Revista

Cadernos de Finanças Públicas

02 | 2025

TESOURONACIONAL

The Pro-Cyclicality of Brazilian Fiscal Policy in the Context of Fiscal and Monetary Dominance Regimes in the Post-Real Plan Period (1998 to 2019)

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ABSTRACT

The aim of this study is to analyze the pro-cyclical nature of fiscal policy in Brazil and its relationship with regimes of fiscal dominance and monetary dominance in the post-Plano Real period. The theoretical framework for the economic model is based on Wagner's Law and Fiscal Reaction Functions. In addition to the use of fiscal and debt data, as a proxy for the output gap, the cyclical component of the Brazilian GDP obtained through the Hodrick-Prescott Filter was used, but considering different values reported in the literature for the smoothing parameter. The econometric results obtained show that, between the years 1998 to 2019, the pro-cyclicality of Brazilian fiscal policy is independent of the dominance regime, the economic model and the value of this parameter.

Keywords: Pro-cyclical fiscal policy, dominance regimes, economic cycle.
JEL: E32, E63, H30, H50, H62

SUMMARY

1. INTRODUCTION

The literature on the interaction between fiscal and monetary policies addresses the concepts of monetary dominance and fiscal dominance regimes under three approaches. In the first approach, Sargent and Wallace (1981) argue that, in the case of a monetary dominance regime, the fiscal authority is committed to maintaining the stability of the debt/GDP ratio, thus generating fiscal surpluses without the monetary authority having to increase the monetary base in order to meet the government's fiscal budget constraint. On the other hand, in the case of the fiscal dominance regime, the monetary authority would have to contribute to generating the seigniorage revenues needed to meet the government's timeless budget constraint, jeopardizing the stability of the price level because of the increase in the monetary base. In this situation, the monetary authority would finance the public debt, since the fiscal authority would not be generating the fiscal surplus necessary to stabilize the debt/GDP ratio.

Leeper (1991) calls these different policies active or passive. If the government's deficits are entirely covered by future increases in taxation, this would be characterized as a regime of monetary dominance according to Sargent and Wallace (1981), and would thus have a passive fiscal policy as well as an active monetary policy, given that the monetary authority is not forced to monetize the public debt. If the government's deficits are covered by seigniorage revenues, this would characterize the fiscal dominance regime, in which there is a passive monetary policy and an active fiscal policy.

Aiyagari and Gertler (1985) consider that there is a monetary dominance regime (also known as a Ricardian fiscal regime) when monetarist assumptions prevail. In fiscal dominance (non-ricardian fiscal regime), the price level is proportional to the supply of debt securities by the government and the nominal interest rate depends on the composition of the money supply and securities issued. An increase in the money supply due to a temporary open market operation, for example, lowers the interest rate but does not affect the price level. If this increase is due to a temporary shock in fiscal policy, prices adjust proportionally.

The second approach became known as the Fiscal Theory of the Price Level (TFNP). According to this view, the government's budget constraint would influence the price level, making the monetarist assumptions part, but not all, of the explanation of how prices behave in the economy. Woodford (1995) argues that the real value of public debt is equal to the present value of future primary surpluses. Thus, the price level would be influenced by the supply of government bonds as well as the seigniorage revenue needed to keep the debt under control.

Finally, in the third approach, Blanchard (2004) argues that a restrictive monetary policy combined with a high debt/GDP ratio, under an inflation targeting regime, can lead to explosive public debt dynamics, which are worse the higher the initial level of debt, the proportion of this debt in foreign currency and the higher the country risk. Blanchard (2004) concludes that this was the case in Brazil in the period from the end of 2002 to the beginning of 2003. Blanchard (2004) argues that when public debt is high, and a large portion of this debt is denominated in foreign currency, and when there is high risk aversion on the part of foreign investors, an increase in the nominal interest rate will lead to exchange rate depreciation rather than exchange rate appreciation, adversely affecting country risk, the general price level and the country's fiscal situation. Blanchard (2004) found this to be the case for Brazil in 2002, using a static theoretical model that analyzes the relationship between interest rates, exchange rates and the probability of public debt *default*.

Summarizing the three approaches, in the monetary dominance regime the monetarist assumptions prevail, which are: a) money is the only government obligation that affects real economic variables; b) monetary policy, and not fiscal policy, affects the money supply; c) the price level varies according to the money market; d) money supply and demand affect the nominal interest rate (AIYAGARI; GERTLER, 1985).

With regard to the fiscal dominance regime, however, when the fiscal authority does not generate a primary surplus compatible with stabilizing the debt/GDP ratio, the monetary authority has to satisfy this intertemporal relationship via seigniorage. This increase in the monetary base in order to finance the public debt can distort the monetary authority's control of inflation. On the other hand, the expectations of economic agents regarding the risk of debt default could lead the country into an inflationary spiral where the "interest - price level" channel is not the standard: an increase in the nominal interest rate could not reduce but increase inflation expectations, given the risk of debt default.

However, when studying the interaction between fiscal and monetary policies, the cyclical nature of fiscal policy must also be analyzed. According to Ilzetzki (2011), countercyclical fiscal policy refers to the combination of countercyclical public spending, procyclical or acyclical tax rates, and countercyclical budget deficits. On the other hand, pro-cyclical fiscal policy refers to a deviation of any of these variables from the anti-cyclical definition. That is, by analogy, pro-cyclical fiscal policy refers to the combination of pro-cyclical spending, anti-cyclical tax rates and pro-cyclical budget deficits.

For emerging countries, the literature points to the following hypotheses to explain the

pro-cyclical nature of fiscal policy: difficulty in obtaining credit on the international market during periods of economic recession; corruption and institutional fragility; informal labor market; variability of the tax base.

As for the pro-cyclicality of fiscal policy in emerging countries, Alesina, Campante and Tabellini (2008) argue that corruption is one of its explanatory factors[1]. In corrupt democracies, rulers take a share of tax revenues directly, for example, through their earnings; but also indirectly, through favors provided by public officials. Voters, although they don't understand exactly how this happens, understand that such unofficial revenues are a reality. When the country experiences a positive income shock, these voters demand more government spending or more income transfers, otherwise they will be forced out of office.

Slimane and Tahar (2010), for their part, empirically analyze the two hypotheses commonly considered in the question of the procyclicality of fiscal policy in emerging countries: a) difficulty in obtaining credit on the international market during periods of economic recession; and b) the weakness of these countries' political and credit institutions. Contrary to Alesina, Campante and Tabellini (2008), Slimane and Tahar (2010) consider the inability of emerging countries to access the domestic and foreign credit markets to be an important factor. Slimane and Tahar (2010), however, also argue that high fiscal deficits and the accumulation of a large stock of debt explain the pro-cyclical nature of developing countries. While in industrialized nations countercyclical discretionary policy helps to dampen aggregate fluctuations, in developing economies automatic fiscal stabilizers, such as income tax and transfer programs, are not significant enough to smooth out the economic cycle.

Akitoby *et al* (2006) carried out an empirical study of the relationship between government spending and GDP, in the short and long term, for 51 emerging economies, using the error correction model (ECM). Akitoby *et al* (2006) found evidence of the cyclical nature and voracity effect in the tendency for government spending to increase over time. In more than 40% of the countries considered, the main components of public spending are pro-cyclical. In at least one of the various spending components considered, in the case of 70% of the emerging countries, there is cointegration between GDP and spending, implying a long-term relationship between these two variables, consistent with Wagner's Law.

1 With regard to the hypothesis of corruption and institutional fragility, according to Alesina, Campante and Tabellini (2008), voters in emerging countries perceive that those in power grab part of the tax revenue for themselves. When there is a positive shock to the economy, these same voters demand part of this shock to income, at the risk of calling for the politicians to be removed from office. The latter would respond by either increasing the transfer of income, decreasing the level of taxes or increasing public spending. Still on the subject of institutional explanation, another relevant hypothesis is that automatic stabilizers, such as income tax and transfer programs, would not be significant in smoothing out economic cycles in developing and highly indebted countries.

It is also known that fiscal policy has been affected by non-recurring effects, understood to be portions of revenue and expenditure that are not explained by the cyclical behavior of the Gross Domestic Product (GDP) or by the evolution of the behavior of the historical series of these fiscal variables. For example, in the case of revenue, we can mention tax collections due to court rulings, capitalization operations of public companies (such as the capitalization of Petrobras in September 2010), or any other events that go beyond the expected economic normality in tax collection. These are significant amounts and, if they are not properly excluded from tax collection, they could jeopardize the analysis of tax collection performance by leading to the understanding of behavior that is not correct. A similar analysis can be made on the expenditure side.

However, some questions have arisen about the relationship between types of dominance regimes and fiscal policy cyclicality, and these characterize the problem of this research. Is the cyclical behavior of fiscal policy affected by the type of dominance regime prevailing in the economy? If the pro-cyclical behavior of fiscal policy is verified, does the existence of non-recurring events in fiscal variables contribute to intensifying this behavior?

This research will test the hypothesis that the cyclical behavior of fiscal policy in Brazil is independent of the type of dominance regime that prevails, the existence of non-recurring events in fiscal policy and the way in which the economy's output gap is modeled.

Therefore, the general objective of this study is to analyze the relationship between the different dominance regimes and the cyclical nature of fiscal policy in the post-Real Plan Brazilian case. To achieve this, the specific objectives are the econometric estimation of the theoretical model of Wagner's Law, as well as the estimation of fiscal reaction functions.

The study of the cyclical nature of fiscal policy in Brazil under different types of dominance regimes (fiscal or monetary) is a relevant topic in the current academic debate, with important implications for economic policy. The results obtained here corroborate the evidence obtained in previous studies that, in the post-Real Plan period, fiscal policy in Brazil is pro-cyclical. However, this study should contribute to the literature on the subject by empirically verifying that the pro-cyclicality of Brazilian fiscal policy is independent of the dominance regime under analysis, the theoretical model analyzed (Wagner's Law or Fiscal Reaction Function) and the specification of the output gap. In addition, we highlight the rigorous treatment of fiscal data in order to exclude atypical or non-recurring events (*outliers*) from the revenue and expenditure series. This study will not deal with the mapping of fiscal and monetary dominance regimes as such, given the existence of previous studies that have investigated this issue for the

Brazilian case, but will focus on the relationship between these regimes and the cyclicality of fiscal policy.

This study has the following divisions. Section 2 presents the theoretical framework and a description of the economic models to be tested empirically. Section 3 describes the variables and the treatment of the data analyzed. The fourth section reports the results obtained from the econometric estimation. The fourth section is dedicated to the final considerations and policy implications of the results found.

2. THEORETICAL FOUNDATION

2.1 Theoretical Framework on Regimes of Dominance in Brazil

Several studies in Brazil have investigated issues related to dominance regimes and the cyclicality of fiscal policy. For example, Fialho and Portugal (2005) estimate a vector autoregressive model (VAR) for the debt/GDP and primary result/GDP series, as well as a vector autoregressive with *Markov* shifts (MS-VAR) for the period from January 1995 to September 2003, bearing in mind that the relationship between fiscal and monetary policies can vary over time. Based on the theoretical framework of the Fiscal Theory at the Price Level (TFNP), the evidence obtained suggests the existence of a monetary dominance regime for that period. Gadelha and Divino (2008) carried out a rigorous Granger causality analysis by estimating a vector autoregressive model with an error correction mechanism (VEC model), as well as estimating autoregressive models with distributed lags (ADL models), and the results obtained showed that the Brazilian economy was under a monetary dominance regime in the period considered, according to Sargent and Wallace's view, while no empirical evidence was found to validate the view proposed by Blanchard (2004) for the Brazilian case.

Palma and Althaus (2014), based on the Fiscal Theory of Price Levels (TFNP), analyzed whether there was fiscal dominance or monetary dominance between 2000 and 2013. Using an SVAR, the results obtained indicated that the Brazilian economy was in a Ricardian regime (i.e. a monetary dominance regime). Araújo and Besarria (2014) analyzed the different dominance relationships between fiscal and monetary policies for the Brazilian economy between 2003 and 2009. The main objective was to analyze whether the relationships found in Blanchard (2004) were still valid for that period. Araújo and Besarria (2014) specify a VECM model and conclude that monetary dominance exists.

Andretta (2016) investigates the existence of fiscal dominance and monetary dominance regimes in Brazil for the period 2001-2016. Based on the study by Blanchard (2004), the Fiscal Theory of the Price Level (TFNP), and the study by Sargent and Wallace (1981), it is proposed to use a VAR model to verify which regime the country was subject to in the period considered. The conclusion is that Brazil went through situations in which it almost reached the fiscal dominance regime, but did not enter this condition. Nóbrega, Maia and Besarria (2020) analyze the period from 2003 to 2015. Using a VAR model, they conclude that monetary dominance exists; however, when they use a MS-VAR to capture the change in regime, they conclude that there was a structural change from 2011 onwards, towards fiscal dominance.

Silva (2020) proposes to study the cyclical aspect of the prevailing regimes in Brazil, that is, to study whether or not there is cyclicality in the changes in the Fiscal Dominance and Monetary Dominance regimes, using monthly data from January 1995 to June 2019. Based on the estimation of an econometric model using the Markov Switching (MS) approach, Silva (2020) concludes that, given the statistical evidence found, there is cyclicality in the dominance regimes, depending on the country's economic conditions. Table 1 below summarizes the main results obtained for the Brazilian economy from the literature on the types of dominance regimes:

Chart 1: Mapping Dominance Regimes in Brazil

Author(s)	Method	Period	Results
Araújo and Besarria (2014)	VEC	2003 a 2009	DM
Fialho and Portugal (2005)	VAR and MS-VAR	1995 a 2003	DM
Gadelha and Divino (2008)	VAR	1995 a 2005	DM
Andretta (2016)	VAR	2001 a 2016	DM: Brazil would sometimes have almost reached the FD without entering this condition.
Palma and Athaus (2015)	SVAR	2000 a 2013	DM
Nóbrega et al (2020)	VAR and MS-VAR	2003 a 2015	DM, with a possible structural change as of 2011
Silva (2020)	MS	1995 a 2019	DF: from 1999 to 2001; DM: from 2001 to 2006; DF: from 2007 to 2015; DM: from 2016 onwards. At the end of the sample, 2019:

Source: Own elaboration. "DM" stands for Monetary Dominance. "FD" stands for Fiscal Dominance.

2.2 Theoretical Framework on Fiscal Policy Cyclicality in Brazil

Akitoby *et al.* (2006) use the theoretical framework of Wagner's Law to examine the short- and long-term cyclical behavior of government spending, under various spending catego-

ries, in relation to aggregate output in 51 developing countries over the period 1970-2002, using a panel data error correction model. The results show that in 2/3 of the nations in Latin America there is a statistically significant short-term relationship between shocks to real output and real primary spending, and that spending and output move in a pro-cyclical manner.

For the Brazilian economy, Gadelha and Divino (2013) took up the initiative of Akitoby *et al*. (2006) and tested three explanatory theories for the pro-cyclical nature of fiscal policy: (a) variability of the tax base; (b) corruption and the informal economy; and (c) international credit restrictions. Of these 3 hypotheses, Gadelha and Divino (2013) conclude that the variability of the tax base and corruption and the informal economy help to explain the pro-cyclical behavior of Brazilian fiscal policy.

According to the IDB (2018), countercyclical spending requires the government to spend less in good times and more in bad times, in order to increase its savings so that it can take advantage of a larger tax base in the first case and accelerate the recovery of the economy in the second. According to the IDB (2018), and in line with the above arguments, policymakers' lack of vision and political pressure to spend in times of economic boom (voracity effect) encourage overspending during expansions.

The IDB (2018) also highlights limited access to international credit markets. Since they didn't build up savings during the good times, developing countries in recessions tend to have difficulty accessing credit markets because they are excessively indebted. In this way, the IDB (2018) corroborates the hypothesis of difficulty in accessing international credit markets.

An important factor highlighted by the IDB (2018) is the issue of unemployment insurance, which is often not well designed (there are exceptions) in Latin America and the Caribbean. There are some countries in this region that, for example, tend to increase unemployment insurance in good times (Uruguay) or not enough during recessions. Another problem is that other benefits, such as social security benefits, instead of being indexed to inflation, as in developed nations, are indexed to tax revenues and wages, both of which are intrinsically cyclical. Thus, in addition to these expenses following the cycle, given the way they are indexed, which goes in the opposite direction to that preached by economists, the beneficiaries are still not protected from inflation.

As can be seen above, the empirical studies cited used various econometric strategies. It will be seen below that the mapping of dominance regimes for the Brazilian economy is not as controversial as it seems, meaning that there is convergence in the results already obtained in the literature on the subject. Furthermore, unlike the empirical studies mentioned above, this

study was concerned with removing atypical events (non-recurring, extraordinary or *outliers*) from the public spending and net revenue variables, in order to better capture the true character of fiscal policy in the Brazilian economy, in terms of cyclicality, in the recent period. Given the existence of various studies that have sought to map the types of dominance regimes for the Brazilian economy, the scope of this study is limited to investigating the relationship between these types of regime and the cyclical nature of fiscal policy in Brazil.

3. THEORETICAL FOUNDATIONS ON ECONOMIC MODELS AND FISCAL POLICY CYCLICALITY

In this study, in order to test the cyclical nature of fiscal policy, two economic models will be used for econometric estimations.

With regard to the first economic model, Wagner's Law states that government spending follows the economic cycle. Thus, they tend to increase when GDP increases, and tend to decrease when GDP decreases. Scott and Peacock (1998) state that Wagner thought he had detected regularities in the growth of government spending, and was careful to discriminate between central and local government. However, Wagner did not present an articulated model of spending growth in which cause and effect were clearly delineated (SCOTT; PEACOCK, 1998). Wagner's Law (WAGNER, 1911) considers public spending as a behavioral variable, i.e. endogenous, postulating that growth in economic activity causes an increase in government activities. The version used to measure the elasticity of government spending in relation to changes in income has the following specification (AKITOBY *et al*., 2006):

$$G_t = AY_t^{\eta} \tag{1}$$

Where G_t is real government spending, Y_t is real national income or real gross domestic product, and A is a constant. The term η measures the income elasticity of government spending in relation to GDP. A positive value of η is consistent with the expansionist interpretation of Wagner's Law, implying that government spending increases less than proportionally with national income. On the other hand, $\eta > 1$ is consistent with the restrictive interpretation defended by Wagner (1911), that government spending increases faster than the level of income in the economy. Following Gadelha and Divino (2013), equation (1) as a proportion of GDP will be expressed as:

$$\left(\frac{G_t}{Y_t}\right) = \left(\frac{AY_t^{\eta}}{Y_t}\right) \Rightarrow \left(\frac{G_t}{Y_t}\right) = AY_t^{\eta-1} \quad (2)$$

The log-linear version is described by:

$$log\left(\frac{G_t}{Y_t}\right) = log(A) + (\eta - 1)log\left(Y_t\right) \Rightarrow g_t = a + \phi y_t \quad (3)$$

where : $a = log(A)$, $g_t = log\left(\frac{G_t}{Y_t}\right)$, $y_t = log\left(Y_t\right)$ e $\phi = (\eta - 1)$. Akitoby *et al.* (2006) use real GDP as a *proxy* for the level of economic activity, but this study will use the output gap according to Gadelha and Divino (2013). Thus, by analogy, we propose estimating the following functional form of the basic model in its static version:

$$g_t = a + \phi y_t^c + \varepsilon_t \quad (4)$$

The dynamic version of the functional form of this model is proposed as follows:

$$g_t = a + \beta g_{t-1} + \phi y_t^c + \varepsilon_t \quad (5)$$

Equations (4) and (5) represent fiscal reaction functions to be estimated econometrically. The cyclical behavior of fiscal policy will be determined by assessing the sign and significance of the elasticity of government spending in relation to the output gap (ϕ). Thus, in pro-cyclical fiscal policy, we observe $\eta>0$, which results in $\phi > -1$. In the case of acyclical fiscal policy $\eta = 0 \Rightarrow \phi = -1$. In the case of countercyclical fiscal policy, we see $\eta < 0 \Rightarrow \phi < -1$. The terma is *a* constant, and $\varepsilon_t \sim i.i.d.\left(0, \sigma^2\right)$ is the error term.

The term g_{t-1} is lagged government spending, included in equation (5) to allow for reversion to the long-term average in government spending, and is consistent with fiscal sustainability, since fiscal policy decisions in the previous period can have lasting effects in the following period. In this study, the use of only one lag of government spending in the empirical modeling is sufficient to capture the rigidity (inertia) of government spending in Brazilian fiscal policy (GADELHA; DIVINO; 2013).

The output gap $\left(y_t^c\right)$ is added to the equation in order to represent the influence of the level of economic activity on the trajectory of government spending. Defined as the difference between an economy's actual output and potential output, the output gap acts as an indicator

of economic fluctuations, giving economic policymakers the chance to anticipate potential demand pressures on prices, for example. Positive output gap values indicate that actual output is higher than potential output and suggest the possibility of a future rise in price levels, and vice versa (GADELHA; DIVINO; 2013).

As for the second economic model, Fiscal Rules Theory has developed in different directions since Bohn's (1995) seminal contribution. As in Moreira and Monte (2020), in this study the main interest is focused on the responses of the primary surplus to changes in public debt over time. The following fiscal reaction equation describes the relevant relationship between these two variables:

$$\left(\frac{S}{Y}\right)_t = \alpha\left(\frac{B}{Y}\right)_{t-1} + \varepsilon_t \quad (6)$$

Where $\left(\frac{S}{Y}\right)_t$ is the primary result as a proportion of GDP in period *t*; and $\left(\frac{B}{Y}\right)_{t-1}$ represents the public debt as a proportion of GDP in period $t-1$. The parameter has two important meanings in equation (6). Firstly, the parameter measures the cyclicality (or cyclicality) of fiscal policy, i.e. the magnitude of the reaction of the primary surplus to the debt/GDP ratio. The greater the fiscal cyclicality, the higher the coefficient . Countercyclical fiscal policy is represented by the positive value of this parameter ($\alpha > 0$), meaning that when the public debt increases, the fiscal authority increases the primary surplus, thus avoiding an indefinite upward trend in public financial liabilities and maintaining the solvency of the public debt in the long term. On the other hand, when this parameter is negative ($\alpha < 0$), fiscal policy is pro-cyclical, so that fiscal reactions are not consistent with the stabilization or sustainability of public debt in the long term. Finally, the term $\varepsilon_t \sim N(0, \sigma_\varepsilon)$, is independent and identically distributed (i.i.d.) and represents other factors that explain the primary result as a proportion of GDP, such as the inflation rate or the level of economic activity, and which can also calibrate fiscal decisions over time.

Secondly, the parameter is also a measure of public debt sustainability. In other words, the condition of public debt sustainability is given by $\alpha > 0$. A positive value of this parameter($\alpha > 0$) indicates that the government reacts to increases in debt by generating a primary surplus and, therefore, the public debt is sustainable. On the other hand, the negative value of this parameter ($\alpha < 0$) indicates that the public debt is not sustainable.

Chart 2 – Fiscal austerity and public debt sustainability

Measure	Fiscal austerity	Sustainability of public debt
$\alpha > 0$	Countercyclical fiscal policy	Sustainable public debt
$\alpha < 0$	Pro-cyclical fiscal policy	Public debt is not sustainable

Note: own elaboration.

The government's reaction function considers that if there is a positive relationship between the primary surplus and the level of public debt - that is, if governments react systematically to rising debts by increasing the current surplus - there is a sufficient condition for the debt trajectory to be reversed. In Uctum, Thurston and Uctum (2006) this fiscal reaction function is given by:

$$s_t = \mu + \alpha b_{t-1} + \beta g_t^c + \gamma \tau_t^c + \varepsilon_t \quad (7)$$

Where $s_t = \left(\frac{S}{Y}\right)_t$, $b_{t-1} = \left(\frac{B}{Y}\right)_{t-1}$, g_t^c e τ_t^c the cyclical components of expenditure and revenue, respectively, both as a proportion of GDP. The surplus is expected to decrease with an increase in transitory government spending ($\beta<0$), and increase with increases in revenue ($\gamma>0$). The term μ is a constant and $\varepsilon_t \sim$i.i.d. $(0, \sigma^2)$ is the random error term.

The Hodrick-Prescott (HP) filter was used to obtain a measure of the economic cycle, which is used as a *proxy* for the output gap. This filter removes the cyclical component of a time series and is calibrated depending on the value assigned to the lambda parameter (λ), which in turn is a multiple of the sum of the squares of the second differences of the trend component. Hodrick-Prescott (1997) suggested a λ of 1600 for quarterly series. Ravn and Uhlig (2002) suggested a λ of 129.6 for monthly series.

ABefore carrying out the econometric estimations, a rigorous analysis of the stationarity of the time series analyzed here is necessary. The modified Dickey-Fuller and Phillips-Perron tests proposed by Elliot, Rottemberg and Stock (1996) and Ng and Perron (2001) are applied in order to verify the stationarity of the time series. The modifications to the standard unit root test of Dickey and Fuller (1979, 1981) and Said and Dickey (1984) are based on two central aspects: the extraction of trend in time series using ordinary least squares (OLS) is inefficient and the importance of an appropriate selection for the lag order of the augmented term, in order to obtain a better approximation to the true data generating process. Proposals to solve these problems were as follows: a) use generalized least squares (GLS); b) use the modified Akaike

information criterion (MAIC) instead of the Akaike (AIC) and Schwarz (SIC) information criteria.

However, even the modified ADF and GLS tests are underpowered in the presence of structural breaks, becoming biased in the sense of not rejecting the null hypothesis of a unit root, even when the series is stationary. This is where the work of Saikkonen and Lütkepohl (2002) and Lanne, Lütkepohl and Saikkonen (2002, 2003) comes in. They propose that structural breaks can occur over a number of periods and expose a smooth transition to a new level. Therefore, a level shift function is added to the deterministic term of the data generating process.

4. DESCRIPTION OF VARIABLES AND DATA TREATMENT

This study uses monthly data covering the period from January 1998 to December 2019, i.e. the post-Real Plan period. This period was chosen because the historical series on the Central Bank's website for the Gross General Government Debt (GGGBD) began in January 1998. It is also a period characterized, for the most part, by the inflation target regime, fixed and floating exchange rate regimes, as well as the primary surplus target regime.

The data used in the estimates are listed below, with their respective sources. From the Central Bank of Brazil's Time Series Management System[2], we obtained time series data for the following variables, in current values (R$ million): (i) estimated monthly GDP (code 4380), as a *proxy* for the level of economic activity; (ii) Gross General Government Debt (DBGG) (code 4182), as a *proxy* for public indebtedness.

From the National Treasury Report[3], time series fiscal data was obtained for the following variables: (i) Total Central Government Expenditure, as a *proxy* for primary spending; (ii) Central Government Net Revenue, as a *proxy* for tax collection; (iii) Central Government Primary Result, as a *proxy* for budget balance.

The data was processed as follows. First, *outliers* (i.e. atypical, non-recurring or extraordinary events) were removed from the Central Government Total Expenditure and Central Government Net Revenue series, as shown in Table 3 below. With the exception of the primary result series, all the other time series were deseasonalized using the Census X12-ARIMA method.

2 Available at: <<https://www3.bcb.gov.br/sgspub/localizarseries/localizarSeries.do?method=prepararTelaLocalizarSeries>>. Accessed on 31/10/2020.

3 Available at: << https://www.gov.br/tesouronacional/pt-br >>. Accessed on 31/10/2020.

Chart 3: Atypical Events: Primary Expenditure (G) and Tax Collection (T). In R$ million

Period	Expenses	Revenue	Comments
1998.12	1.100,0	-	Extraordinary transfer to SUDENE, fight against drought plus court sentences against the Union (value obtained from the monthly difference since it is not explicit in the report)
1999.12	198,0	-	Precatories paid to TRANSBRASIL
2001.12	109,8	-	Extraordinary credit, e.g. emergency civil defense actions
2002.12	1.300,0	-	Extraordinary credit for the transfer of the federal highway network to the state.
2003.12	2.100,0	-	Official Credit Operations Program - agricultural securitization.
2004.12	1.900,0	-	Official Credit Operations Program - agricultural securitization.
2006.12	1.500,0	-	Extraordinary Credit
2007.12	3.100,0	-	Extraordinary Credit
2008.12	632,0	-	Payment of shares in the Andean Development Corporation and the International Development Association
2010.09	42.900,0	74.800,0	Capitalization of Petrobras / Transfer of rights for oil exploration
2013.11	-	35.400,0	REFIS installment payment (20.4) plus signing bonus for the Libra Field concession contract (15.00)
2015.12	55.800,0		Union payments to public banks and the FGTS, in the context of TCU rulings 825/2015 and 3,297/2015
2016.01	-	11.000,0	Hydroelectric power plant concession bonuses
2016.10	-	45.069,4	Collection from the Special Regime for Exchange and Tax Regularization (Law 13.254/2016)
2016.12	23.300,0	-	Expansion of payment limits, mainly to reduce unpaid debts (perhaps related to the adoption of the New Fiscal Regime).
2018.01	-	7.800,0	Special Tax Regularization Program - PERT (Law 13.496/17)
2018.12	1.100,0	-	Economic subsidy for the sale of diesel oil (Provisional Measure No. 838 of 2018)
2019.12	34.400,0	70.000,0	payment to Petrobras resulting from the revision of the onerous transfer contract / onerous transfer auction held in November 2019.

Source: Monthly Reports: National Treasury Results.

Next, all the fiscal and debt variables were converted into a proportion of GDP. In particular, the total central government expenditure series, as a proportion of GDP, was converted into its logarithmic form in the econometric estimations related to the Wagner's Law theoretical model.

Finally, the econometric estimations related to the fiscal reaction function used the cyclical component of the series of total central government expenditure and net central government revenue, both as a proportion of GDP, obtained using the HP Filter.

Finally, with regard to the period analyzed, a few additional comments are in order. From the second FHC administration to the first Lula administration, 1999 to 2006, Brazilian economic policy was characterized by austerity and control of public accounts. It was in 1999 that the inflation target regime, the floating exchange rate regime and the primary surplus target

regime were adopted. However, from the second Lula administration until the end of the Dilma administration (2007 to 2016), economic policy moved away from austerity. According to Pellegrini (2017), the following reasons can be cited: a) Brazil incurred, from 2006 onwards (with the exception of the period referring to the international crisis), successive primary surpluses, the result of successive trade balance surpluses; b) the world was going through the *commodities boom*, which explains these surpluses; and c) the Central Bank reduced liquidity, given the greater supply of foreign currency on the market, via repurchase agreements (thus increasing the public debt given that repurchase agreements are accounted for in the Gross Debt of the General Government - DBGG).

5. RESULTS

Table 1 below shows the results of the unit root tests. All the time series proved to be stationary at the 1% significance level.

Table 1: Results of the Unit Root Tests

Variables	Model	No Structural Breakdown			With Structural Breakdown							
		MADF (GLS)	MZ (GLS)	*Lags*	Saikkonen-Lütkepohl (2002)				Volsesang and Perron (1998)			
		Statistics-Test			Type of Breakage	Breakdown date	Statistics-Test	*Lags*	Type of Breakage	Breakdown date	Statistics-Test	*Lags*
g_t	C	0,05	0,8	5	*Rational shift*	1998:12	-2	2	*Innovation Outlier*	1998:11	-12,78(a)	-
g_t	C, T	-2,12	-1,35	9	*Rational shift*	1998:12	-6,22(a)	2	*Innovation Outlier*	1998:11	-12,92(a)	-
b_t	C	0,92	1,41	15	*Exponential shift*	2014:06	-2,71(a)	2	*Innovation Outlier*	2015:01	-3,28	15
b_t	C, T	-1,68	-1,13	15	*Exponential shift*	2014:06	-0,86	2	*Innovation Outlier*	2012:06	-2,81	15
τ_t	C	-1,00	-0,89	9	*Exponential shift*	1998:08	-4,45(a)	2	*Innovation Outlier*	1999:05	-11,42(a)	0
τ_t	C,T	-1,66	-1,26	9	*Exponential shift*	1998:08	-4,21(a)	2	*Innovation Outlier*	1999:05	-11,42(a)	0

Source: own elaboration.

Note:

1 - "Lags" means lags. is the first difference operator. "C" stands for constant. "T" stands for deterministic trend. (a) significance at 1%; (b) significance at 5%; (c) significance at 10%. Maximum initial count of 15 lags.

2 - The critical values of the MADFGLS test are (Elliot, Rothenberg and Stock, 1996): (i) model with constant: -2.57 (1%); -1.94 (5%) and -1.62 (10%). (ii) model with constant and deterministic trend: -3.46 (1%); -2.91 (5%) and -2.62 (10%).

The asymptotic critical values of theMZGLS test are (Ng and Perron, 2001, Table 1): (i) model with constant: -2.58 (1%); -1.98 (5%) and -1.62 (10%). (ii) model with constant and deterministic trend: -3.42 (1%); -2.91 (5%) and -2.62 (10%).

3 - The critical values of the Saikkonen-Lutkepohl test are as follows (Lanne et al. 2002): (i) model with constant: -3.48 (1%); -2.88 (5%) and -2.58 (10%); (ii) model with constant and deterministic trend: -3.55 (1%); -3.03 (5%) and -2.76 (10%).

4 - The critical values of the Perron test (PERRON, 1998) by type of structural break (Additive Outlier or Innovation Outlier), using the AIC criterion to select the optimum number of lags; minimization of the Dickey--Fuller t-statistic to select the break point (Dickey-Fuller min-t); and trend and constant to specify the deterministic

trend, are as follows: (i) model with constant: -5.35 (1%); - 4.86 (5%); -4.61 (10%). (ii) model with constant and deterministic trend: -5.72 (1%); - 5.17 (5%); -4.89 (10%).

It is important to note that for the primary result and gap series, there was no need to apply these tests, as they are stationary series in level. When it comes to the structural break tests, the break date for the public spending/GDP series is the end of 1998, which is related to the start of the inflation targeting regime and the adoption of the primary result target. For the debt/GDP series, mid-2014 and early 2015 are the break points. Since 2014, the federal government has been running a primary deficit.

Once the stationarity analysis of the time series has been obtained, the next step is to carry out the econometric estimations via ordinary least squares. For equations (4) and (5), which analyze the cyclicality of fiscal policy, it can be seen below that there are no significant differences in the estimated coefficients, in other words, the pro-cyclical nature of fiscal policy was maintained, regardless of the value assigned to the smoothing parameter in the HP Filter. Table 2 below reports these results.

Table 2: Econometric Estimation Results (Equations (4) and (5))

Hodrick-Prescott (1997)					Ravn and Uhlig (2002)				
Static Equation					Static Equation				
Variable	Coefficient	Error^2	Stat-t	P-value	Variable	Coefficient	Error ^2	Stat-t	P-value
a	-1,783108[a]	0,006286	-283,6733	0,0000	a	-1,783108[a]	0,00627	-284,3999	0,0000
y_t^c	-2.35E-06[b]	1,16E-06	-2,022664	0,0441	y_t^c	-2.24E-06[b]	9,59E-07	-2,335832	0,0203
Dynamic Equation					Dynamic Equation				
Variable	Coefficient	Error^2	Stat-t	P-value	Variable	Coefficient	Error ^2	Stat-t	P-value
a	-0,339339[a]	0,065586	-5,173942	0,0000	a	-0,341934[a]	0,065821	-5,19488	0,0000
g_{t-1}	0,80912[a]	0,036705	22,04414	0,0000	g_{t-1}	0,807671[a]	0,036836	21,9262	0,0000
y_t^c	-1.30E-06[c]	6,91E-07	-1,887266	0,0602	y_t^c	-9.84E-07[c]	5,74E-07	-1,716445	0,0873

Source: Own elaboration (a) significance at 1%; (b) significance at 5%; (c) significance at 10%.

The coefficient of the output gap (ϕ) is $\phi > -1$ in all situations, characterizing the pro-cyclicality of the Brazilian economy's fiscal policy. The *t-statistics* sare statistically significant at 1%, 5% and 10. Thus, Brazil has not yet managed to "graduate", as the IDB (2018) puts it, and is still a victim of the so-called voracity effect. In other words, the country's fiscal policy tends to increase public spending in good economic times, while failing to save for bad times.

As a final exercise, the fiscal reaction function based on equation (7) is estimated in order

to check how the Primary Result responds to variations in revenue, public spending and debt. The results are shown in the table below (here, as before, the two parameters were used in the filters to capture the cyclical components of those variables):

Table 3: Econometric Estimation Results (Equation (7))

Hodrick-Prescott (1997)					Ravn and Uhlig (2002)				
Variable	Coefficient	Error ^2	Stat t	P	Variable	Coefficient	Error ^2	Stat t	P
μ	0,069717[a]	0,011539	6,041674	0,0000	μ	0,069735[a]	0,011409	6,112247	0,0000
b_{t-1}	-7.87E-03[a]	1,50E-03	-5,236855	0,0000	b_{t-1}	-7.87E-03[a]	1,49E-03	-5,299499	0,0000
g_t^c	-1.01E+00[a]	2,22E-01	-4,54818	0,0000	g_t^c	-1.02E+00[a]	2,10E-01	-4,831741	0,0000
τ_t^c	9.80E-01[a]	1,79E-01	5,466857	0,0000	$\gamma\tau_t^c$	1.00E+00[a]	1,74E-01	5,775397	0,0000

Source: Own elaboration (a) significance at 1%; (b) significance at 5%; (c) significance at 10%.

In both cases, the estimated coefficients showed the expected signs and were statistically significant. As for the lagged debt/GDP ratio, the results show not only that fiscal policy is pro-cyclical, but also that public debt is not sustainable, as shown in Table 2. Thus, the results show that the fiscal effort that has been made, in terms of generating primary surpluses, has been insufficient to stabilize the debt/GDP ratio. If the public debt is not sustainable, this is evidence that the Brazilian economy, in principle, is under a regime of fiscal dominance in the period under analysis. However, additional studies are needed to corroborate this argument, in the sense that while the estimated coefficient of the lagged debt/GDP ratio is negative and statistically significant, its value is very low ($\alpha = -7{,}87e^{-03}$).

6. FINAL CONSIDERATIONS AND POLICY IMPLICATIONS

The aim of this study was to analyze the pro-cyclical nature of fiscal policy in Brazil and its relationship with fiscal dominance and monetary dominance regimes in the post-Real Plan period. The theoretical framework for the economic model is based on Wagner's Law and Fiscal Reaction Functions. In addition to the use of fiscal and indebtedness data, as a proxy for the output gap we used the cyclical component of Brazilian GDP obtained through the Hodrick-Prescott Filter, but considering different values reported in the literature for the smoothing parameter.

The results obtained here corroborate the evidence obtained in previous studies that, in

the post-Real Plan period, fiscal policy in Brazil is pro-cyclical. However, this study should contribute to the literature on the subject by empirically verifying that the pro-cyclicality of Brazilian fiscal policy is independent of the dominance regime under analysis, the theoretical model analyzed (Wagner's Law or Fiscal Reaction Function) and the specification of the output gap.

Brazil, as an emerging Latin American country, still has to work on its fiscal policy planning. Advanced countries tend to have counter-cyclical or acyclical fiscal policies.

According to the IDB (2018), the pro-cyclical nature of fiscal policy can harm the most vulnerable groups in society, poor people, low-income elderly people, etc. The IDB (2018) also recommends linking social benefits to inflation (and not to cyclical components, such as revenue collected, for example).

The IDB (2018) suggests increasing capital expenditure during recessions, if the country has a low capital stock, of course. Whereas it proposes reducing current expenditure during recessions. Now, what we have seen is that Brazil, despite some improvement in the current public debate, has at least historically increased current spending in periods of economic boom (instead of keeping it constant or even decreasing it, as advanced nations do). While capital expenditure is sometimes increased for controversial reasons and sometimes reduced in recessions, for example. The path to "graduation", in the words of the IDB (2018), has been planted, but the country must work harder to make it a reality and inform the public of its importance.

For future work, we suggest investigating the degree of pro-cyclicality of fiscal policy for different types of expenditure, for example, current and capital expenditure.

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