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Evidence of the Effects of Fiscal Illusion in Brazil Using Mill Hypotheses and Wagner Law Tests

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Abstract
In order to verify if Mill's hypothesis on the fiscal illusion explains the increase of the expenses of the Brazilian government, the demand for national public goods was estimated using the model of the median voter, with annual data of public expenditure of the federal government, from 1995 to 2015. It was admitted that reducing the visibility degree of the Taxation, by serving as a vector for the induction of taxpayer voters in underestimating the cost of government-provided goods, could influence the outcome of the public choice of rulers. The results revealed that the expansion of public spending in Brazil is partly a consequence of the existence of fiscal illusion. In the long run, the study confirmed Wagner's Law. The article underscores the importance of publicly discussing the use of fiscal illusion.

Keywords: *Mill Hypothesis, Fiscal Illusion, Brazilian government, Taxation, Public Expenditure, Average Voter.*

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I. INTRODUCTION

The performance of public expenditures and their relationship with the expectations of the voter who contributes to the demand for public services has been the subject of empirical studies. It is noticed that not always the increasing state indebtedness is a reflection of the increase of the collection or the improvement in the quality of the services made available to the citizen. The concept that typifies this situation is the fiscal illusion, characterized by the mistaken perception of the individuals regarding the size of the tax burden and other taxes charged by the public power and the benefit that returns to the society, as well as the influence of the voter on the relative decisions to local public spending.

According to the tax illusion literature presented in this article, one of the strategies most used by the tax authorities is the increase in the participation of indirect or less visible taxes in relation to the total revenue collected. Thus, it is assumed that the greater the share of indirect taxes in relation to total taxes paid, the greater the probability that the voter will underestimate the tax burden to which he is exposed.

In this regard, the international literature provides several evidences and presence of increased public spending and fiscal illusion, notably the works of [31] [36][8][10]. Fiscal illusion also influences the cyclical nature of government spending as forecasts are formed from government dependence on indirect tax revenues and intergovernmental transfers. Government spending is more likely to be pro-cyclical when citizens systematically underestimate the cost of taxation.

However, fiscal illusion is a phenomenon that limits the taxpayers' understanding of the actual tax burden, enabling the increase of public expenditures as proposed by [2]. Studies on fiscal illusion, as defined by [40][24][13][22], reveal how taxpayers are subject to misperceptions about the fiscal situation of a country. Several mechanisms have been analyzed to create fiscal illusions, such as indirect taxation and indebtedness.

In the case of Brazil, public spending has increased substantially in the last 20 years. According to data from the Ministry of Finance, the federal government's primary expenditure reached 19.6% of GDP in December 2015. The matter has become so relevant that at present the Brazilian government is discussing with the society the Proposed Amendment to the Constitution (in Portuguese *Proposta de Emenda à Constituição - PEC 55*), which provides for the adoption of an annual ceiling for the expenditure of the three powers for the next twenty years. If the rule is approved, public spending can only increase according to the inflation of the previous year.

Thus, this growing tendency of public debt in Brazil, especially in the post-redemocratization period, and the massive presence of indirect taxes in the tax system, are aspects that characterize the presence of the phenomenon of fiscal illusion. However, despite this context, there are few studies addressing the topic of fiscal illusion in Brazil. [43] argue that fiscal illusion can explain the low effectiveness of Brazilian fiscal policy, associating high tax burden and income inequality, as well as low quality public services. Among the pioneering empirical studies on the subject, we highlight those developed by [41][2].

Considering this scenario, the central objective of this article is to verify if the fiscal illusion can explain the effect of the strong growth of federal public spending in the last 20 years. More specifically, the research aims to test the validity of Mill's [31] hypothesis, which finds further support in the empirical literature, using the data from 1995-2015, using the modified median voter model to include fiscal illusion as specified by [21]. In addition, this model also aims to test the Wagner Law and ratify the model developed by [41].

Further to this introductory part, which contextualizes the theme and defines the objectives, the article includes: a review of the literature on the subject, highlighting the aspects related to the theory of fiscal illusion (Section 2); The definition of methodological procedures for conducting empirical tests (Section 3); The data demonstration and the econometric methodology used in the estimation of the model (Section 4) and the analysis of the results (Section 5). The last section reiterates the final considerations about the study, comparing the results with the theoretical premises.

II. THEORETICAL REFERENCE

In 1848, John Stuart Mill already signaled that direct taxes are more noticeable than indirect taxes in taxpayers' view. For [31], the amount that the taxpayer is obligated to pay directly out of his pocket is the only taxation that he is sure to pay in whatever he consumes. They may underestimate the tax burden of indirect taxes on direct taxes because indirect taxes are incorporated and therefore "hidden" in the prices of goods. Therefore, if all taxes were direct, taxation would be much more visible to the citizen.

Given the above argument, one of the strategies most used by tax authorities to promote fancy and increase the participation of indirect taxes - or "less visible" - in revenue collected. It is assumed, therefore, that the greater the proportion of indirect taxes in relation to the total taxes paid, the greater the probability that the taxpayer underestimates the tax burden he will pay. This hypothesis is known in the literature as Mill's hypothesis, since the origin of this argument is attributed to John Stuart Mill.

From the aforementioned theory, it begins the term “fiscal illusion”, which appears in the year 1903, with the publication of the book by Amilcare Puviani, entitled Teoria dell’illusione finanziaria. According to the book, fiscal illusion is characterized as an artifice used by rulers to restrict taxpayers' perception of public taxes and expenditures so that they do not offer resistance to taxation schemes. Thus, rulers note that citizens are against payment of taxes and therefore seek taxation strategies that make voters underestimate the costs of public goods and services and are induced to accept exorbitant public expenditures. Consequently, the theory of fiscal illusion is related to high levels of public spending [41].

The work of [36] sought to demonstrate the existence of the asymmetry of information generated by public managers in the imposition of taxes and in the manipulation of public expenditures. However, the meaning of the term "fiscal illusion" has evolved over the years. The preliminary hypothesis developed by Amilcare Puviani promoted a broad discussion in the methodological field and in the evidence obtained, for example, the verification that other economic disciplines (such as the Monetary Economy) used terminology to explain phenomena different from those originally described in Theory of Fiscal Illusion.

Thus, in a very specific way, the economist Amilcare Puviani [36] introduced the hypothesis of fiscal illusion as an observable answer to the question presented. Despite Mill's [31] precedence over the diversity of perceptions on the part of the taxpayer, [36] was the first author to use the term 'fiscal illusion'. According to [32], the author's ideas about fiscal illusion are interpreted as answers to the question: "how can government actions be diminished from the perspective of taxpayers?"

The Mill hypothesis finds strong support in the empirical literature [21][38][11][14]. The works of [29][31][36] sought to answer an original question: "How can a politician use the powers transmitted by the population in order to promote their own projects?" [47]. The answer was fundamentally based on Puviani's book.

In the 1960s, interest in the subject was revived by [8], arguing that Puviani's work would provide a powerful basis for exploring the structure of political institutions using the academic developments that emerged in the field of Public Finance, as well as generating a possibility of expansion of the discussion about the assumption of the agents' perfect rationality. [8] locates Puviani's economic thinking in the context of the Italian Fiscal School of the late nineteenth century, which focused on the analysis of a monopolistic state (in contrast to the hypothesis of a state as a voluntary political institution).

One of the most important traditions about fiscal illusion is the propensity of governments to obscure the implementation of public programs and budgets. [36] reports that for centuries there was no precise distinction between state accounting and private accounting of rulers.

According to the seminal paper on the complexity hypothesis test of Wagner's tax revenue, which takes the dispersion of total tax revenue among different taxes, as measured by the Herfindahl index, as a proxy for the degree of complexity of the tax system, It is prescribed that the more complex and fragmented the tax system, the greater the difficulty for the taxpayer to perceive his share of the contribution to the financing of the State and the greater the demand for public expenditure. The empirical results on this hypothesis are varied. However, it can be argued that there is considerable evidence of its validity [25][16][14].

[9] argue that high public deficits increase the likelihood that the current generation of taxpayers will underestimate the cost of government-provided goods and services, resulting in higher levels of public spending. Several studies support the hypothesis of fiscal illusion [3][26][12][14].

Already in the late 1980s, [34] gives the investigation of fiscal illusion a new impetus, through a well-referenced work. For [34] fiscal illusion refers to the notion that the systematically wrong perception of fiscal parameters can significantly distort the choices made by voters. For [34], fiscal illusion can take many forms, dividing them into three sources: debt sources, transfers, and tax sources.

[17] also discusses fiscal illusion through the issue of indebtedness. For this author, fiscal adjustments should be viewed as illusions when reducing the public deficit or public debt, but they do not alter, in essence, the final weight of the public sector. However, [48], referring to the work of [44], recalls that the assumption of a permanently misinformed or ideologically manipulated constituent constituency is too restrictive. For [48], as the evaluating group increases, so does the likelihood of obtaining a correct final judgment on a subject, based on two conditions: That the majority vote be won and that there is a greater probability that the individual will be right than wrong.

[48]‘s work argues in a Puvian sense that irrationality (or nonlogical actions, according to Pareto's terminology) may be more frequent in democratic life more than the classical authors of the Public Choice would wish. The work of [47], in line with [19], pointed to the area of economic regulation, particularly the presentation of associated costs, as one of the areas where maneuvers of political illusion became more evident, emphasized the general nature Of processes of fiscal illusion, which can be found both in totalitarian regimes and in democratic regimes.

[37] sought to understand why the structure of tax systems is deliberately opaque. For this purpose, they resort to a different classification of the causes of the fiscal illusion according to [36], grouping them into causes based on the School of Public Picks with limited rationality (focusing mainly on the behavior of interest groups) and causes based on the studies Economic psychology (focusing on the beliefs of the contributing electorate).

[8] describes several strategies used by governments to reduce the tax burden perceived by the taxpayer. [45] also relates some of the sources of illusion most exploited by tax authorities. One of the most discussed and empirically tested forms of fiscal illusion in the literature is the collection of revenue through taxes that remain "hidden" in product prices, the so-called indirect taxes. The original idea that the participation of indirect taxes in the collection may lead the taxpayer to underestimate the tax burden that falls on him is commonly attributed to [31].

In this way, [8] stated that the fiscal illusion originates through public expenditure programs and through taxation and collection, and can be created in at least five different forms of taxation. The first comprises the use of public income to finance government spending programs. In this situation, taxpayers fail to verify that unused income could be returned, thereby reducing levels of taxation. The second form arises when the tax is inserted in the payment that an individual makes when acquiring private goods or services, configuring the indirect taxation. In this case, the citizen may not be aware of the amount of tax that is paid. That is, the greater the participation of indirect taxes in the total of taxes paid, the greater the chance of the taxpayer believing that the tax burden is lower than it really is [41].

Moreover, according to [8] if the tax existed for some time the fiscal illusion is more complete. Thus, it is verified that the Brazilian tax system has several taxes, several forms of collection and a plethora of taxes and exemptions. Thus, the work of [8] shows that the more the tax burden is fragmented so that the taxpayer faces numerous small tax rates, the greater the possibility of creating illusory effects in these circumstances.

The third form, in [8]'s classification, concerns the public debt and the relation with the Ricardian proposition that the payment of a single and one-time tax would be equivalent to the payment of a certain percentage of the single tax by means of a perpetual annual payment. However, taxpayers do not consider the two alternatives to be equivalent and prefer payment of a smaller amount annually than the single payment of a larger amount. Hence, the financing of public spending through indebtedness and perpetual annual collection would receive less resistance than the single and immediate collection of a larger amount. Thus, the financing of

public spending via debt is among the mechanisms used to reduce the taxpayers' perception of the costs and benefits of government goods and services [2].

The fourth form, according to [8], refers to the use of the issue of coins to finance public goods and services, which may lead to inflation and the loss of the purchasing power of the currency held by citizens. Finally, the fifth way to generate a fiscal illusion is through false promises. This trick makes the taxpayer believe that many government-spending programs are temporary and short-lived. But in fact, when initiated, these programs will be kept indefinitely. In this way, the cost of the program will be much higher than the taxpayer initially envisaged.

The essence of the argument of the fiscal delusion scheme is therefore that it is easier for the government to make it difficult to obtain complete information from the taxpayer on its share of the contribution to the financing of the State. The taxpayer, on the other hand, is not encouraged to invest time and money in obtaining adequate information, since his vote has no significant impact on the outcome of public choices, since it represents one of millions of taxpayers.

Studies on the flypaper effect test the hypothesis that government public spending is more sensitive to the increase in transfers received from other spheres of government than the rise in local private income. Fiscal delusion literature proposes that this is because it is more difficult for taxpayer voters to perceive their share of the contribution in the opportunity cost of public spending when it is financed by transfers rather than through local taxes, leading the government to demand excessive expenditures. Despite the controversy in the literature on the flypaper effect, several recent studies confirm the existence of this phenomenon [20][30][28][39].

However, the flypaper effect from the perspective of fiscal illusion ends up reproducing a myopic view of the median voter on the allocative and distributive decisions of the government, it is worth mentioning that, under the theory of the average voter, the increase in local government revenues from the transfers would be accompanied by a proportional increase in public expenditures of the federative entity, which, in a way, conflicts with the increasing expenses observed in the flypaper effect. Thus, bureaucrats offer baskets of public goods and services that, despite being even demanded by the electorate, do not coincide with the demands and desires of an environment without information asymmetry.

In environments of information asymmetry, it is possible to reconcile the flypaper effect with the hypothesis of the average voter. As expressed in the following hypothetical situation, where local governments do not collect taxes efficiently. Hence, when the amount coming from intergovernmental transfers is not sufficient in the face of low revenue collection, governments would be forced to meet the pent-up demand of society in order to raise their welfare. This makes it even more feasible and stimulating for public spending to be proportionally higher than the transfer revenues, only in the context of taxpayer utility maximization.

Despite the abundance of international studies on the subject, there are still few studies in Brazil, highlighting those of [41][2]. [41] is the first work that seeks to empirically test the influence of fiscal illusion on public spending in Brazil. [41] examined whether fiscal illusion could help explain the expenditure behavior of the Brazilian federal government during the period 1990-2011, using the median voter model. Evidence was found that the greater the proportion of income tax ("more visible") in total taxes collected by the federal government, the lower the federal government spending, which confirms the hypothesis that there is fiscal illusion in the demand for public spending federal. The study also confirmed Wagner's law in the long run.

Another empirical study was that of [2]. Using data for the year 2010 for 5,249 municipalities in Brazil, the demand for local public goods, based on the model of the median voter, was estimated, inserting variables that captured the fiscal illusion. The short-term and long-term intertemporal relationship between spent and a revenue variable of the Brazilian federal government was analyzed. The results showed that the expansion of local public spending is directly influenced by the mechanisms of fiscal illusion clearly manifested in the flypaper effect and in the absence of simplicity of the local tax system.

III. METHODOLOGY

As pointed out, the purpose of this study was to verify if the Mill hypothesis of fiscal illusion contributes to explain the growth of Brazilian federal government expenditure. The theoretical model used was specified by [21], which is the modified version - to include fiscal illusion - of Borcherding's public spending model, [4], based on the theory of the median voter. The demand for goods supplied by the government G can be modeled according to [6] [4] as:

$$G_i = aY_i^{\alpha} P_{gi}^{\beta}, \qquad i = 1,2 \ldots, N \tag{1}$$

In which G_i is the consumption of goods supplied by the government demanded by the voter-taxpayer, such as the taxation price paid by G_i, and the coefficients α and β respectively capture as elasticities of income and price of demand for goods supplied by the government.

The price is calculated as $P_{gi} = T_i\, CN^{\eta}$, where T_i is a tax share paid for i, C is the unit cost of G, and N is a population with the degree of advertising η. Borcherding and Deacon (1972) assumes that taxation is non-discriminatory, and that all pay the same amount of tax, specifying the price of tax as $P_{gi} = CN^{\eta-1}$. Substituting P_{gi} into equation (1), we can rewrite it as $G_i = aY_i^{\alpha}\,(CN^{\eta-1})^{\beta}$, solving the exponent β we obtain:

$$G_i = aY_i^{\alpha}\, C^{\beta} N^{\beta(\eta-1)} \qquad 2)$$

If there is a delay in productivity in the public sector, the implicit difference between public and private sector prices should be considered, so government spending should be adequately deflated, since the model variables are defined in real terms and, Consequently, a measure of the differences between the public-private price should be included in (2). Using relative prices and aggregating to express demand in terms of total expenses, we have:

$$G = aY^{\alpha} P_r^{\beta} N^{\theta} \ \text{, em que} \ \ \theta = (\beta+1)(\eta-1) + \eta - \alpha \qquad (3)$$

In which G and Y are total government expenditures and GDP respectively, both in real terms, and $P_r (= C/P_x)$ is the relative price, where P_x is the price of private goods.

Equation (3) is the standard model of public spending demand based on the median voter model. This specification adopts the theory of the democratic process in which citizens are supposed to be fully aware of the costs and benefits of government spending. If voters are subject to fiscal illusion, the perceived and true prices-tributes will be different. In this case, equation (3) must be modified. Gemmell, Morrissey and Pinar (1999; 2002) define the price-tribute perceived by the voter as $\widehat{P}_{gi} = \prod P_{gi}$, where Π is a parameter of perception. In this study, it is assumed that Π depends only on the degree of visibility of taxation, given by:

$$\Pi = V^{\pi_1} \qquad (4)$$

As a proxy for visibility, the study uses the ratio of direct tax revenue to total tax revenue. Changing $\widehat{P}_{gi}$ to P_{gi}i in (1), and replacing (4) in the model (3).

$$G_i = aY_i^{\alpha}\, \hat{P}_{gi}\ ; \quad G_i = aY_i^{\alpha}\,(\Pi)^{\beta}\ ; \quad G = Y^{\alpha} P^{\beta} V^{\pi_1 \beta} N^{\theta} \qquad (5)$$

Applying the natural logarithm on both sides of equation (5) gives the following equation:

$$\ln(G) = \ln\left(aY^{\alpha} P^{\beta} V^{\pi_1 \beta} N^{\theta}\right)$$

$$lnG = \ln(a) + \alpha lnY + \beta lnP + \rho lnV + \theta lnN \quad \text{em que} \ \ \rho = \pi_1 \beta \qquad (6)$$

Equation (6) was used to estimate the parameters: $lna, \alpha, \beta, \rho, \theta$.

IV. DATA SAMPLE

The data used to estimate the parameters of the model (6) relative to expenditures and revenues of the federal government and the national macroeconomy are annual for the period 1995-2015. The first were obtained from the National Treasury Secretariat at nominal values and taken to 2015 values by the General Price Index - Internal Availability (in Portuguese *Índice Geral de Preços - Disponibilidade Interna*). The others were obtained from the Central Bank of Brazil. The expenditure variable (G) was derived from the total expense, taking out the amortization of the debt and other current expenses, as highlighted in Table 1.

Table 1: Nominal value of the federal government expenditure group -2015.

Expense Group	Settlement Expenses
	Nominal value
CURRENT EXPENSES	1,399,017,922,507.00
Personnel and Social Charges	235,452,588,430.57
Interest and Debt Charges	208,360,341,749.48
Other Current Expenses	955,204,992,326.95
Transfers to States, DF and Municipalities	213,859,550,580.17
Social Security Benefits[2]	402,864,916,983.23
Other Current Expenses	338,480,524,763.55
CAPITAL EXPENSES	247,502,335,671.31
Investments	9,634,833,074.37
Financial Investments	55,915,627,251.14
Amortization of Debt[2]	181,951,875,345.80
SUBTOTAL	1,646,520,258,178.31

Debt Amortization - Refinancing	571,631,738,549.37
Refinancing the Debt	569,108,356,331.01
Refinancing of the Contractual Debt	2,523,382,218.36
TOTAL	2,218,151,996,727.68

Source: SIAFI - STN / CCONT / GEINC (2015)

The other GDP (Y) data, deflated at 2015 prices, the GDP (P) and population (N) deflator, although produced by the Brazilian Institute of Geography and Statistics (In Portuguese *Instituto Brasileiro de Geografia e Estatística - IBGE*), were obtained from the Central Bank of Brazil Brazil. In the composition of the population, the estimates and census of the resident population on July 1 were used, according to IBGE.

Table 2: Sub-category of federal government revenues -2015

Subcategory of Recipes	Realized Realized
	Nominal value
CURRENT REVENUES	1,282,514,801,609.55
Tax Revenue	424,674,627,285.75
Contribution Revenue	688,386,636,415.15
Asset Revenue	65,809,363,378.53
Agricultural Revenue	28,485,707.22
Industrial Revenue	625,624,311.12
Service Revenue	43,886,404,773.19
Current Transfers	1,115,841,900.06
Other Current Income	57,987,817,838.53
CAPITAL REVENUE	561,094,622,438.15
Credit Operations²	252,169,728,699.69
Related searches	1,502,671,903.81
Depreciation and amortization	55,099,901,340.33
Capital Transfers	95,601,842.28
Other Capital Revenues	252,226,718,652.04
SUBTOTAL	1,843,609,424,047.70
Credit Operations - Refinancing	771,117,711,060.95
Refinancing of Domestic Debt	771,117,711,060.95
Refinancing of Foreign Debt	0.00
TOTAL	2,614,727,135,108.65

Source: SIAFI - STN/CCONT/GEINC (2015)

It should be noted that only the government's primary revenues were considered, not including the revenues from the refinancing of the securities debt, as previously shown in Table 2. [41] argue that income tax is the most visible of Brazilian taxes and it is expected that a higher share of this tax in the total collected by the federal government is associated with a lower level of spending. The measure used to capture the fiscal illusion (V) was obtained by the ratio between total income tax (individuals and legal) and the total revenue obtained by the federal government.

4.1 Descriptive Statistics

The log (neperian logarithm) function was applied to each of the variables G, Y, P, N and V, that is, they were logarithmized, becoming respectively lnG, lnY, lnP, lnN and LnV. Table 3 presents the basic statistics of the model variables (6), which describes the position measurements (simple, minimum and maximum arithmetic mean), and the standard deviation, which is a measure of variability.

Table 3: Descriptive statistics of variables

Variables	lnG	lnY	lnP	lnN	lnV
Description	Expenditure	GDP	Price	Population	Visibility
Average	27.62	29.16	1.87	19.02	-1.82
Medium	27.69	29.14	1.79	19.04	-1.81

Standard deviation	0.171	0.19	0.52	0.09	0.10
Minimum	27.26	28.89	0.50	18.86	-2.16
Maximum	27.85	29.45	3.11	19.14	-1.66

Source: Prepared by the authors

In the five variables, the means and medians are not very distant from each other. This probably indicates that the series in the dataset are slightly symmetric. However, nothing can be said about its distribution. A normality test was then performed for each series.

The normality test has as null hypothesis that the series is normally distributed, and as an alternative hypothesis, that the series is not normally distributed. For this purpose, the Shapiro-Wilk test was used and the normality of the variables was tested to verify if the series in the dataset is well modeled by a normal distribution.

Table 4: Shapiro-Wilk normality test

Variable	W	P-value	Decision
lnG	0.927	0.122	Normal
lnY	0.906	0.045	Not normal
lnP	0.943	0.246	Normal
lnN	0.934	0.163	Normal
lnV	0.852	0.005	Not normal

Table 4 provides the summary results of the Shapiro-Wilk normality test. For the variables lnG, lnP and lnN the p-values are greater than 10%, indicating that they are normally distributed. For the other variables lnY and lnV the p-values are lower than 5% and 1%, respectively, meaning that the normality hypothesis can be rejected at the level of significance corresponding to 5% and 1%, respectively.

Next, the procedures will be performed to verify the presence of unit root in each series. For this purpose, the correlogram was used in an attempt to identify the number of lags and the Dickey-Fuller Increment test for the stationarity.

Supported in Figure 1 and 2 of the lnG variable, which shows the residuals graphs and correlograms in level and 1st difference, there is an increasing tendency of the series and a lag. In the Results Analysis section the conclusions of the application of the Dickey-Fuller Increment test are presented.

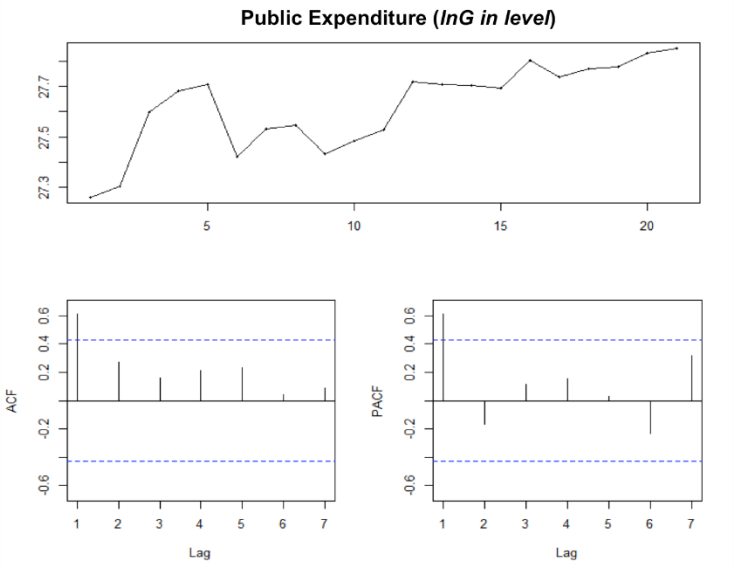


Figure 1: Graphs and correlograms of the lnG variable in level

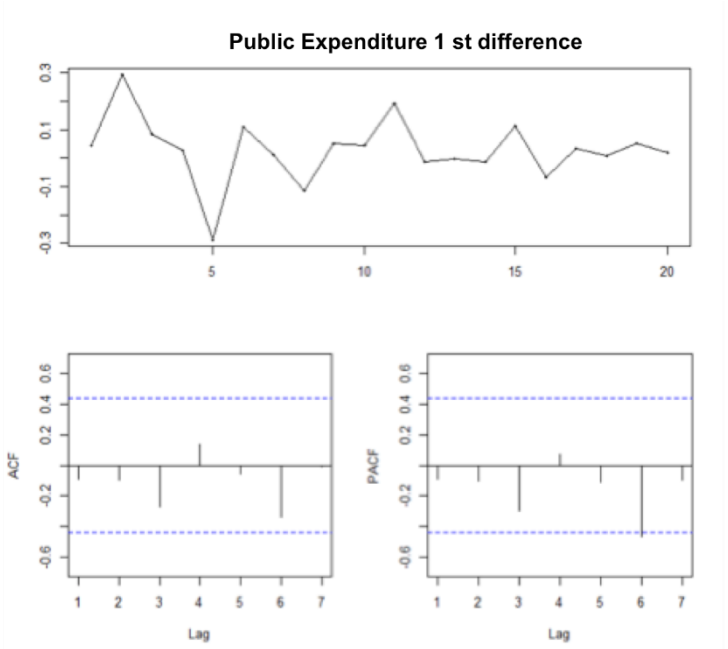


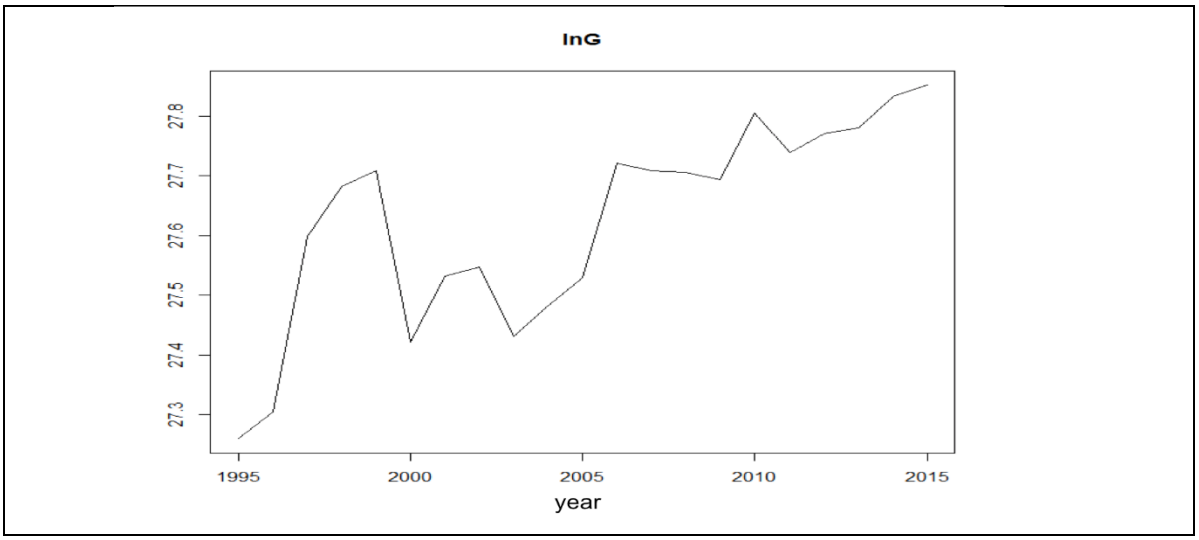
Figure 2: Graphs and correlograms of the lnG variable in the 1st difference.

The expected signs of the model variables (6) are based on the references of the authors of the public finance literature. A positive signal is expected for lnY, as predicted by [47][33], negative signal for lnP and positive for lnN, according to [21], and finally, [31] assigns signal negative for the lnV variable.

Once the data are related, the expected signals of the parameters of the model (6) are followed by the analysis of the results using the presented methodology. The data in question present features of time series, since naturally occur serial autocorrection among the errors, which suggests a time series approach as the most appropriate.

V. RESULTS

Figure 3 shows the series evaluated in the research. Initially, the residue graphs and correlograms were analyzed to indicate the order of lag of each series, adopting the smallest delay when the choice was not clear. The graphs suggest that the variables lnG, lnY and lnN are evaluated taking into account the trend for lnP and lnV.



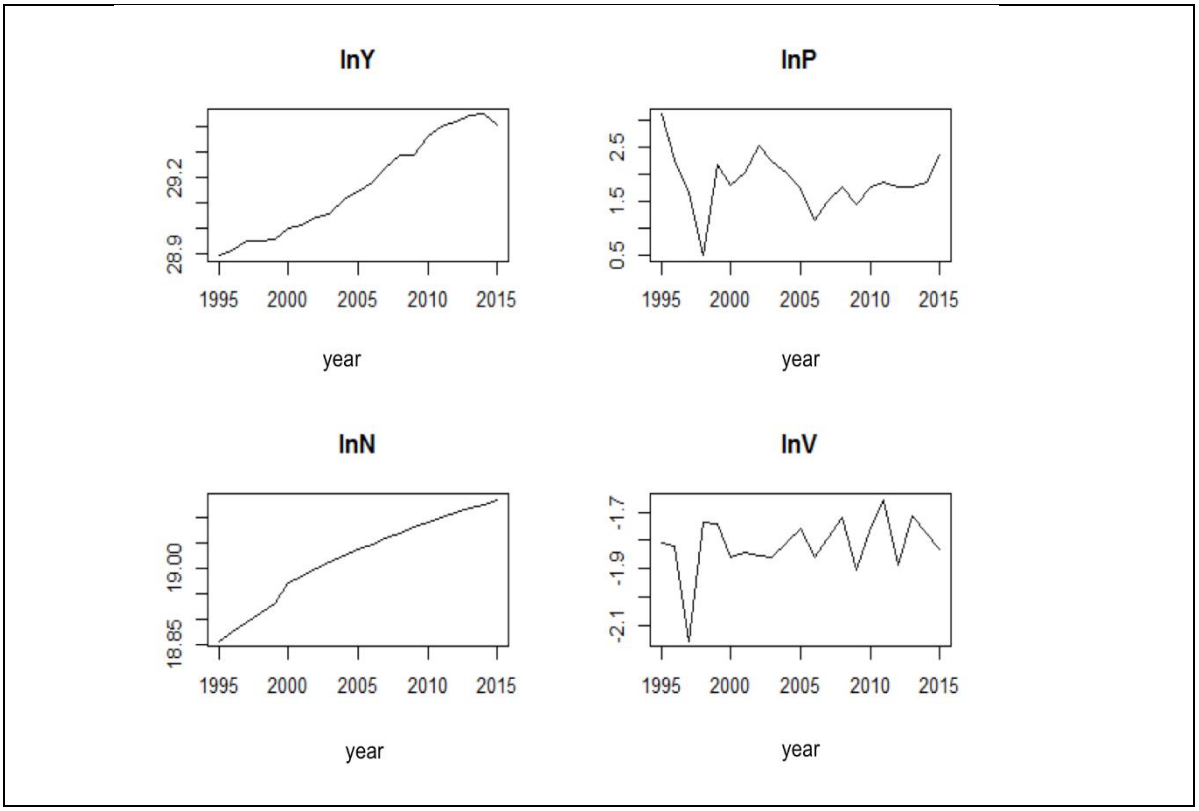


Figure 3: Graphics of the series lnG, lnY, lnP, lnN and lnV

Table 5 shows the Dickey-Fuller Increment tests for the variables under study, in which the type of equation used (without intercept, with intercept or trend) was analyzed, if the series was in level or in the 1st difference. The results show that all variables are non - stationary at level, that is, they presented unit root and, consequently, are integrated of order 1 - I (1). Only two possibilities of the test were presented, since only one of them can be correctly specified, and the others can only corroborate to the result, when they agree.

It should be noted that the variables lnG, lnY and lnN were evaluated with trend, lnP without trend, but with the intercept, and finally, lnV was evaluated without intercept, that is, it did not take the trend into account. [23] points out that care must be taken in the treatment of a time series due to problems of sub-differentiation and overdifferentiation. The first occurs when one considers a stationary series in the differences and treats it as stationary in a trend; the second, superdifferentiation, would be the opposite, that is, the series is stationary in trend and treated as stationary in the differences.

Table 5: Dickey-Fuller Increment test and integration order

Variable	Equation	Series	Integration	Dickey-Fuller Increment test	Result
lnG	Intercept	Level	I(1)	-2.376	Not Stationary
		1ª Difference	I(0)	-4.515	Stationary
	Tendency	Level	I(1)	-3.566	Not Stationary
		1ª Difference	I(0)	-4.437	Stationary
lnY	Intercept	Level	I(1)	-0.798	Not Stationary
		1ª Difference	I(0)	-3.029	Stationary
	Tendency	Level	I(1)	-1.356	Not Stationary
		1ª Difference	I(1)	-2.848	Not Stationary
lnP	Intercept	Level	I(1)	-3.336	Not Stationary
		1ª Difference	I(0)	-5.330	Stationary

	Tendency	Level	I(0)	-3.094	Stationary
		1ª Difference	I(0)	-5.385	Stationary
LnN	Intercept	Level	I(1)	-3.285	Not Stationary
		1ª Difference	I(0)	-2.508	Stationary
	Tendency	Level	I(1)	-1.577	Not Stationary
		1ª Difference	I(0)	-4.106	Stationary
LnV	Without intercept	Level	I(1)	-2.390	Not Stationary
		1ª Difference	I(0)	-7.353	Stationary
	Intercept	Level	I(0)	-3.964	Stationary
		1ª Difference	I(0)	-7.145	Stationary

Source: Estimated data in the equation (6)

Notes: Critical values for the test: Intercept [1%(-3.75). 5%(-3.0) e 10%(-2.63)]; Tendency [1%(-4.38). 5%(-3.60) e 10%(-3.24)].

In order to verify the long-term relationship between the variables described in equation (6) the cointegration test was performed between the variables using the Johansen procedure, calculating the trace and eigenvalue statistics, as reported in Table 6. It is observed That the null hypothesis of absence of cointegration is rejected in all cases, indicating the existence of at least one cointegrated vector. However, there is a divergence in the maximum eigenvalue statistic, in which one of the hypotheses was not rejected. After this analysis, cointegration regression (7) was estimated, the estimation presented was performed using the Ordinary Minimal technique.

$$\hat{ln}G_t = 9{,}793 + 0{,}702\hat{ln}Y - 0{,}109\hat{ln}P - 0{,}134\hat{ln}N - 0{,}052\hat{ln}V \quad (7)$$
$$(1{,}434) \quad (1{,}829)^{*} \quad (-2{,}55)^{**} \quad (-0{,}156) \quad (-0{,}226)$$

$$R^2 = 0{,}7328 \quad R^2\ ajustado = 0{,}666 \quad F = 10{,}97$$

In equation (7), the values in parentheses are the "t" statistics and the asterisks indicate the significance levels are: 1% (***), 5% (**) and 10% (*). It is observed that the coefficients associated with the variables lnY and lnP are significantly different from zero. Despite the fact that lnV (visibility) is not statistically significant, the negative sign indicated is correct, since when the income tax revenue collection increases, government spending tends to decrease, according to [41]. This relationship corroborates with the literature that there is evidence of fiscal illusion in the demand for public spending in the union.

It is observed that the variable lnP (price) generates a negative impact on the expenditure, as found in [2]. However, the sign of the coefficient of the variable lnN (population) is negative, and according to [2], a justification for this relationship is associated with a gain in scale in the supply of public goods and services in large urban centers.

It should be noted that Wagner's law proved to be valid for federal government expenditures, since the coefficient of income is statistically significant, different from 0 and well greater than 1. It can be said that a 1% increase in the real income of the economy would lead to a 9.8% increase in federal government real expenditures in the period 1995-2015.

Table 6: Result of the Johansen cointegration test

Hypothesis		Statistics	Statistical significance			Result
Null	Alternative		110%	5%	11%	
r <= 4	r > 4	10.02	6.50	8.18	11.65	Rejects H0
r <= 3	r > 3	22.81	15.66	17.95	23.52	Rejects H0
r <= 2	r > 2	40.03	28.71	31.52	37.22	Rejects H0
r <= 1	r > 1	74.28	45.23	48.28	55.43	Rejects H0
r = 0	r > 0	147.88	66.49	70.60	78.87	Rejects H0
Maximum Eigenvalue Statistics						
r = 4	r = 5	10.02	6.50	.18	1.65	Rejects H0
r = 3	r = 4	12.79	12.91			Rejects H0

				4.90	9.19	
r = 2	r = 3	17.23	18.90	1.07	5.75	Not Rejects H0
r = 1	r = 2	34.25	24.78	7.14	2.14	Rejects H0
r = 0	r = 1	73.60	30.84	3.32	8.78	Rejects H0

The long-term analysis proved to be valid for several assumptions. In continuity, the error correction model (ECM) was estimated, in order to test the equation of demand for public expenditure for short-term adjustments towards the long-term equilibrium, that is, if there is any implication of fiscal illusion in the short term. The results of the ECM analysis are shown in equation (8).

$$\Delta\hat{l}nG_t = \underset{(-0,797)}{-0,035} - \underset{(-1,199)}{0,713\Delta\hat{l}nY} + \underset{(0,132)}{0,003\Delta\hat{l}nP} + \underset{(1,755)}{5,260\Delta\hat{l}nN} + \underset{(0,569)}{0,063\Delta\hat{l}nV} - \underset{(-5,939)^{***}}{1,46\Delta\hat{\epsilon}_{t-1}} \quad (8)$$

$$R^2 = 0,782 \quad R^2\ adjusted = 0,7041 \quad F = 10,04$$

In equation (8) the test statistic "t" is in brackets, and the significance levels are: 1% (***), 5% (**) and 10% (*). In the short term, the only significant variable was the residue, indicating that $\alpha^* = -1.46$ with correct and small signal. Indicating that the velocity of adjustment for equilibrium is high, which concludes that, ceteris paribus, the variables do not cointegrate and the ECM brings the economy back to equilibrium at a high rate.

Since the other coefficients were not statistically significant, their performance will not be commented. However, it should be highlighted from the perspective of the fiscal illusion, measured in this work by the variable lnV, which, although not statistically significant, corroborates Wagner's Law on the long term, and it is not appropriate to test its validity in the short term.

VI. FINAL CONSIDERATIONS

The present article aimed to verify the fiscal illusion in Brazil and to verify by means of econometric analysis the effect of the strong growth of Brazilian federal public spending in the last 20 years. Using the modified median voter model, as specified by [21], the validity of the Mill hypothesis [31] was tested for the period from 2005 to 2015.

The empirical results showed that the fiscal illusion associated with the low "visibility" of taxation plays a significant role in explaining the growth of public spending in Brazil in the last 20 years, confirming Mill's hypothesis. In addition, the study also served to test Wagner's law, finding support for the premise that the income elasticity of demand for public goods is greater than unity in the long run.

In general, the results presented lead us to conclude that, in recent years, Brazil has reduced incentives to create fiscal illusion, but the level of variables is still high when compared to other countries, denoting that the problem of fiscal illusion in the Country is still worrying.

The Dickey-Fuller Increment tests for the variables under study, in which the type of equation used (without intercept, with intercept or trend) was analyzed, if the series was at level or in the 1st difference. The results show that all variables are not stationary at level, that is, they presented unit root and, consequently, are integrated of order 1 - I (1). Only two possibilities of the test were presented, since only one of them can be correctly specified, and the others can only corroborate to the result, when they agree.

The main limitation of this research was the availability of data for a longer time horizon, since some analysed variables had no available data prior to the year of 2002, while other variables still did not have data published for the year 2015 and the beginning of 2016. It is suggested that future research carry out an analysis for a longer time horizon. It would also be interesting to evaluate the fiscal illusion in other entities of the federation and to use more robust statistical methods.

The results of the article contribute to the deepening of discussions within society and the academy on the need to take into account the influence of fiscal illusion mechanisms in the debate on public expenditure control policies in Brazil.

VII.REFERENCES

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