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# Decomposition of the Brazilian debt-to-GDP ratio from 2004 to 2021: a demand-led growth analysis

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## Abstract

This paper analyzes Brazilian debt-to-GDP dynamics using a demand-led growth decomposition model based on the Supermultiplier theory. The method connects the models proposed by Haluska (2023) and Freitas and Ligiéro (2024) to analyze the contribution of the public, private and external sectors to the evolution of the debt-to-GDP ratio. It separates the contribution of autonomous components of demand and changes in the Supermultiplier parameters for output growth, and financial components of net public debt. The main findings indicate that an expansionary fiscal policy can help to decrease debt-to-GDP, especially if it is taken together with increase in tax revenues. On the other hand, contractionary fiscal policy can lead to an increase in the debt-to-GDP ratio. By analyzing the case of Brazil, we suggest that the contractionary fiscal policy adopted from 2015-21 have contributed to increase debt-to-GDP, a result contrary to its alleged purposes, indicating a possible case of paradox of debt or self-defeating austerity.

**Keywords:** Public debt; Decomposition model; Debt-to-GDP ratio; Demand-led growth.

**JEL codes:** E11, E62, H63

# 1 Introduction

Even though Post-Keynesian scholars argue that sovereign public debt is issued in state money where the state cannot be forced to default in its own currency, and also Central Bank has some sort of control over the interest rate paid over the public debt (Lerner, 1943, Serrano and Pimentel, 2019), the public debt is ever present in policy debates. In Brazil, this is also the case. For instance, the control of the public-debt to GDP ratio was officially mentioned as a motivation for pursuing fiscal targets, such as the Public Spending Cap in 2016 (Haluska et al, 2026).

From the demand-led growth perspective, output growth depends on macroeconomic policies, and is not a result of a given path of growth of the ‘factors of production’ in full employment and changes in technology (Blecker and Setterfield, 2019, Lavoie, 2022, Hein, 2023). Moreover, post-Keynesians argue that interest rate is a monetary variable set institutionally and there is no such thing as a natural rate of interest.

We know since Domar (1944) that debt-to-GDP stability condition depends on the difference between these two variables – the growth rate of the GDP and the real interest rate. In the stable case, where growth rate is higher than the real interest rate, an increase in the growth rate would reduce the equilibrium level of the debt-to-GDP ratio. The supermultiplier demand-led growth model add another positive effect of higher growth rates, as it will lead to a higher business investment share and a level effect on output, thus contributing to a further decrease in the debt-to-GDP ratio (Freitas and Christianes, 2020, Fazzari *et al*, 2022). As both interest rate and growth rate are ultimately related with macroeconomic policies, it is interesting to compare concrete cases where the dynamics of the debt-to-GDP is associated with changes in the macroeconomic policy stance.

In this paper, we apply a demand-led growth decomposition inspired by the Supermultiplier theory to the analysis of the dynamics of debt-to-GDP ratio. We use the case of Brazil for an illustration of the application of such method. Brazil has both a historically high average real interest rate, and presented an important shift in the direction of the macroeconomic policy stance, and consequently, in the average growth rate in 2015 (Haluska et al, 2026). The decomposition method connects the research made

by Haluska (2023) for Brazilian output growth with Freitas and Ligiéro (2024) for the debt-to-GDP in US.

The methodology helps to demonstrate how each component of the sectors' autonomous spending, as well as the parameters of the Supermultiplier and the financial components of the net debt, contribute to debt-to-GDP dynamics. The results show that an expansionary fiscal policy can contribute to decrease debt-to-GDP, while a contractionary policy can help to increase it.

Besides this introduction, this paper is divided into four more sections: the second section is dedicated to reviewing the output and debt decomposition models. The third section presents the decomposition model for changes in debt-to-GDP ratio used in this paper. Finally, the fourth section describes the main results. Final considerations are presented at the end.

## **2 Supermultiplier demand-led growth decomposition and public debt**

The Sraffian Supermultiplier, which in its seminal versions (Serrano, 1995, Freitas and Serrano, 2015) assumed an economy without a public sector, was then used to analyze public spending and public debt (Allain, 2015, Casseti, 2017, Hein, 2018, Brochier and Macedo e Silva, 2019, Freitas and Christianes, 2020, Fazzari, Ferri and González, 2022), and Pedrosa, Brochier and Freitas, 2023). As shown in those studies, a demand-led growth economy driven by growth of public spending can have the result of decreasing the debt-to GDP ratio (Freitas and Christianes, 2020, Fazzari et al, 2022).

Parallel to this theoretical literature, there is also an effort to apply the Supermultiplier theory to analyze concrete cases, such as the decomposition models that have been inserted in the Supermultiplier literature. These decomposition models provide the contributions of the components of aggregate demand, helping to identify the patterns of output growth in the countries under analysis (see Summa et al, 2025 for a survey). In this case, the general idea behind growth decomposition models is to describe the

percentage impact of the components of aggregate demand on GDP. Examples of the application of those decomposition models are found in Freitas and Dweck (2013), Haluska (2023), Campana *et al* (2023), Labat-Moles and Summa (2024), Morlin *et al* (2024) and Barbieri-Goes *et al* (2024), for different countries.

In the Supermultiplier decomposition, the main characteristics of the models follow the hypotheses that *i*) investment should be disaggregated to differentiate the behavior of non-residential private investment, household residential investment and investment made by the public sector; *ii*) household consumption should be disaggregated into autonomous consumption financed by credit and consumption induced by wages, and; *iii*) demand variables should remove the imported content to assess the contribution to growth. In addition to these, other details or levels of disaggregation can be applied to deepen the results. This is what papers like Haluska (2023), and Labat-Moles and Summa (2024) do for consumption based on transfers and public sector wage payments, respectively – highlighting the importance of analyzing disposable income as a source for consumption. One of the aspects of the models that were adapted from Freitas and Dweck (2013) is the separation of the institutional sectors of the economy into public, private and external sectors, for example, which has been kept in other output models.

In addition to the output decomposition, the model for decomposing the dynamics of the debt-to-GDP ratio was developed by Freitas and Ligiéro (2024). It was formulated to explain two periods in the US economy in which austerity policies were applied but had different results. The first one was under Clinton administration, in the period from 1993 to 2000, with the so called "*expansionist austerity*" (although there are controversies with the nomenclature given to the period and the economic policy practiced, questioned by Serrano and Braga, 2006). The second one was during Obama's government, between 2011 and 2016, with his "*turn to austerity*".

In both periods, the objective was to reduce government spending to varying degrees, and the results were equally divergent. In the Clinton period, the result was a period of relatively high growth rates of GDP and, consequently, a reduction in the debt-to-GDP ratio. In the Obama period, on the other hand, there was low GDP growth, as well as an increase or stagnation in the debt-to-GDP ratio. This result shows that there was no reduction, as expected. Therefore, it is possible to verify the adverse effects such as *self-*

*defeating austerity* and the debt paradox, which attempts to reduce Debt end up having the opposite effect.

### **3 Decomposition of the dynamics of the debt-to-GDP ratio**

We decompose the changes of the net debt-to-GDP ratio<sup>1</sup>, using the Brazilian economy as an illustration. The decomposition allows to check the contributions of the primary fiscal result, the interest rate, the GDP growth rate, exchange rate adjustments and other adjustments that impact the debt, such as privatizations and the recognition of debts. These are the components of the factors conditioning net public debt, according to the Brazilian Central Bank data (see also Borça Jr and Barbosa-Filho, 2023).

This methodology follows two studies that serve as pillars for the development of the decomposition model: Haluska (2023) and Freitas and Ligiéro (2024). The model from Haluska (2023) is used to calculate the contributions to the growth of GDP, while the model from Freitas and Ligiéro (2024) is used as a basis for the decomposition of the changes in the debt-to-GDP ratio.

The data used for GDP and its components are from the System of National Accounts, the Integrated Economic Accounts and the Table of Resources and Uses, from the Brazilian Institute of Geography and Statistics (IBGE), and data from investment from public companies from the Ministry of Finance. The data about debt, primary result, and interest rate payments were obtained from the statistics published by the Central Bank.

First, we present the decomposition to GDP growth calculated based on the Sraffian Supermultiplier model. Next, we present the decomposition of changes in debt-to-GDP ratio, combined with the contributions to GDP growth.

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<sup>1</sup> The data used refers to public sector net debt data provided by the Central Bank. GDP was taken from the IBGE's National Accounts System.

### 3.1 The decomposition of GDP growth

Let us assume an open economy with a government sector. The supply of goods and services equals total demand, as described in the following equation:

$$Y_t + M_t = C_t + I_t + G_t + X_t \quad (1)$$

Where  $Y_t$  represents output (GDP),  $M_t$  represents imports,  $C_t$  is household consumption,  $I_t$  is investment,  $G_t$  is government consumption and  $X_t$  stands for exports.

Imports are a function of total demand and imported content ( $m$ ). Here, we incorporate the simplifying assumption that imported content is the same for all demand components – such as household consumption, investment, government consumption and exports (Haluska, 2023, p. 299).

$$M_t = m_t(C_t + I_t + G_t + X_t) \quad (2)$$

One portion of household consumption consists of consumption out of disposable income ( $Y_t^d$ ) and another component consists of autonomous consumption which depends on credit conditions ( $C^A$ ).

$$C_t = cY_t^d + C_t^A \quad (3)$$

Where  $c$  is marginal propensity to consume out of disposable income. Disposable income, in its turn, consists of GDP minus taxes ( $T_t$ ) plus transfers to households ( $Tr_t$ ):

$$Y_t^d = Y_t - T_t + Tr_t \quad (4)$$

Taxes, in turn, are a function of the tax burden, represented by  $t$ , as follows:

$$T_t = tY_t \quad (5)$$

Therefore, household consumption can be expressed as:

$$C_t = c(1 - t)Y_t + cTr_t + C_t^A \quad (6)$$

Investment is divided between a) investments made by the government ( $I_t^G$ ), b) investment made by public companies ( $I_t^{PC}$ ), residential investment made by households ( $I_t^R$ ) and non-residential private (business) investment ( $I_t^B$ ):

$$I = I_t^G + I_t^{PC} + I_t^R + I_t^B \quad (7)$$

We assume here that public investment, investment made by public companies, and household residential investment are autonomous expenditures. First, because they do not generate productive capacity for the private sector. Second, because they are not induced by current output, depending on government discretionary decisions or on credit conditions.

Business investment, in turn, is induced by current and expected income, according to a flexible accelerator mechanism. It can be expressed by:

$$I_t^B = hY_t \quad (8)$$

Where  $h$  represents the propensity to invest.

By combining the equations 1, 2, 6, 7 and 8, we can express GDP as the sum of all autonomous expenditures multiplied by the supermultiplier:

$$Y_t = \left( \frac{1 - m}{1 - (1 - m)[c(1 - t) + h]} \right) Z_t \quad (9)$$

Where the term in parenthesis represents the supermultiplier and  $Z_t$  represents autonomous demand.  $Z_t$  can be expressed as the following sum:

$$Z_t = G_t + cTr_t + I_t^G + I_t^{PC} + X_t + C_t^A + I_t^R \quad (10)$$

In this decomposition, autonomous expenditures are represented by seven components: government consumption, consumption out of transfers to households, government investment, investment by state-owned enterprises, exports, autonomous household consumption that depends on credit – proxied by the consumption of durable goods – and residential investment by households.

Therefore, changes in output depend on variations in these terms, as well as on components of the supermultiplier, such as the imported content, the propensity to consume, the propensity to invest, and the tax burden.

From this model, it is possible to calculate the contribution to the growth of GDP of each component. Equation 11 presents the final equation for the growth decomposition. Growth depends on a) the increase of each of the components of autonomous expenditures, b) changes in the parameters of the supermultiplier and c) the contributions of changes in inventories ( $E$ ). The change in inventories must be included so that the sum of the calculated contributions equal exactly the rate of growth of GDP. The calculations to obtain equation 11 are presented in Haluska (2023, p. 322-323).

$$\begin{aligned}
 g_t = \alpha_t \left( 1 - t_t + \frac{Tr_{t-1}}{Y_{t-1}} \right) \Delta c + \alpha_t \Delta h - \alpha_t c_t \Delta t & \quad (11) \\
 - \frac{\alpha_t}{(1 - m_t)(1 - m_{t-1})} \Delta m + \alpha_t c_t \left( \frac{\Delta Tr}{Y_{t-1}} \right) + \alpha_t \left( \frac{\Delta G}{Y_{t-1}} \right) & \\
 + \alpha_t \left( \frac{\Delta I^G}{Y_{t-1}} \right) + \alpha_t \left( \frac{\Delta I^{PC}}{Y_{t-1}} \right) + \alpha_t \left( \frac{\Delta X}{Y_{t-1}} \right) + \alpha_t \left( \frac{\Delta C^A}{Y_{t-1}} \right) & \\
 + \alpha_t \left( \frac{\Delta I^R}{Y_{t-1}} \right) + \alpha_t \left( \frac{\Delta E}{Y_{t-1}} \right) &
 \end{aligned}$$

Where  $\alpha_t$  represents the value of the supermultiplier:

$$\alpha_t = \frac{1 - m_t}{1 - (1 - m_t)[c_t(1 - t_t) + h_t]} \quad (12)$$

The changes in each component of autonomous demand were deflated using the GDP deflator, as in Freitas and Dweck (2013).

### 3.2 The decomposition of public debt

In this section, the debt decomposition is based on the model developed by Freitas and Ligiéro (2024). We are considering here the net debt of the public sector<sup>2</sup>. Initially, public debt can be expressed as follows:

$$D_t = D_{t-1} (1 + i_t) + ((G_t + I_t + Tr_t) - T_t) + EA_t + OA_t \quad (13)$$

Where  $D_t$  is the net debt and  $D_{t-1}$  is the net debt from the previous period. The term  $i_t$  refers to the nominal interest rate. The term  $((G_t + I_t + Tr_t) - T_t)$  represents primary deficit, i.e., the sum of primary expenditures minus taxes. The remaining terms are the exchange rate and currency parity adjustments,  $EA_t$ , and other adjustments,  $OA_t$ , which include the effects of the recognition of new debts (which increases debt) and of privatizations (which reduces debt). The interest rate was calculated as the total amount of interest paid in one period in relation to the stock of net debt at the end of the previous period. This interest paid is net of interest received for international reserves in foreign currency. The net debt of the public sector, also includes the monetary base, which consists in a liability that does not pay interest.

To express each element as a proportion of nominal GDP, each is divided by  $Y_t$ :

$$\frac{D_t}{Y_t} = \frac{D_{t-1}}{Y_t} (1 + i_t) + \frac{(G_t + I_t + Tr_t) - T_t}{Y_t} + \frac{EA_t}{Y_t} + \frac{OA_t}{Y_t} \quad (14)$$

$Y_t$  can be expressed as:

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<sup>2</sup> It includes the Central Bank and non-financial public companies but excluding Petrobras and Eletrobras: two “mixed” companies in Brazil, which means that the State is the main shareholder.

$$Y_t = Y_{t-1}(1 + \pi_t)(1 + g_t) \quad (15)$$

Where nominal GDP at time  $t$  is equal to nominal GDP in the previous period, multiplied by the GDP deflator, represented by  $\pi_t$ , and by the real GDP growth rate in period  $t$ ,  $g_t$ . This modification transforms the debt-to-GDP ratio equation into the following:

$$\frac{D_t}{Y_t} = \frac{D_{t-1}}{Y_{t-1}} \left( \frac{1 + i_t}{(1 + \pi_t)(1 + g_t)} \right) + \frac{(G_t + I_t + Tr_t) - T_t}{Y_t} + \frac{EA_t}{Y_t} + \frac{OA_t}{Y_t} \quad (16)$$

Now, let us consider that:

$$\frac{1 + i_t}{1 + \pi_t} = 1 + r_t \quad (17)$$

$$\frac{D_t}{Y_t} = d_t \quad (18)$$

$$\frac{(G_t + I_t + Tr_t) - T_t}{Y_t} = pd_t \quad (19)$$

$$\frac{EA_t}{Y_t} = ea_t \quad (20)$$

$$\frac{OA_t}{Y_t} = oa_t \quad (21)$$

Where  $r_t$  is the real interest rate on net public debt; and  $d_t$  is public debt,  $pd_t$  is primary deficit,  $ea_t$  are the exchange-rate adjustments in public debt, and  $oa_t$  represents other adjustments, all expressed as a percentage of GDP.

Now, equation 16 can be expressed as follows:

$$d_t = d_{t-1} \left( \frac{1 + r_t}{1 + g_t} \right) + pd_t + ea_t + oa_t \quad (22)$$

Where each term is already expressed as a proportion of nominal GDP,  $Y_t$ . The expression  $\left(\frac{1+r}{1+g}\right)$  can also be expressed as  $1 + \left(\frac{r-g}{1+g}\right)$ , so we get:

$$d_t = d_{t-1} \left(1 + \frac{r_t - g_t}{1 + g_t}\right) + dp_t + ea_t + oa_t \quad (23)$$

Subtracting  $d_{t-1}$  from the equation above, we obtain the variation in the debt-to-GDP ratio:

$$d_t - d_{t-1} = \left(\frac{d_{t-1}}{1 + g_t}\right) r_t - \left(\frac{d_{t-1}}{1 + g_t}\right) g_t + dp_t + ea_t + oa_t \quad (24)$$

According to this equation, changes in debt-to-GDP ratio can be decomposed between: a) the contribution of the payment of real interest rates – expressed by  $\left(\frac{d_{t-1}}{1+g_t}\right) r_t$ ; b) the contribution of GDP growth – expressed by  $-\left(\frac{d_{t-1}}{1+g_t}\right) g_t$ ; c) the contribution of the primary deficit; d) the contribution of exchange rate adjustments; and e) the contribution of other adjustments.

Replacing  $g_t$  in equation 24 for the expression in equation 11, we obtain out final expression for changes in debt-to-GDP ratio:

$$\begin{aligned} \Delta d_t = & \frac{d_{t-1}}{1 + g_t} r_t \quad (25) \\ & - \frac{d_{t-1}}{1 + g_t} \left[ \alpha_t \left( 1 - t_t + \frac{Tr_{t-1}}{Y_{t-1}} \right) \Delta c + \alpha_t \Delta h - \alpha_t c_t \Delta t \right. \\ & - \frac{\alpha_t}{(1 - m_t)(1 - m_{t-1})} \Delta m + \alpha_t c_t \left( \frac{\Delta Tr}{Y_{t-1}} \right) + \alpha_t \left( \frac{\Delta G}{Y_{t-1}} \right) \\ & + \alpha_t \left( \frac{\Delta I^G}{Y_{t-1}} \right) + \alpha_t \left( \frac{\Delta I^{PC}}{Y_{t-1}} \right) + \alpha_t \left( \frac{\Delta X}{Y_{t-1}} \right) + \alpha_t \left( \frac{\Delta C^A}{Y_{t-1}} \right) \\ & \left. + \alpha_t \left( \frac{\Delta I^R}{Y_{t-1}} \right) + \alpha_t \left( \frac{\Delta E}{Y_{t-1}} \right) \right] + pd_t + ea_t + oa_t \end{aligned}$$

It is worth mentioning that in the term  $\left(\frac{d_{t-1}}{1+g_t}\right)$ , the growth rate was taken as given, because on the contrary, results would be too difficult to interpret. However, for growth rates sufficiently low, the growth rate of GDP could be omitted, and this term could be

expressed just as  $d_{t-1}$ , which would lead to very similar results (although it would probably not match exactly the change in the debt-to-GDP ratio).

This methodological elaboration is an adaptation of the debt decomposition for the Brazilian case, observing the structure maintained by the Central Bank and considering the work of Freitas and Ligiéro (2024), with modifications. These adaptations are largely present in the structuring of the model, in which it was necessary to adapt to the availability of data, in addition to analytical measures sensitive to Brazilian economic policy over the periods, with their due prominence in the analysis.

As a byproduct of the methodology adopted here, we also get a measure of the real deficit of the public sector<sup>3</sup>. The real deficit as a percentage of GDP ( $rd$ ) can be expressed by:

$$rd_t = \frac{(G_t + I_t + Tr_t) - T_t + rD_{t-1}}{Y_t} = pd_t + d_{t-1}r \quad (26)$$

## 4 Results and interpretation

The decomposition of the net debt-to-GDP was calculated for the Brazilian economy for the period from 2004 to 2021<sup>4</sup>. Figure 1 presents the evolution of the net debt of the public sector as a percentage of GDP during this period. As can be seen, the net debt-to-GDP

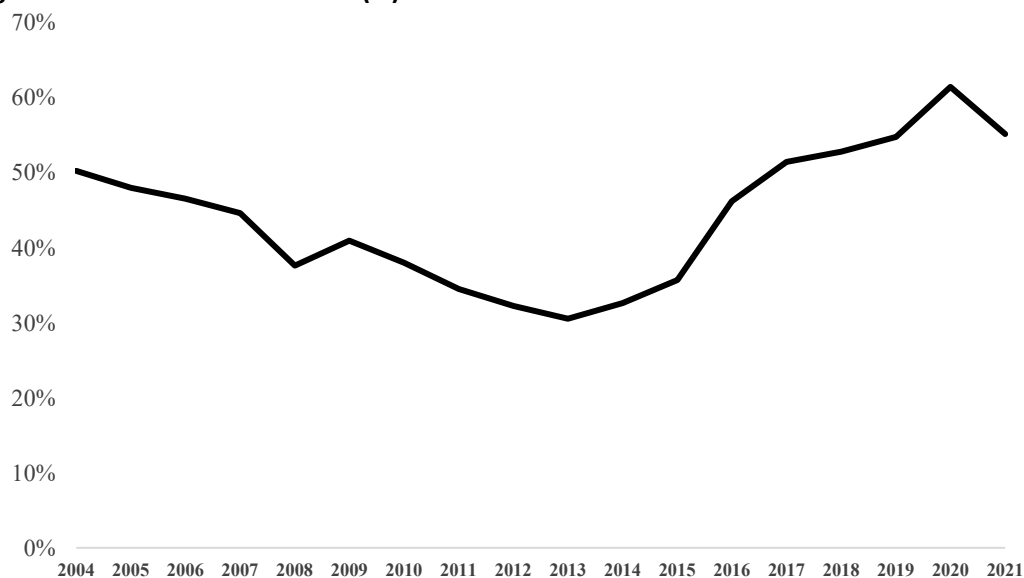
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<sup>3</sup> The real deficit measure differs from the operational deficit measure. The operational deficit accounts for the primary deficit and the payment of real interest on public bonds, while the real deficit differs from the operational deficit because it also accounts for the loss of value in real terms of the monetary base due to inflation. The variable calculated in equation 26 consists on real deficit because we are considering net debt, which includes the monetary base. Therefore, real interest rate considered here is actually a weighted average of the real interest rate on bonds and the real interest of the monetary base (which will be negative as long as there is positive inflation), and also considering the interest received on international reserves in foreign currency.

<sup>4</sup> The database from the GDP statistics at the required level of detail to calculate the decomposition are currently available for the years from 2000 to 2021. The decision to start at the year of 2004 is because this is the first year of a period of relatively high growth where the government sector was important to expand aggregate demand.

ratio presented a declining trend from 2004 until 2013, and after that it started to present an increasing trend.

**Figure 1: Net Debt-to-GDP ratio (%)**

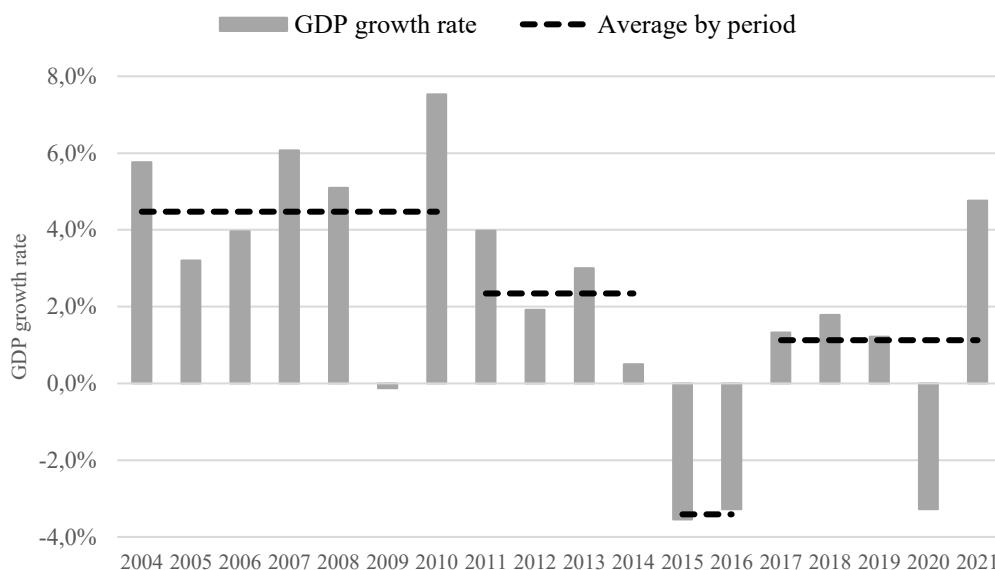


Source: Central Bank. Own elaboration.

Since 2004, the Brazilian economy has seen changes in the direction of the macroeconomic policy stance.

We divided our sample in four periods. The first one is from 2004 to 2010, when the average growth rate of GDP was 4.5%; the second one is from 2011 to 2014, when GDP growth rate decreased to 2.3%; the third period accounts for the years of 2015 and 2016, when GDP fell 3.4% a year, on average; and finally, the fourth period goes from 2017 to 2021, when GDP grew 1.1% a year. The analysis of the results is made considering these four periods, which were defined based on economic performance and by some relative continuity in the macroeconomic policy stance within each period. Other works, such as Serrano and Summa (2015), Haluska (2023) and Haluska et al (2026) also use this same periodization. Figure 2 below shows GDP growth rate and its averages by period.

**Figure 2: GDP growth rate (%)**



Source: IBGE. Own elaboration.

Table 1 summarizes some key variables for the changes in debt-to-GDP ratio in Brazil during the four periods. As can be seen, even though growth rate and interest rate varied during these periods, interest rate was higher than growth rates in all the four periods considered, so the difference between them always contributed to increase the debt-to-GDP ratio. However, the size of this difference varied considerably among the four periods considered, being relatively lower in 2004-2010 and in 2017-2021. It is also worth noticing that although these differences were similar in these two periods (2.1% and 2.7%, respectively), the levels of the real interest rate and GDP growth were very distinct in each of these periods. Brazilian government, in average, ran primary surpluses during the first two periods – which contributed to reduce debt-to-GDP ratio, – and had primary deficits in the last two periods – contributing to increase the debt-to-GDP ratio. It is interesting to notice that in 2004-2010, primary surplus was large enough to compensate for the interest component, so the government ran real surpluses on the average of that period.

**Table 1: Summary of key variables for changes in the debt-to-GDP ratio.**

	2004-2010	2011-2014	2015-2016	2017-2021
Real interest rate over Net Debt (r)	6,6%	7,8%	13,9%	3,9%
GDP growth rate (g)	4,5%	2,3%	-3,4%	1,1%
r-g	2,1%	5,5%	17,3%	2,7%
Primary Deficit (% of GDP)	-3,1%	-1,6%	2,2%	2,5%
Real Deficit (% of GDP)	-0,4%	0,8%	6,7%	4,4%

Source: IBGE, BCB. Own elaboration.

To analyze the results, we present the contributions to the changes in the debt-to-GDP ratio under two classifications. The first classification decomposes the changes in debt-to-GDP ratio into four categories, which follow the contributions presented in equation 24: a) the contribution from real interest, which is represented by  $\left(\frac{d_{t-1}}{1+g_t}\right)r_t$ ; b) the contribution from GDP growth, which is represented by  $-\left(\frac{d_{t-1}}{1+g_t}\right)g_t$ ; c) the contribution from primary result, which is represented by  $dp_t$ ; and d) the contribution from exchange rate adjustments and other adjustments, which is represented by  $ea_t + oa_t$ . Notice that this last contribution includes both the effects of changes in the nominal exchange rate and the effects of the recognition of new debts and privatizations.

The second classification used to analyze the results is built based on equation 25. It consists in bringing more detail into the causes of GDP growth, so the contribution from GDP growth is divided between: a) the effect on debt-to-GDP ratio due to contributions from the government sector to the GDP growth, b) the effect on debt-to-GDP ratio due to contributions from the private sector to the GDP growth, and c) the effect on debt-to-GDP ratio due to contributions from the external sector to the GDP growth. The contributions from the government sector includes the contributions from changes in i) government consumption, ii) government investment, iii) transfers to households, iv) investment from public companies, and v) in the tax burden. The contributions from the private sector include the contributions from changes in i) the autonomous consumption that depends on credits, ii) residential investment, iii) the propensity to consume out of disposable income, iv) the propensity to invest, and v) the changes in inventories. Finally, the contributions from the external sector include the contributions from changes in i) exports and ii) the imported content. The contributions from exchange rate adjustments and other adjustments are also divided, isolating the contribution from exchange rate adjustments

from the other adjustments. Table 2 presents the components of equation 25 classified into each of the groups of contributions.

**Table 2: Groups of contributions to the changes in the debt-to-GDP ratio.**

Type of contribution	Calculation
Payment of real interest	$+ \frac{d_{t-1}}{1 + g_t} r_t$
Primary deficit	$+ pd_t$
Exchange-rate adjustments	$+ ea_t$
Other adjustments	$+ oa_t$
Contribution of the government sector	$-\frac{d_{t-1}}{1 + g_t} \left[ -\alpha_t c_t \Delta t + \alpha_t c_t \left( \frac{\Delta Tr}{Y_{t-1}} \right) + \alpha_t \left( \frac{\Delta G}{Y_{t-1}} \right) + \alpha_t \left( \frac{\Delta I^G}{Y_{t-1}} \right) + \alpha_t \left( \frac{\Delta I^{PC}}{Y_{t-1}} \right) \right]$
Contribution of the private sector	$-\frac{d_{t-1}}{1 + g_t} \left[ \alpha_t \left( 1 - t_t + \frac{Tr_{t-1}}{Y_{t-1}} \right) \Delta c + \alpha_t \Delta h + \alpha_t \left( \frac{\Delta C^A}{Y_{t-1}} \right) + \alpha_t \left( \frac{\Delta I^R}{Y_{t-1}} \right) + \alpha_t \left( \frac{\Delta E}{Y_{t-1}} \right) \right]$
Contribution of the external sector	$-\frac{d_{t-1}}{1 + g_t} \left[ -\frac{\alpha_t}{(1 - m_t)(1 - m_{t-1})} \Delta m + \alpha_t \left( \frac{\Delta X}{Y_{t-1}} \right) \right]$

Source: Elaborated by the authors.

On a more theoretical level, government expenditures and the tax burden affect the debt-to-GDP ratio through three channels. The first channel is a direct one, to the extent that they enter directly into the calculation of primary deficit. The second channel is an indirect one, to the extent that these policy variables affect the level of GDP and consequently, the total amount of taxes and the primary result. The third channel is another type of indirect channel, to the extent that these policy variables change GDP, altering the denominator of the debt-to-GDP ratio. Variables such as autonomous private expenditures, exports, the propensity to consume, to invest and the imported content affect the debt-to-GDP ratio through the two indirect channels aforementioned: a) through their effect on the total amount of taxes and consequently on the primary result, and b)

through their effect on GDP, the denominator of the debt-to-GDP ratio. However, in the decomposition model presented here, we are only taking into account the third effect, which is the effect of these variables on GDP, while we take the primary deficit as given. Therefore, an expansion of public expenditure, for example, necessarily contributes to reduce the debt-to-GDP ratio in the present exercise, since we are only accounting for its positive effect on GDP. Another way to put this is by saying that the potential for an expansionary fiscal policy to reduce the debt-to-GDP ratio is somewhat overestimated. We intend to integrate all these effects in future research.

Let us now present the results according to each of the two classifications. Table 3 presents the contributions to changes in the debt-to-GDP ratio according to the first classification, built based on equation 24. Since the real interest rate was always positive, it always contributed to increase the debt-to-GDP ratio, although the size of its contribution depends, of course, on the level of the real interest rate and on the previous debt-to-GDP ratio. The size of the contribution of GDP growth also depends on the rate of growth of GDP and on the previous level of debt-to-GDP (but in this case, positive growth contributes to decrease debt-to-GDP). It is possible to see that in 2004-2010, when GDP growth rate was higher, the contribution of growth to reduce debt-to-GDP was also larger, and in 2015-2016, when GDP fell, it contributed to increase debt-to-GDP. Since real interest rate was always higher than GDP growth (considering the averages by period), as seen in Table 1, the sum of the contributions of real interest payments and of GDP growth ( $a + b$ , in table 3) is always positive and always contributes to increase the debt-to-GDP. In periods when there were primary surpluses (2004-2010 and 2011-2014), it contributed to decrease debt-to-GDP, and when there were primary deficits, its contribution had the opposite sign. Exchange rate and other adjustment contributed to reduce debt-to-GDP in all the four periods. The causes of this result are going to be discussed further below.

From 2004 to 2010, the contribution of the primary surplus to reduce debt-to-GDP was larger than the combined contribution of real interest and growth to increase it, while the effect of exchange rate and other adjustments were negligible. As a result, debt-to-GDP reduced 2.3 percentage points (pp) a year, on average. In 2011-2014, the primary surplus was lower and did not offset the combined contribution of interest and GDP growth.

However, a negative contribution from exchange rate and other adjustments still resulted in a decreasing debt-to-GDP ratio, although at a slower pace. In 2015-2016, almost all variables contributed to increase debt-to-GDP, since GDP growth rates were negative and the government had primary deficits. These effects were only partially offset by the negative contribution from exchange rate and other adjustments, and as a result, debt-to-GDP increased 6.8 pp a year, on average. In 2017-2021, the difference between the real interest rate and GDP growth rate was relatively low for Brazilian recent history, so their combined contribution to increase debt-to-GDP was relatively low. However, primary deficits persisted, and these effects were not offset by the negative contribution from exchange rate and other adjustments, so debt-to-GDP increase 1.8pp a year.

**Table 3: Contributions to changes in the debt-to-GDP ratio, average by year.**

	2004-2010	2011-2014	2015-2016	2017-2021
Real interest (a)	2,9%	2,6%	4,9%	1,9%
GDP growth (b)	-2,0%	-0,8%	1,2%	-0,6%
a+b	0,9%	1,8%	6,1%	1,3%
Primary deficit (c)	-3,1%	-1,6%	2,2%	2,5%
Exchange rate and other adjustments (d)	-0,1%	-1,5%	-1,5%	-2,0%
<b>Change in Debt-to-GDP ratio (a+b+c+d)</b>	<b>-2,3%</b>	<b>-1,3%</b>	<b>6,8%</b>	<b>1,8%</b>

Source: IBGE, BCB. Own elaboration.

Let us now present the results according to the second classification adopted, which is presented in table 4.

**Table 4: Contribution of sectors to the debt-to-GDP ratio (%)**

	2004-2010	2011-2014	2015-2016	2017-2021
Real interest	2,9%	2,6%	4,9%	1,9%
Public sector	-1,2%	-0,5%	0,5%	0,3%
Private sector	-0,6%	-0,3%	1,4%	-0,7%
External sector	-0,2%	0,1%	-0,7%	-0,2%
Primary deficit	-3,1%	-1,6%	2,2%	2,5%
Exchange rate adjustment	-0,2%	-1,5%	-1,5%	-2,0%
Other adjustments	0,0%	-0,1%	0,0%	0,0%
<b>Change in Debt/GDP ratio</b>	<b>-2,3%</b>	<b>-1,3%</b>	<b>6,8%</b>	<b>1,8%</b>

Source: IBGE, BCB, Aggregate report of federal state-owned companies. Own elaboration.

In the period from 2004 to 2010, all institutional sectors contributed to the reduction in Brazil's debt-to-GDP ratio, especially the public sector, which contributed to a reduction of 1.2pp.

Between 2011 and 2014, the average rate of growth decreased, so it also had a smaller negative contribution to reduce debt-to-GDP (as seen in table 3). The contributions of the three institutional sectors to reduce debt-to-GDP was smaller in 2011-2014 than in 2004-2010. This is mainly explained by the lower rates of growth of most of the components of autonomous expenditures, such as government expenditures, household autonomous expenditures and exports (for a detailed discussion on the growth performance of this period, see Serrano and Summa, 2015).

In 2015-2016, the large cuts in government expenditures and in household autonomous expenditures contributed to increase the debt-to-GDP ratio, while the contribution from external sector partially offset these effects.

At last, in the period from 2017 to 2021, the public sector was the only one to contribute to increase the debt-to-GDP ratio, since the private and external sectors contributed to reduce it, with contributions of -0.7% pp and -0.2% pp, respectively.

Curiously, the exchange rate adjustment contributed to reducing the debt-to-GDP ratio in all periods, although this is not a necessary result. However, during most of the time of the period from 2004 to 2010, the Brazilian government had a net debtor position in foreign currency – because foreign reserves were increasing and outpaced foreign debt, - and the domestic currency presented an appreciation trend. In the following periods, the Brazilian government had already established a net creditor position in foreign currency, while the domestic currency showed a depreciation trend. The contribution of other adjustments (such as privatization and recognition of new debts) was negligible in all four periods.

Therefore, in times when the government actively fostered economic growth, such as in 2004-2010, the effects of the public sector on GDP gave an expressive contribution to decrease debt-to-GDP ratio by 1.2 pp a year. In this period, the government also managed to maintain large primary surplus, which also contributed to decrease the debt-to-GDP.

The modest increase in the tax burden in this period was probably an important factor to maintain large primary surpluses even in a context of high growth rates of public expenditures.

According to Orair et al (2014), the tax burden increased 3.2 percentage points from 2002 to 2012, and this increase was not related to significant increases in tax rates, but rather can be explained by the pattern of economic growth. During that period, the share of formal jobs in total employment increased, resulting in higher social security contributions and higher income taxes on wages. Orair et al (2014) also demonstrate that the tax on profits as a share of GDP also increased. One possible explanation for that is that the increase in international prices of commodities resulted in higher profits (and consequently, higher taxes) in those industries. The channels through which commodity prices affect taxes were discussed in more detail in Braga et al (2023). In 2011-2014, the fiscal policy was less expansionary, so the contribution of the public sector was also lower. Additionally, the primary surplus was gradually being reduced during those years, which can be partially explained by a series of tax exemptions granted for several sectors.

After 2015, there were important changes in the orientation of fiscal policy towards reforms and to diminish the size of the public sector in the economy (see Haluska et al, 2025). After large expenditure cuts in 2015-2016, in 2017 the federal government adopted a new fiscal rule (that lasted until 2022) that established that the primary expenditures of the federal government could be adjusted only by inflation, with no real increases. The alleged purpose of this fiscal rule was to promote a structural fiscal adjustment that would change the pattern of growth of the economy to a pattern led by private investment and a more competitive insertion in global trade.

Anyway, figure 1 shows that this new orientation of fiscal policy that started in 2015 clearly failed in reducing the debt-to-GDP, and the decomposition presented here provides an explanation for that. As shown in table 4, the effects of the contractionary fiscal policy on GDP contributed to increase debt-to-GDP after 2015. Besides, it also failed in achieving primary surpluses or in reducing the size of the deficit (considering

the average of the entire period)<sup>5</sup>, as show in table 1. Under the sraffian supermultiplier approach framework, and considering that the tax burden remained relatively stable during these years, it means that the cuts in government expenditures were accompanied by reductions in other components of autonomous expenditures or by a decrease in the share of induced expenditures in GDP.

This suggests that the experience of Brazil after 2015 can be interpreted as a case of paradox of debt or of self-defeating austerity, in which attempts to reduce debt end up increasing it.

## 5 Concluding remarks

In this paper, we applied a demand-led growth decomposition inspired by the Supermultiplier theory to the analysis of the dynamics of debt-to-GDP ratio. The decomposition method connects the research made by Haluska (2023) for Brazilian output growth with Freitas and Ligiéro (2024) for the debt-to-GDP in US. The main results of this research can be summarized by the contributions of the public, private and external institutional sectors, as well as the debt components, such as the real interest rate, the primary deficit, the exchange rate adjustment and other adjustments to the changes in the debt-to-GDP ratio.

The case of Brazil was chosen to illustrate the adoption of this method because there were important changes in the regime of economic policy after 2015 market by a turn to fiscal austerity. Additionally, the real interest rate has been very high in Brazil, so the real interest rate on public debt has always been higher than GDP growth rate, contrary to what is usually assumed in theoretical models, which assumes the stable scenario in which the growth rate is higher than the interest rate. Therefore, for the debt-to-GDP to remain

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<sup>5</sup> However, it is worth mentioning that the primary deficit of 2.5% of GDP on the average of the period from 2017 to 2021 is considerably affected by the first year of the covid pandemic, when the primary deficit was of 9.2% of GDP.

stable or to decrease in Brazil, it requires the government to run primary surpluses or that the exchange rate adjustments to contribute to reduce net debt.

We also demonstrated that the change in economic policy regime since 2015 has not resulted in decreases in debt-to-GDP ratio – quite the contrary, indicating a possible case of paradox of debt or self-defeating austerity and suggesting that the effect of contractionary policies to reduce GDP and increase debt-to-GDP ratio may be relevant.

It is worth mentioning that this empirical exercise seeks to fill a gap in decomposition models based on the dynamics of debt-to-GDP. It also aims at filling a gap in studies on public debt and fiscal policy, especially from a demand-led growth perspective.

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