference operator. All other variables are integrated of order zero, I(0).

As motivation for the study, it can be observed in Fig. 1, in relation to the disagreement variables, that there is a considerable increase in them in the period from 2015 to 2017 that coincides with the beginning of a sharp drop in the IIR variable and a more discrete drop in the PMDP variable.

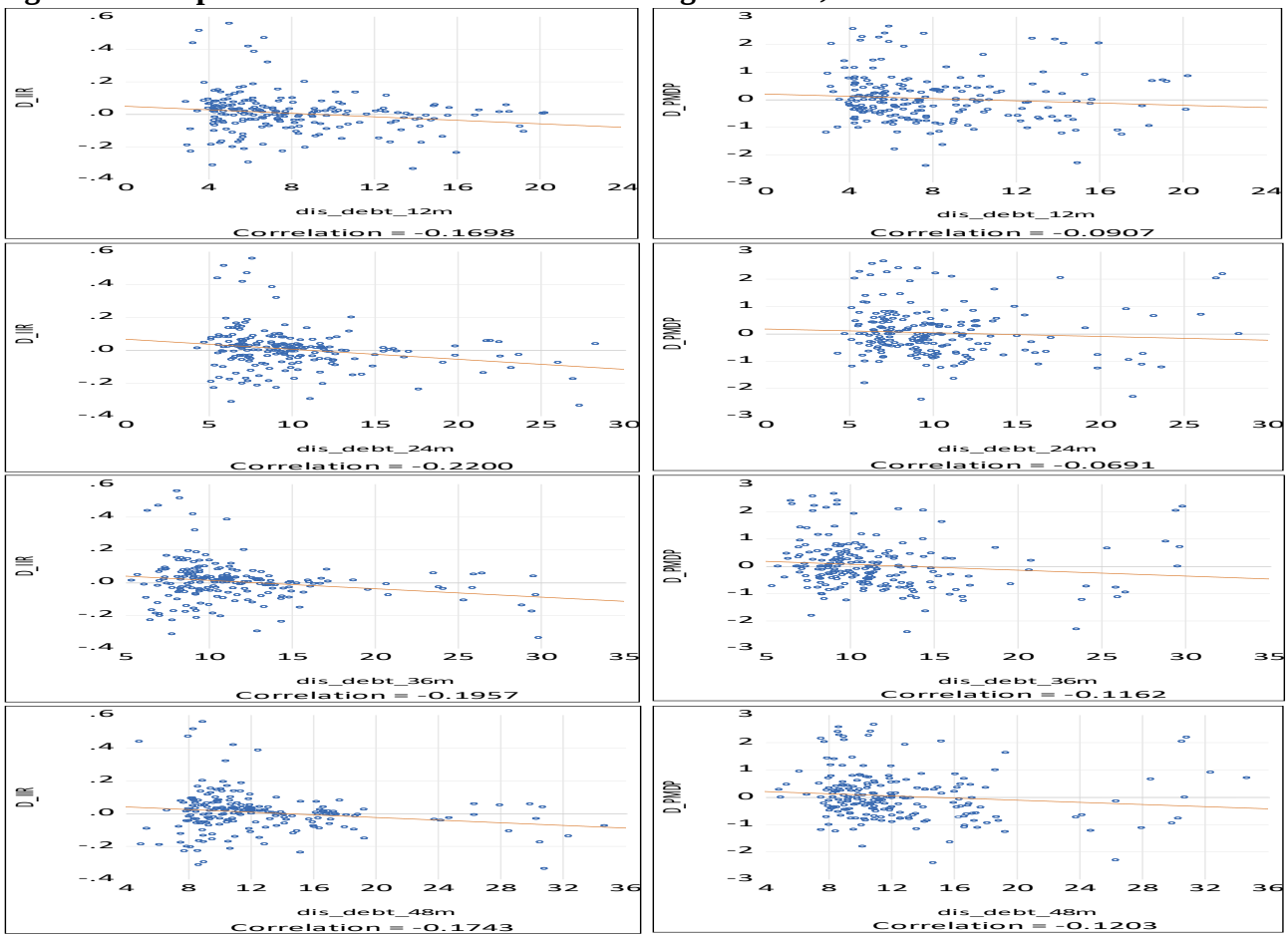
Fig. 1 – Disagreements in expectations about debt, IIR and PMDP



Source: Eviews 10.0. Own elaboration.

The Figure 2 presents the correlations between the DEDLP variables and the explanatory variables of main interest. For the public debt management variables related to indexation and average payment period, a negative correlation with DEDLP is observed. This is expected, since an increase in pre-fixed and post-fixed inflation-indexed securities relative to Selic and exchange-indexed securities is desired, as is a longer average payment period for securities.

Fig.2 - Scatter plots and correlations between Disagreements, ΔIIR and ΔPMDP



Source: Eviews 10.0. Own elaboration.

The variables described in item 2.1 were used in the following estimation models, according to the following general equation:

(6) $$DES\_DIV_{i,t} = \alpha_i + \beta_i \Delta IIR_t + \gamma_i \Delta PMDP_t + \omega_i Z_t + \theta_i Dum\_Fisc_t + \varphi_i Dum\_Subprime_t + \varepsilon_t$$

where, $DES\_DIV_{i,t}$ is the variable disagreement of the public debt in period *t*, being *i* = 1, 2, 3, 4 and 5 according, respectively, to each estimation 12, 24, 36, and 48 months, besides the PCA; a_i is the constant; β_i is the parameter related to the effect of the variable ΔIIR_t; γ_i is the parameter related to the effect of the variable $\Delta PMDP_t$; ω_i is the parameter related to the effect of the control variables Z; θ_i is the parameter related to the effect of variable Dum_Fisc; φ_i is the parameter related to the effect of variable $Dum\_Subprime$. The choice of the lags of the variables was determined empirically, following Hendry (2001).

2. Analysis of results: empirical evidence

As per equation 6, the effects of the main independent variables, which correspond to public debt management, and the control variables on public debt disagreements were estimated for time horizons of 12, 24, 36 and 48 months, as well as for principal component of these time horizons. In addition to the principal and control variables, two *dummies* were used in all estimations: one in relation to the *sub-prime* crisis, comprising the period from 11/2009 to 04/2010, receiving a value of 1 for this period and 0 for the others; and one in relation to the Dilma government's fiscal crisis, comprising the period from 01/2015 to 02/2017, receiving a value of 1 for this period and 0 for the others.

Tables 1, 2 and 3 present the results of the estimations using the OLS, GMM and GMM-2s methods respectively.

Table 1 – OLS Estimations – dependent variable: *DES_DIV*

Explanatory Variable	m=12	m=24	m=36	m=48	PCA
ΔIIR_t	-2.662**	-3.015**	-3.012*	-3.120*	-1.297**
	(1.167)	(1.263)	(1.489)	(1.942)	(0.773)
$\Delta PMDP_t$	-0.311**	-0.291	-0.585**	-0.737**	-0.205**
	(0.179)	(0.215)	(0.267)	(0.306)	(0.107)
VAR_TRIB_t	0.039**	0.041*	0.099***	0.131***	0.033***
	(0.016)	(0.023)	(0.034)	(0.042)	(0.010)
EPU_BRA_t	0.009***	0.012***	0.014***	0.015***	0.005***
	(0.002)	(0.003)	(0.003)	(0.004)	(0.001)
FI_t	4.400***	6.533***	6.700***	7.445***	2.733***
	(1.528)	(2.041)	(2.106)	(2.523)	(0.929)
ΔDIV_LIQ_{t-3}	0.927***	0.717***	0.7269**	0.572*	0.328***
	(0.256)	(0.240)	(0.282)	(0.336)	(0.099)
INF_t	0.468***	0.416***	0.320***	0.219*	0.160***
	(0.101)	(0.105)	(0.115)	(0.136)	(0.033)
DUMMY_FISCAL	2.507**	5.544***	4.770**	4,779	1.925***
	(1.329)	(1.982)	(2.556)	(3.460)	(0.343)
DUMMY_SUBPRIME	4.833***	1,338	-1,105	-0.994*	0.517
	(1.034)	(1.536)	(0.868)	(0.489)	(0.528)
Observations	209	209	209	209	209
Ajusted R^2	0.499	0.615	0.538	0.44	0.557
F-statistic	24.060	37.986	27.933	19.188	30.135
F-stat Prob	0.000	0.000	0.000	0.000	0.000

Marginal Significance Levels:*** denotes 0,01; ** denotes 0,05; e * denotes 0,1. Robust (Newey–West) standard erros are in parentheses.

Source: Eviews 10.0. Own Elaboration.

Table 2 – GMM Estimations – dependent variable: *DES_DIV*

Explanatory Variable	m=12	m=24	m=36	m=48	PCA
ΔIIR_t	-7.903***	-7.786**	-7.514***	-8.372**	-3.905***
	(2.619)	(3.078)	(2.766)	(3.556)	(1.230)
$\Delta PMDP_t$	-0.801***	-0.675**	-0.851***	-1.277***	-0.429***
	(0.273)	(0.301)	(0.279)	(0.398)	(0.130)
VAR_TRIB_t	0.078**	0.057*	0.125***	0.279***	0.048***
	(0.039)	(0.030)	(0.035)	(0.077)	(0.017)
EPU_BRA_t	0.013***	0.016***	0.012***	0.016***	0.005***
	(0.003)	(0.003)	(0.004)	(0.005)	(0.001)
FI_t	6.374**	21.046***	13.173***	20.577***	4.891***
	(2.900)	(3.950)	(4.022)	(6.355)	(1.737)
ΔDIV_LIQ_{t-3}	0.880***	1.021***	2.140***	2.876***	0.926***
	(0.139)	(0.390)	(-0.529)	(0.722)	(0.241)
INF_t	0.360***	0.387***	0.182*	0.163*	0.115**
	(0.051)	(0.099)	(0.098)	(0.092)	(0.047)
DUMMY_FISCAL	2.897***	6.600***	7.179***	3.833**	2.390***
	(0.934)	(1.064)	(1.308)	-2	(0.565)
DUMMY_SUBPRIME	8.058***	5,541	-4,232	-4,320	0.704
	(2.491)	(1.064)	(3.878)	(5.701)	(1.802)
Observations	201	201	201	201	201
Ajusted R^2	0.442	0.429	0.385	0.199	0.416
J-statistic	19.307	23.029	24.385	24.624	22.066
Prob J-estat	0.962	0.683	0.83	0.82	0.631
D-W-H test	5.096	6.674	5.123	4.839	3.466
Prob D-W-H test	0.825	0.663	0.823	0.848	0.943
N. instruments	42	37	42	42	35

Note: Marginal Significance Levels:*** denotes 0,01; ** denotes 0,05; e * denotes 0,1. Robust (Newey–West) standard erros are in parentheses. Prob J-stat reports the respective p-value of the J-test. The D–W –H test is the Durbin–Wu–Hausman (difference in J-statistics) with a null hypothesis that the regressores are exogenous. Prob D-W-H test reports the respective p-value of the D-W-H.

Source: Eviews 10.0. Own Elaboration.

Table 3 –Estimations by GMM-2s – dependent variable: *DES_DIV*

Explanatory Variable	m=12	m=24	m=36	m=48	PCA
ΔIIR_t	-6.517*	-8.117**	-9.106*	-7.175*	-3.945**
	(3.806)	(3.678)	(4.732)	(4.118)	(1.740)
$\Delta PMDP_t$	-0.780*	-0.727**	-1.039**	-0.946*	-0.400**
	(0.426)	(0.364)	(0.491)	(0.482)	(0.201)
VAR_TRIB_t	0.118**	0.105*	0.162***	0.256***	0.057**
	(0.056)	(0.063)	(0.061)	(0.075)	(0.027)
EPU_BRA_t	0.016***	0.013*	0.012**	0.009*	0.004*
	(0.003)	(0.006)	(0.005)	(0.005)	(0.002)
FI_t	9.008**	12.828*	18.065***	14.191*	5.940**
	(4.367)	(6.372)	(5.787)	(7.407)	(2.399)
ΔDIV_LIQ_{t-3}	0.484*	3.581***	3.116***	3.249***	1.386***
	(0.285)	(1.235)	(1.115)	(1.011)	(0.468)
INF_t	0.436***	0.469**	0.355**	0.269**	0.166***
	(0.069)	(0.195)	(0.154)	(0.129)	(0.052)
DUMMY_FISCAL	2.109*	4,590	5.119***	4.113**	1.695**
	(1.139)	(2.783)	(1.927)	(1.669)	(0.791)
DUMMY_SUBPRIME	8.503**	2,504	-0.996	-3,445	0.076
	(4.098)	(5.809)	(6.036)	(5.924)	(2.026)
Observations	202	200	200	199	200
Ajusted R^2	0.383	0.38	0.32	0.32	0.353
J-statistic	18.762	19.537	25.776	28.444	24.035
Prob J-estat	0.992	0.849	0.872	0.789	0.918
D-W-H test	6.298	6.312	5.067	4.614	2.872
Prob D-W-H test	0.709	0.708	0.828	0.866	0.969
N. instruments	46	37	45	49	45

Note: Marginal Significance Levels:*** denotes 0,01; ** denotes 0,05; e * denotes 0,1. Robust (Newey–West) standard errors are in parentheses. Prob J-stat reports the respective p-value of the J-test. The D–W –H test is the Durbin–Wu–Hausman (difference in J-statistics) with a null hypothesis that the regressors are exogenous. Prob D-W-H test reports the respective p-value of the D-W-H.

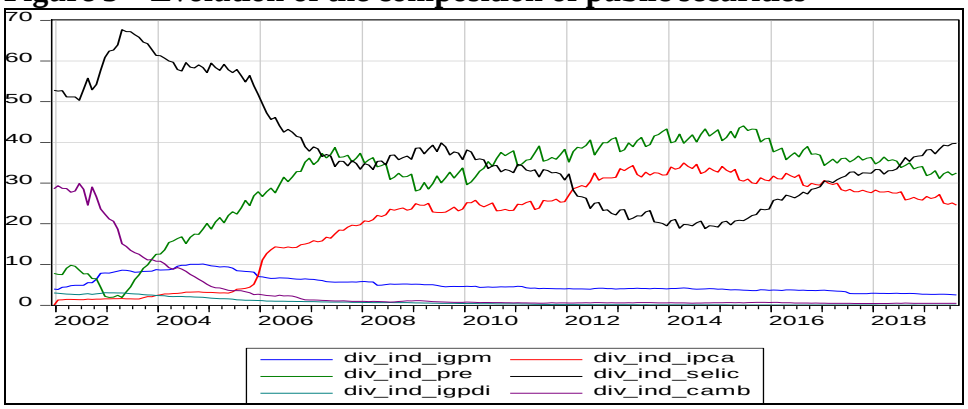
Source: Eviews 10.0. Own Elaboration.

Main Variables

The results for the main variables were as expected in all methods. The analyses of the results are presented by variable, as follows:

(i) The negative and significant sign of the coefficient of the variable ΔIIR, for all time horizons, including for the PCA, shows that an increase in the ratio of prefixed securities and inflation-indexed securities/post-fixed securities at the Selic rate and securities indexed to the exchange rate, reduces the DES_DIV. The results are in line with the recommendations of Calvo and Guidotti (1990) and Giavazzi and Missale (2004), that the Brazilian public debt have in its portion more pre-fixed and inflation-indexed securities than Selic rate and exchange rate-indexed securities. This composition, which is pursued by the National Treasury according to Annual Borrowing Plans (PAF) in recent years, has been successful, even though as of 2015 there has been a downward trend in fixed-rate and inflation-indexed securities and an upward trend in Selic-indexed securities, as shown in figure 3.

Figure 3 – Evolution of the composition of public securities



Source: Eviews 10.0. Own Elaboration.

In sum, the findings indicate that this relationship of composition of the government bond portfolio impacts the disagreements of public debt expectations in a way that reduces them when more pre-fixed and inflation-indexed securities increase relative to Selic and exchange rate-indexed securities.

(ii) The negative and significant sign of the coefficient of the variable ΔPMDP for all time horizons, including for the PCA, shows that a lengthening in the average term of the government bond portfolio reduces the DESV_DIV. This result agrees with Calvo and Guidotti (1990), Giavazzi and Pagano (1990), Missale et al. (2002), Barro (2003), and Giavazzi and Missale (2004), who conclude that the optimal strategy for managing the public debt is the one capable of partially indexing the public debt and, at the same time, extending its average maturity term. This finding is empirical evidence that confirms this optimal strategy for the disagreements of the expectations of the debt, since the increase of the PMDP leads to a reduction in the disagreements of the expectations of the public debt.

The findings reported in items (i) and (ii) are important and relevant, since they concern variables related to public debt management. They are relevant evidence findings for *policymakers*, as they confirm the need for public debt management in order to reduce fiscal policy uncertainties, here translated by divergences in public debt expectations.

Control Variables

Regarding the control variables, results with the expected and significant relationships were also found in all estimations. The analyses of the results for the control variables are presented as follows:

(iii) The positive and significant sign of the coefficient of the VAR_TRIB variable, for all time horizons, including for PCA, shows that if VAR_TRIB decreases, it reduces DES_DIV. This agrees with Barro (1979). Tax smoothing has important policy implications, as it is plausible to expect tax distortions or excessive tax burdens to increase more than proportionately with tax rates. Thus, the government can minimize tax distortions by keeping tax rates relatively smooth or constant by using tax indebtedness, rather than raising them in some periods and lowering them in other periods (Barro, 1979). The empirical evidence found here shows that a reduction in VAR_TRIB would be minimizing tax distortions, represented by the reduction in disagreements in expectations of public debt.
(iv) The positive and significant sign for the EPU_BRA variable, for all time horizons, including for the PCA, shows that an increase in the political and economic uncertainty index for Brazil, raises the disagreements of public debt expectations.
(v) The positive and significant sign for the FI variable, for all time horizons including the PCA, shows that an increase in fiscal impulse leads to an increase in disagreements in public debt expectations. This finding may have grounds based on Lucas' Critique, that public policies can destabilize rather than stabilize the economy, according to the interpretations of economic agents before such policies, often forming expectations that end up bringing different results than expected. In this case, a fiscal impulse leads to increased disagreements in public debt expectations. This result may be related to uncertainties regarding the form of financing and risk intrinsic to the long-term fiscal policy.
(vi) The positive and significant sign for the variable DIV_LIQ, for all time horizons including the PCA, shows that an increase in net debt leads to a greater disagreement of public debt expectations.
(viii) The positive and significant sign for the INF variable, for all time horizons including the PCA, shows that an increase in inflation leads to an increase in disagreement on public debt expectations. The increases in disagreements, given increases in inflation, can be explained, for example, by the issue of the possibility of fiscal dominance, according to Blanchard (2004).
(ix) As for the *dummies*, DUMMY_FISCAL has a positive and significant sign for almost all results, except for the OLS estimation for the 48-month period, where the result is positive but not significant. This shows how significant the impact of the fiscal crisis in the Rousseff administration impacting public debt expectations was, generating a less stable environment in terms of fiscal forecasting. DUMMY_SUBPRIME was positive and significant only for the 12-month time horizon. For all other periods, except for the OLS estimation for the 48-month period, where there was statistical significance for a positive sign, the *dummy subprime* was not significant and the sign varied from positive to negative in the periods. In other words, the *subprime* crisis impacted significantly only the period of public debt expectations for the 12-month time horizon and was not significant and conclusive for practically all the other time horizons.

One result of interest is that R^2 decreases as the time horizon increases. That is, the model's explanatory variables explain the short term better than longer terms.

In the GMM and GMM-2s estimations the instrumental variables listed in appendix A.5 were applied.

Robustness Analysis

ARDL Method Estimation

Since the sample has a mix of I(0) and I(1) variables, one can apply the modeling proposed by Pesaran and Shin (1999) and Pesaran et al. (2001), which is the ARDL (Autoregressive Distributed-lag) estimated model. This model provides robust results and tests for the existence of a relationship between the variables in levels. Based on Eq. (6), an ARDL model can be represented by the equation 7:

(7) $\Delta dis_{debt_{12}t} =$
$a_0 + \sum_{i=1}^{k} b_i \Delta dis\_debt\_12m_{t-i} + \sum_{i=0}^{k} c_i \Delta IIR_{t-i} + \sum_{i=0}^{k} d_i \Delta PMDP_{t-i} + \delta_1\, dis\_debt\_12m_{t-1} + \delta_2 IIR_{t-1} + \delta_3 PMDP_{t-1} + \delta_4 VAR\_TRIB_t + \delta_5 EPU\_BRA_t + \delta_6 FI_t + \delta_7 DIV\_LIQ_t + \delta_8 INF_t + \delta_9 DUMMY\_FISCAL_T + \delta_{10} DUMMY\_SUBPRIME_t + \epsilon_t^0$

Where Δ is the first difference operator k is the optimal size of the *lags*. The parameter δ_i (i = 1,2,3,4,5,6,7,8) represents the long-run relationship.

Table 4 - ARDL – Level relationship obtained from equation (7)

dis_debt_12m - (4,3,1)				
Bond test			Critical value bounds	
Test statistic	Value	Significance %	I(0)	I(1)
F-statistic	3.308	10	1.85	2.85
K	8	5	2.11	3.15

Equation error correction
= DIS_DIV_12M - (-2.7418*IIR + 0.3264*PMDP + 0.0038*EPU_BRA +
1.1100*FI + 0.0068*DIV_LIQ + 0.2065*INFL + 4.3344*DUMMY_FISCAL +
1.5278*DUMMY_SUBPRIME)

Long-run coeficients

Variable	Coeficient	SE	T-statistic
IIR	-2.741835***	(0.933182)	[-2.938158]
PMDP	0.326423***	(0.078350)	[4.166203]
EPU_BRA	0.003832	(0.004109)	[0.932544]
FI	1.109967	(3.248001)	[0.341738]
DIV_LIQ	0.006814	(0.085557)	[0.079644]
INFL	0.206478*	(0.108966)	[1.894895]
DUMMY_FISCAL	4.334432***	(1.604200)	[2.701928]
DUMMY_SUBPRIME	1.527803	(2.820722)	[0.541635]

Model selection is based on adjusted R2. Marginal significance levels: (***) denotes 0.01, (**) denotes 0.05, and (*) denotes 0.10. Robust standard errors (Newey–West) are in parentheses and t-statistic in brackets. Constant term is included, but not reported

The results confirm the previous findings for all variables (statistically significant for the IIR, IFL and the DUMMY_FISCAL variables), except for the PMDP variable. The result with positive sign for the PMDP variable can be explained by the fact that in the long run, in the Brazilian case in which many public bonds are indexed to the Selic rate, the market would accept an increase in bond maturities together with a higher interest rate. This could lead to an increase in the public debt, which would justify an increase in the dispersion of expectations for the public debt. Therefore, for economies with low credibility, the strategy of lengthening maturities may not be adequate for the long term. This is because, under these conditions, the public tends to prioritize liquidity - due to the risk of insolvency, inflation, weakening of economic fundamentals, etc. - so that extending the maturity of the debt can only be obtained at a very high cost, such as paying a very high real interest rate.

Concluding Remarks

This paper sought to answer the following question: is a better management of the public debt, here expressed by the indexation of public securities, average maturity of the public debt, and variation in the tax burden, capable of contributing to anchor expectations of the public debt, reducing DEDLP? The findings of this study indicate that yes.

Studies such as Barro (1979), Calvo and Guidotti (1990), Giavazzi and Pagano (1990), Missale et al. (2002), Barro (2003), and Giavazzi and Missale (2004) show that good public debt management should have a higher ratio of prefixed and inflation-indexed securities / Selic and exchange rate-indexed securities, a longer average public debt term, and a smooth tax burden over time. This good management of the public debt leads to better results in terms of fiscal policy, from which is expected a reduction in uncertainties, here as the disagreement of expectations of the public debt.

To this end, the empirical results of this study on disagreements in public debt expectations are reported for the case of Brazil, based on the period from December 2001 to August 2019. The estimations were performed using the OLS, GMM and GMM-2s methods.

The findings of this study confirm that good public debt management, for the case of Brazil, leads to a reduction in uncertainty, here as disagreements in public debt expectations. The results for the variables ΔIIR and ΔPMDP were significant for all time horizons in all estimation methods.

Theoretical confirmation in these findings is of utmost importance for *policymakers* in their actions in public debt management. The results serve as a recommendation to managers regarding the conduction of an action plan in the management of public securities and tax smoothing, especially regarding public securities and average term that, for example, according to the PAF of the Brazilian National Treasury, one should continue to seek a greater placement of fixed-rate and inflation-indexed public securities, and a smaller placement of Selic and exchange rate-indexed public securities.

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Appendix

Table A.1 – Unit Root Tests

Séries	ADF					PP					KPSS				
	eq.	lag	t-stat	v.c 10%	critério	eq.	band	t-stat	v.c 10%	critério	eq.	band	t-stat	v.c 1%	critério
DES_DIV_12m	I	0	-3.21	-2.57	ak	I	2	-3.05	-2.57	ak	I	11	0.23	0.73	ak
DES_DIV_24m	I	0	-2.51	-2.57	ak	I	6	-2.65	-2.57	ak	*I/T*	11	0.17	0.21	ak
ΔDES_DIV_24m	N	0	-15.73	-1.61	ak										
DES_DIV_36m	I	0	-2.77	-2.57	ak	I	3	-2.67	-2.57	ak	I/T	11	0.19	0.21	ak
DES_DIV_48m	I	0	-2.60	-2.57	ak	I	7	-2.70	-2.57	ak	I/T	11	0.2	0.21	ak
DES_DIV_PCA	N	0	-2.30	-1.61	ak	N	6	-2.44	-1.61	ak	I/T	11	0.2	0.21	ak
IRR	I	6	-1.90	-2.57	ak	I	3	-1.48	-2.57	ak	I/T	11	0.28	0.21	ak
ΔIRR	N	5	-2.51	-1.61	ak	I/T	3	-17.8	-3.13	ak	I/T	1	0.19	0.21	ak
PMDP	I/T	12	-2.43	-3.13	ak	I/T	2	-2.08	-3.13	ak	I/T	11	0.17	0.21	ak
ΔPMDP	N	11	-2.14	-1.61	ak	N	1	-16.5	-1.61	ak					
VAR_TRIB	I	0	-10.69	-2.57	ak	I/T	1	-10.94	-3.13	ak	I/T	4	0.05	0.21	ak
EPU_BRA	I	2	-3.78	-2.57	ak	I/T	6	-7.40	-3.13	ak	I/T	10	0.12	0.21	ak
FI	N	0	-13.59	-1.61	ak	N	4	-15.67	-2.57	ak	I	4	0.04	0.73	ak
DIV_LIQ	I/T	0	0.49	-3.13	ak	I/T	6	0.16	-3.13	ak	I/T	11	0.38	0.21	ak
ΔDIV_LIQ	I/T	6	-6.36	-3.13	ak	I/T	7	-15.84	-3.13	ak	I/T	6	0.16	0.21	ak
INF	I	13	-3.22	-2.57	ak	N	9	-1.27	-1.61	ak	I/T	11	0.15	0.11	ak
ΔINF						N	4	-6.56	-1.61	ak					
FI	N	0	-13.59	-1.61	ak	N	4	-15.67	-2.57	ak	I	4	0.04	0.73	ak

Note: For the ADF test, the choice of *lags* was made based on the Schwarz criterion. For the PP and KPSS tests the choice of lags is the bandwidth truncation chosen by Bartlett kernel. For the choice of the estimation model, the information criterion - Akaike (ak) was considered, where"I" indicates intercept; "I/T" indicates intercept and trend and "N" indicates none.

Source: E-Views 10.0 Own Elaboration.

Table A.2 – Principal Component Analysis

Number	Proportion
PC1	0,882
PC2	0,083
PC3	0,027
PC4	0,006

Source: E-Views 10.0 Own Elaboration.

Table A.3 –Bartlett, Levene e Kaiser-Meyer-Olkin tests.

Method	Value	Probability	MAS
Bartlett	21,182	0,000	-
Levene	2,129	0,095	-
Kaiser-Meyer-Olkin	-	-	0,702

Source: E-Views 10.0 Own Elaboration.

Table A.4 – Descriptive Statistics

Variables	Average	Median	Maximum	Minimum	Standard Deviation	Remarks
DES_DIV_12m	7.9980	6.7940	20.2680	2.9100	3.8920	213
DES_DIV_24m	10.0750	9.0910	28.3000	4.3140	4.4180	213
DES_DIV_36m	11.5940	10.4100	29.8600	5.3500	4.7000	213
DES_DIV_48m	12.5350	10.9230	34.6850	4.8530	5.3140	213
DES_DIV_PCA	5.49E-16	-0.5460	7.2800	-2.4060	1.8830	213
IIR	1.8410	1.7330	4.1370	0.1710	1.0970	213
PMDP	42.1100	41.4900	55.7300	27.2800	8.6840	213
VAR_TRIB	5.9850	4.3750	81.4530	0.0000	8.6520	213
EPU_BRA	157.4010	134.2070	676.9550	22.2960	93.8900	213
FI	0.0001	-0.0030	0.5140	-0.6410	0.0950	213
DIV_LIQ	43.5320	44.1000	62.4500	30.0000	8.4860	213
INF	6.3600	5.9100	17.2400	2.4600	2.8280	213

Source: E-Views 10.0 Own Elaboration.

Table A.5 –Instruments used in the GMM and GMM-2s.

Table	Dependent Variable	Instruments
4 – GMM	*DES_DIV_12m*	dis_div_12m(-1to-12) d_iir(-1to-2) d_pmdp(-1to-6) var_trib(-1) epu_bra(-1to-4) fi(-1to-5) d_div_liq(-4to-9) infl(-1to-3) debt(0to-1).
	DES_DIV_24m	dis_div_24m(-1to-12) d_iir(-1to-2) d_pmdp(-1to-1) var_trib(-1to-6) epu_bra(-1to-4) fi(-1to-5) d_div_liq(-4to-4) infl(-1to-3) debt(0to-1).
	DES_DIV_36m	dis_div_36m(-1to-12) d_iir(-1to-2) d_pmdp(-1to-6) var_trib(-1to-1)epu_bra(-1to-4) fi(-1to-5) d_div_liq(-4to-9) infl(-1to-3) debt(0to-1).
	DES_DIV_48m	dis_div_48m(-1to-12) d_iir(-1to-2) d_pmdp(-1to-6) var_trib(-1to-3)epu_bra(-1to-4) fi(-1to-1) d_div_liq(-4to-9) infl(-1to-3) debt(0to-3).
	DES_DIV_PCA	dis_div_pca(-1to-12) d_iir(-1to-2) d_pmdp(-1to-6) var_trib(-1to-1) epu_bra(-1to-4) fi(-1to-1) d_div_liq(-4to-4) infl(-1to-3) debt(0to-3).
5 – GMM-2s	*DES_DIV_12m*	dis_div_12m(-1to-11) d_iir(-1to-2) d_pmdp(-1to-3) var_trib(-1to-7) epu_bra(-1to-7) fi(-1to-3) div_liq(-4to-9) infl(-1to-1) d_div_liq(-4to-9) debt(0to-1).
	DES_DIV_24m	dis_div_24m(-1to-13) d_iir(-1to-1) d_pmdp(-1to-4) var_trib(-1to-4)epu_bra(-1to-4) fi(-1to-5) d_div_liq(-4to-4) infl(-1to-1) debt(0to-2).
	DES_DIV_36m	dis_div_36m(-1to-13) d_iir(-1to-2) d_pmdp(-1to-10) var_trib(-1to-7) epu_bra(-1to-4) fi(-1to-2) d_div_liq(-4to-4) infl(-1to-3) debt(0to-1).
	DES_DIV_48m	dis_div_48m(-1to-13) d_iir(-1to-2) d_pmdp(-1to-4) var_trib(-1to-8)epu_bra(-1to-14) fi(-1to-1) d_div_liq(-4to-4) infl(-1to-1) debt(0to-3).
	DES_DIV_PCA	dis_div_pca(-1to-13) d_iir(-1to-5) d_pmdp(-1to-6) var_trib(-1to-2)epu_bra(-1to-4) fi(-1to-1) d_div_liq(-4to-9) infl(-1to-3) debt(0to-3).

Note: The variable debt is the General Government Gross Debt (% GDP) – Series 4537 – SGS

Source: E-Views 10.0 Own Elaboration.