

Optimal Labor Tax Using Laffer Curves For Brazil

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ABSTRACT

This study aims to measure the optimal tax rate on labor in Brazil. For this purpose, a Laffer curve was modeled from a nonlinear programming problem where the objective of the problem is to maximize tax revenue subject to the restrictions imposed by economic theory on the Laffer curve. The system of equations was segmented into four economic sectors and a Laffer curve was calculated for each economic activity. The results demonstrated that the optimal tax rate on labor in Brazil is approximately 35.2%. Furthermore, the conclusions show that, with this rate, the highest (lowest) tax revenues occur in industry (services).

Keywords: Optimal taxation, Laffer curve, optimization.

JEL codes: H2, H21, H3.

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1. Introduction

It is common for developing countries to set relatively low tax rates as a strategy to attract investment. In Latin America, for example, it is easy to find economies that adopt this policy to offset structural and technological deficits and to attract foreign producers and capital. However, Brazil has historically taken a stance contrary to this strategy, having a tax burden equivalent to almost double the regional average and ranking among the world countries with the highest tax rates (Ondetti, 2015).

In addition to a high tax burden, the Brazilian labor market has a low level of respect for contracts. At the same time, economic agents face a high degree of legal uncertainty. Furthermore, the Brazilian tax system is inefficient regarding taxes on labor, which hinders mutually beneficial exchanges in the labor market and restricts economic efficiency (Gonzaga, Maloney, and Mizala, 2003).

Given this scenario, if Brazilian workers are unwilling to bear the cost of paying taxes, an increase in labor tax rates may worsen the performance of the local labor market, reducing government tax revenue while a reduction in tax rates could have the opposite effect¹. Therefore, it is necessary to know the occasions on which Brazilian workers accept increases in tax rates. Based on this literature, this study aims to measure the optimal tax rate on labor in the Brazilian labor market.

For this purpose, a static model was used to obtain the coefficients of the relationship between revenue and tax rate proposed by Wanniski (1978). According to this approach, agents in a given economy have a tolerance for paying taxes that can be represented as a parabola defined in the domain $\{0,1\}$. Popularly known as the Laffer curve, this parabola has a downward concavity and roots at the extreme limits of the relationship domain.

According to the basic version of this theory, when the tax rate is very low, agents have an increasing tolerance for paying taxes, that is, as the tax rate increases, the volume of production that agents allocate to taxes will increase. However, when the tax rate is very high, tolerance decreases and the volume of production allocated to paying taxes falls as the tax rate increases. These properties allow us to conclude that there is an optimal rate at which the government would achieve maximum revenue. At this point, any increases or reductions in the tax rate would imply losses in tax revenue (Wanniski, 1978; Trabandt, and Uhlig, 2011; Ehrhart, Minea, and Villieu, 2014).

With improvements to Wanniski's (1978) approach, complementary versions of the Laffer curve have emerged over time. In the present study, by example, I seek to solve the research problem based on the labor Laffer curve. In this case, instead of representing the amount of output from the economy collected by the government in the form of taxes, the image represents the number of hours that workers spend paying taxes, as done by Heijman and Ophem (2005), Trabandt and Uhlig (2011), Holter, Krueger, and Stepanchuk (2019) and Alba and McKnight (2022).

Using this procedure, I found that the optimal tax rate on labor in Brazil is approximately 35.2%. At this rate, workers in agriculture, industry, services, and other

¹ Paes (2017), for example, found that reductions in the Brazilian tax burden would result in growth gains without the possibility of loss of revenue depending on the government's tax policy.

economic activities will fully agree to give the government 15.3 hours, 16.5 hours, 14 hours, and 16.2 hours, respectively, of their weekly labor supply in the form of tax payments. This finding allows regulators and decision-makers to know that any increases in the labor tax rate in Brazil beyond this proportion imply respective revenue losses, generating economic inefficiency while compromising the provision of public goods and forcing the government to compensate for this revenue loss through other means.

This paper is divided into five sections, including this brief introduction. The following section presents the economic basis for the methodological approach. The third section presents the materials and methods of the study. The fourth section presents the results found. Finally, the fifth section corresponds to the final remarks.

2. A brief literature review

The Laffer curve is based on the concept of economic agents' willingness to substitute the consumption of private goods for the financing of goods provided by the government. When taxes increase and, at the same time revenue rises, then economic agents are willing to accept this substitution. On the other hand, if taxes increase at the same time as revenue falls, agents are more likely to give up financing government-provided goods to consume more private goods. Malcomson (1986) and Hartwick (2015) show this context in detail.

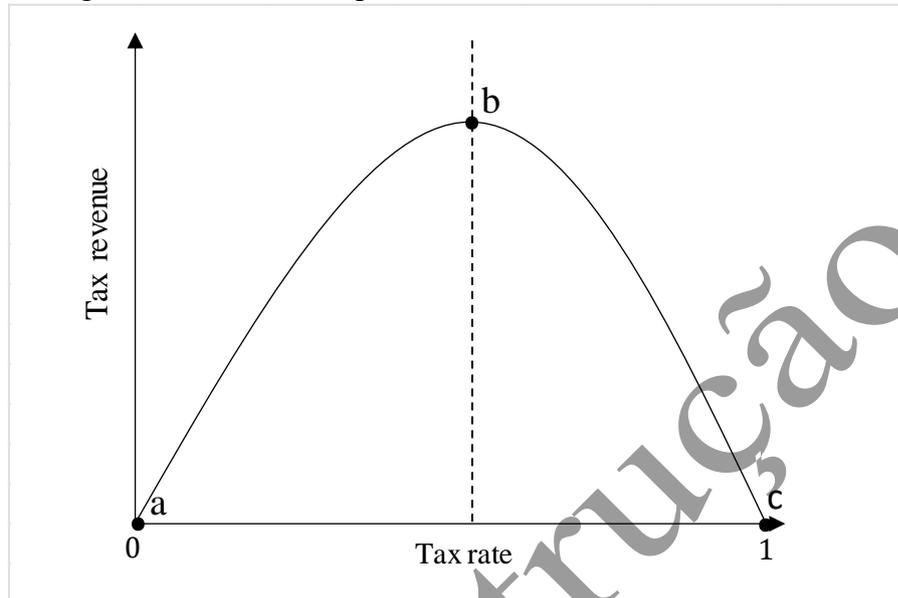
According to the Laffer curve, there are two cases in which tax revenue can be null. The first case occurs when there are no tax rates and the economy tends towards an ungoverned society (Point "a" in Figure 1). The second case occurs when the government requires the population to pay 100% taxes on the economy's wealth (Point "c" in Figure 1). In this case, as the government retains all the resources, society's consumption of private goods is zero, and, as there is no consumption of private goods, consequently, there is no production of these goods, resulting in zero revenue.

Between points "a" and "b", agents agree to give up a greater fraction of their wealth to finance the increase in the supply of public goods. At point "b", this willingness is maximum. On the other hand, from point "b" onwards, agents feel discouraged from giving up more wealth in exchange for more public goods and begin to reject increases in tax rates. When the relationship reaches point "c", the willingness to give up more wealth in exchange for more public goods is minimal, and tax collection becomes null. Consequently, tax rates different from point "b" imply an inefficient allocation between public goods and private goods. Based on this, Braun and Uhlig (2006), and Trabandt and Uhlig (2011) stated that the Laffer curve shows the potential changes in social welfare resulting from changes in tax rates.

The functional form proposed by Wanniski (1978) has been challenged several times in the literature. Mirowski (1982) was one of the first to challenge the assumptions, claiming that the Laffer curve omits important information about the economy, such as the tax redistribution mechanisms. Other authors dispute, for example, the assumption that the vertical intercept of the Laffer curve must start from the origin of the relationship. Lin and Jia (2019), Trabandt and Uhlig (2013), and Oliveira and Costa (2015) simulated different scenarios and showed that the vertical intercept of the Laffer curve can take on a non-zero and non-negative value. Some studies also challenge the assumption that the horizontal intercept of the Laffer curve should occur at the unit rate. In this case, as the tax rate rises beyond the optimum rate, the willingness of agents to finance the increase

in new public goods falls fast enough to make revenue zero even before the rate reaches its upper limit. Hairault, Langot and Sopraseuth (2008), for example, found that this possibility can occur depending on the levels of altruism and risk aversion.

Figure 1: Theoretical representation of the Laffer curve.



Source: Own elaboration according to Wanniski (1978).

Despite these challenges, the Laffer curve is still one of the main approaches capable of providing a good answer on the optimal taxation of an economy. For this reason, many studies choose to circumvent these criticisms by using theoretical arguments that complement Wanniski's (1978) assumptions (Oliveira and Costa (2015); Sanz-Sanz (2016); Miravete, Seim, and Thurk (2018)) or relax these challenges considering that this relaxation would not result in significant losses in the quality of the results (Hsing (1996); Ferreira-Lopes, Martins, and Espanhol (2020); Bhimjee et al. (2020)).

Given these definitions, the Laffer curve has been improved over time and has become the basis for studies on optimal taxation in different lines of research. In addition, the improvement of the assumptions allowed the creation of new aspects of the Laffer curve, such as the behavioral Laffer curve (Lévy-Garboua, Masclet and Montmarquette, 2009), the dynamic Laffer curve (Novales and Ruiz, 2002) and the Laffer curve of the labor factor (Trabandt and Uhlig (2011); Hiraga and Nutahara (2018)).

Given that the initial assumptions of the Laffer curve referred to the production and wealth of the economy in general, the objective of a Laffer curve applied to the labor factor is to measure the tax rate at which workers are most willing to give up a greater proportion of their labor income in exchange for a greater supply of public goods. In this case, the domain of the relationship represents the rate levied on the labor factor, and the relationship between the rate and revenue remains in the shape of a parabola with a downward concavity. In theory, this approach would circumvent some criticisms of Mirowski (1982) about the absence of labor market characteristics in the Laffer curve. This approach was used by Monissen (1999), Nutahara (2015), and Alba and McKnight (2022).

3. A static approach to the Laffer curve

Consider that the representative worker offers x working hours in a specific period. Consequently, the labor supply requires the worker to dedicate less time to leisure activities, which generates a disutility of labor (D). Following the assumptions of Umer (2018), consider that this disutility has the following functional form:

$$D(x) = e^{\alpha x} \quad (1)$$

Where α is a positive constant representing the sensitivity of the disutility of labor to working hours. Considering a hypothetical scenario in which taxation is zero, the utility of the representative consumer (u) depends both on labor (which enables the acquisition of goods) and on the disutility of labor, so that:

$$u = x - D(x) \quad (2)$$

However, in the presence of non-zero taxation, the consumer's utility decreases as the tax rate (t) increases. To represent this relationship, consider that in the presence of taxes, the utility of the representative consumer assumes the following functional form:

$$u = x(1 - t) - D(x)\gamma(t) \quad (3)$$

Where $\gamma(t)$ measures the perception of unfairness of taxation and $\partial \gamma(t) / \partial t > 0$. Taking the first-order condition of the previous equation to labor:

$$\frac{\partial u}{\partial x} = 1 - t - \gamma(t) \left(\frac{\partial D(x)}{\partial x} \right) = 0 \quad (4)$$

Taking $\partial D(x) / \partial x$ in Equation 1 and substituting it into Equation 4:

$$x = \left(\frac{1}{\alpha} \right) \log \left(\frac{1 - t}{\alpha \gamma(t)} \right) \quad (5)$$

The previous equation shows the optimal labor supply of the representative consumer. Substituting into the labor disutility equation:

$$D(x) = \frac{1 - t}{\alpha \gamma(t)} \quad (6)$$

Which corresponds to the disutility of labor given the optimal choice of labor supply. Substituting Equation (5) and Equation 6 into Equation 3:

$$u = \left(\frac{1}{\alpha} \right) \log \left(\frac{1 - t}{\alpha \gamma(t)} \right) (1 - t) - \left(\frac{1 - t}{\alpha} \right) \quad (7)$$

Since $u > 0$ must necessarily occur, then (7) results in:

$$t \leq 1 - e^1 \alpha \gamma(t) \quad (8)$$

Now consider the Laffer curve equation, which assumes that tax revenue (A) has the shape of a parabola with a downward concavity, as shown below:

$$A = \beta_0 + \beta_1 t + \beta_2 t^2 \quad (9)$$

Where β_0 is the vertical intercept, and β_1 and β_2 define the opening and concavity of the parabola. The first-order condition states that:

$$t^* = -\frac{\beta_1}{2\beta_2} \quad (10)$$

Rearranging Equation (9):

$$\beta_2 t^2 + \beta_1 t + \beta_0 - A = 0 \quad (11)$$

According to the roots of this equation:

$$t = \frac{-\beta_1 \pm \sqrt{\beta_1^2 - 4\beta_2(\beta_0 - A)}}{2\beta_2} \quad (12)$$

Substituting Equation (10) into Equation (12):

$$\beta_1 = 2\sqrt{-\beta_2(A - \beta_0)} \quad (13)$$

Taking the first-order condition of the utility function (Equation (7)) on the tax rate, we obtain:

$$(t - 1)\gamma'(t) = \gamma(t) \log\left(\frac{1 - t}{\alpha\gamma(t)}\right) \quad (14)$$

Umer (2018) suggests that a positive linear relationship of the tax rate is a good representation for γ , and assumes that $\gamma(t) = 0$ if $t = 0$, that is:

$$\gamma(t) = \theta t \quad (15)$$

Where $\theta = \gamma'(t)$ measures the sensitivity of γ to changes in the tax rate. Substituting into Equation (14):

$$t - 1 = t \log\left(\frac{1 - t}{\alpha\theta t}\right) \quad (16)$$

$$t = \frac{1}{1 - \alpha\theta}$$

Given that $t = -\beta_1/2\beta_2$, then:

$$\beta_1 = \frac{-2\beta_2}{1 - \alpha x} \quad (17)$$

Substituting (13) into (17):

$$\beta_2 = (\beta_0 - A)\sqrt{1 - \alpha x} \quad (18)$$

Using elasticity concepts, Saez (2001) obtained a value for the optimal taxation of the Laffer curve that occurs at the point where:

$$t^* = \frac{1}{1 + \sigma\epsilon} \quad (19)$$

Where σ is the Pareto value and ϵ is the income elasticity of collection. Making (16) = (19):

$$x = \frac{\sigma\epsilon}{\alpha} \quad (20)$$

Where x corresponds to the optimal value of the choice of working hours. For a time horizon of T hours, the time dedicated to leisure is $T - x$. Note that the arrangement of constraints determined so far already has equations that allow calculating β_1 and β_2 , but there is still no specific definition for β_0 . To make it possible to calculate the vertical intercept of the Laffer curve, consider the case in which the tax rate is unitary. In this case, the theory about the Laffer curve postulates that the total revenue must necessarily be zero. With $A = 0$ and $t = 1$, Equation (9) can be rewritten as:

$$\beta_0 = -\beta_1 - \beta_2 \quad (21)$$

Given $\beta_2 < 0$, since $|\beta_2| > |\beta_1|$, then the system has a solution for t , β_0 , β_1 , and β_2 that maximizes tax revenue. In addition to enabling the solution, Equation (21) ensures that the optimal tax rate does not exceed unity and imposes the restriction that the right end of the Laffer curve must always intersect the horizontal axis at the point where $t = 1$.

4. Materials and methods

Considering the rationale expressed in the previous section, this study aims to obtain the coefficients of the Laffer curve based on solving the following constrained optimization problem:

$$\begin{aligned} \max A &= \beta_0 + \beta_1 t + \beta_2 t^2 \\ \text{Subject to:} & \end{aligned} \quad (22)$$

$$\left\{ \begin{array}{l} A = tx \\ \beta_1 = -\frac{2\beta_2}{1 - \alpha x} \\ \beta_2 = (\beta_0 - A)\sqrt{1 - \alpha x} \\ t = -\frac{\beta_1}{2\beta_2} \\ x = \frac{\sigma\epsilon}{\alpha} \\ \beta_0 = -\beta_1 - \beta_2 \\ \gamma = \theta t \\ \beta_2 < 0 \\ \beta_1 > 0 \\ \beta_0 > 0 \\ 0 \leq t \leq 1 - e^{-\alpha\gamma} \\ x \geq 0 \\ |\beta_2| > |\beta_1| \end{array} \right.$$

The optimization problem was applied to four sectors where the representative worker could offer work, namely, agriculture, industry, services, and an aggregate with the other economic sectors called other activities. The segmentation of the financial sectors followed the definition of the Brazilian Ministry of Labor and Employment (*Ministério do Trabalho e Emprego – MTE (2024)*) of 2002 for the Brazilian Classification of Occupations (*Classificação Brasileira de Ocupações 2002 - CBO 2002*).

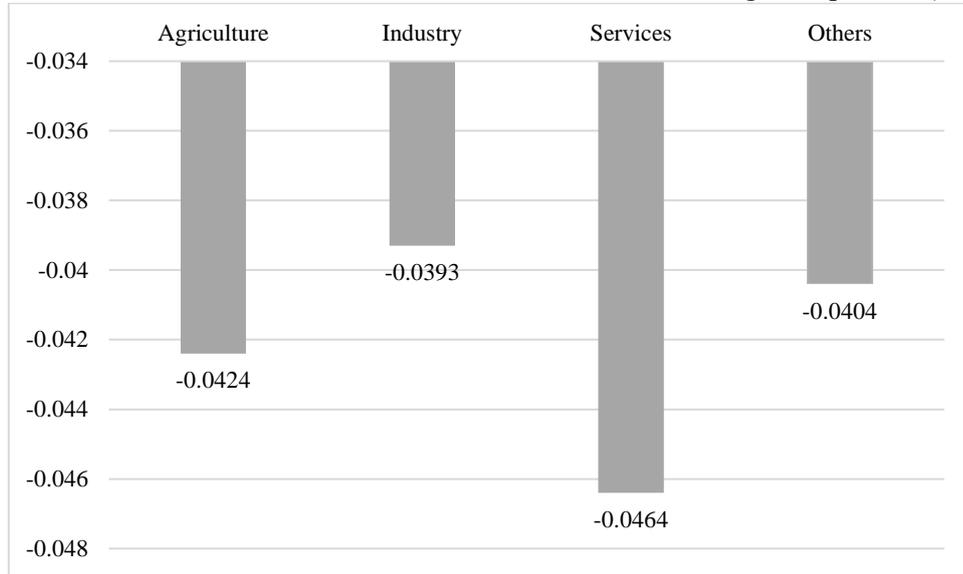
To allow the system to be solved, it is necessary to inform the values of the parameters in each equation. To this end, some values were obtained from the literature based on the assumption of homogeneity in the representativeness of these values for each sector. In other words, it was necessary to assume that the values of the parameters extracted from the literature are the same in each economic activity. Based on this assumption, this study considers $\epsilon = 0.92$, corresponding to the value of the income elasticity of taxation calculated by Mendonça and Medrano (2016). The Pareto number comes from the calculations made by Saez (2001), who obtained a value of approximately 2 for σ . Finally, the calculations use $\theta = 5.4$, corresponding to the value of this parameter calculated by Umer (2018) for Brazil.

The parameter α was calculated using data from the Annual Social Information Report (RAIS) based on the definition of the study by Lévy-Garboua, Masclet, and Montmarquette (2009), where it was considered that the reduction in hours dedicated to leisure due to a greater supply of labor is a good measure for the disutility of work. Based on this assumption, consider that in a period of T hours, the worker dedicates x hours to work and $T - x$ hours to leisure. In this case, the disutility of work in relative terms of available time is the ratio between the time of leisure and the total time. Thus, Equation (1) can be rewritten as:

$$\begin{aligned} \frac{T - x}{T} &= e^{\alpha x} \\ \log(T - x) - \log(T) &= \alpha x \\ \alpha &= \frac{\log(T - x) - \log(T)}{x} \end{aligned} \quad (23)$$

For the calculation of α in this work, T corresponds to the total number of hours available in seven days (one week), and x corresponds to the average number of hours worked by workers in each economic sector in that same number of days. The Figure 2 shows the results of this calculation.

Figure 2: $\alpha \Rightarrow$ Values calculated with the RAIS database according to Equation (23).



Source: Research results.

Figure 2 shows that, as expected, the parameter is negative for all economic activities, reflecting that any increase in working hours results in disutility for the worker. The calculated value of α was higher (in absolute terms) for the service sector, demonstrating that these workers have a greater propensity to dedicate a greater fraction of their time to leisure, given that a greater dedication to work would result in relatively higher utility losses when compared to other economic activities. On the other hand, compared to other sectors, industrial workers lose less utility when they allocate more time to work.

5. Results

After calibrating the parameters and verifying that the optimization problem is mathematically feasible, the next step is to solve the equation system. For each of the four economic activities, solving the optimization problem makes it possible to obtain the values of the variables inserted in the equations, including the optimal tax rate and the coefficients of the Laffer curve. Figure 3 shows the representation of the sectoral Laffer curves calculated from this procedure, where each curve shows the relationship between the weekly working hours that workers dedicate to paying taxes and the tax rate on labor.

According to the results, there are no major differences between the optimal tax rates of the four economic activities, since the inflection points of the sectoral Laffer curves occur when labor is taxed at approximately 35.2%². This result shows that

² Differences between sectoral optimal rates are marginal and occur only after six decimals.

regardless of the activity, Brazilian workers agree to pay more taxes as long as the taxation does not exceed 35.2% of their weekly labor supply. This result is in line with the calculations made by Alba and McKnight (2022), who calculated that the optimal tax rate on informal labor in Brazil is between 33% and 35.1%. However, concerning the formal labor market, these results have a relative disparity with the calculations made by Alba and McKnight (2022). In this case, the authors calculated that depending on Frish's labor elasticity, the tax rate on labor can reach a level of 64% without incurring revenue losses in Brazil. Although this rate is relatively high concerning the results of this study, other studies available in the literature present optimal labor tax rates that are lower than the results of Alba and McKnight (2022). Silva, Paes, and Ospina (2015), for example, concluded that the optimal labor tax rate in Brazil is approximately 17.2%³.

Despite the small disparities between the optimal tax rates, the results show that total revenue changes according to economic activity. Note that the lowest revenue comes from the service sector, while workers in the industry spend the most working hours paying taxes. This result shows that workers in the service sector are less likely to pay taxes on their labor than workers in other sectors. The opposite occurs in the industry.

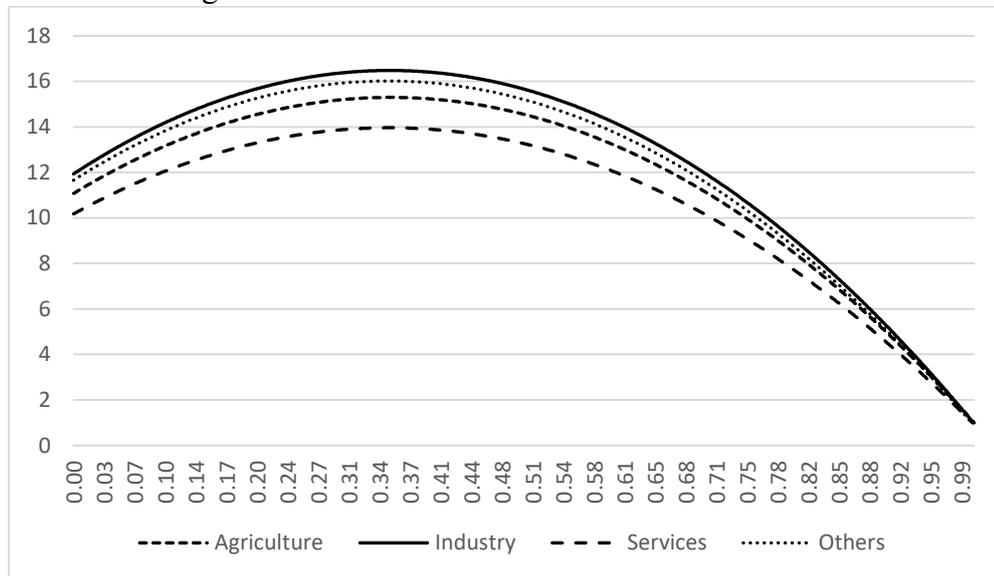
The vertical intercept of the Laffer curve represents potential revenue collection at a zero rate, which can be understood as the willingness of workers to finance the provision of public goods in an economy without government. In other words, β_0 reflects the minimum demand for public goods that workers would have in a hypothetical scenario where there is no government. The results show that workers in the service sector demand fewer public goods and are less willing to give up leisure and the consumption of private goods to finance the provision of goods provided by the government. In contrast, the industry has the largest vertical intercept, indicating that these workers have a greater demand for public goods and are more willing to give up leisure and the consumption of private goods to finance government actions in a hypothetical economy without government. In other words, when compared to other sectors, Brazilian workers who offer work in the industry are more certain about the need for state presence in the economy. In contrast, workers in the service sector are more convinced that the presence of the State in the Brazilian economy should not be so intense.

The vertical intercept of the Laffer curve represents potential revenue collection at a zero rate, which can be understood as the willingness of workers to finance the provision of public goods in an economy without government. In other words, β_0 reflects the minimum demand for public goods that workers would have in a hypothetical scenario where there is no government. The results show that workers in the service sector demand fewer public goods and are less willing to give up leisure and the consumption of private goods to finance the provision of goods. Analyzing the points on the Laffer curves where the working hours dedicated to paying taxes fall below the vertical intercept, it is possible to note that Brazilian workers change their concepts about the need for the government to provide public goods when the tax rate exceeds 70% of the weekly labor supply. In other words, even those workers who feel more satisfied with greater consumption of public goods to the detriment of the consumption of private goods and leisure goods completely change their perception about the need for state presence in the economy when greater government intervention requires that a fraction greater than 70% of their work

³ These authors calculate the optimal rate as the ratio of labor tax revenue to GDP, a different approach from the modeling of Alba and McKnight (2022).

be collected by the government in the form of taxes. From the government's point of view, this result indicates that if the objective is to maximize revenue collection, then it is better to institute a rate close to zero than to tax labor at more than 70%.

Figure 3 - Sectorial Laffer curves for Brazil.

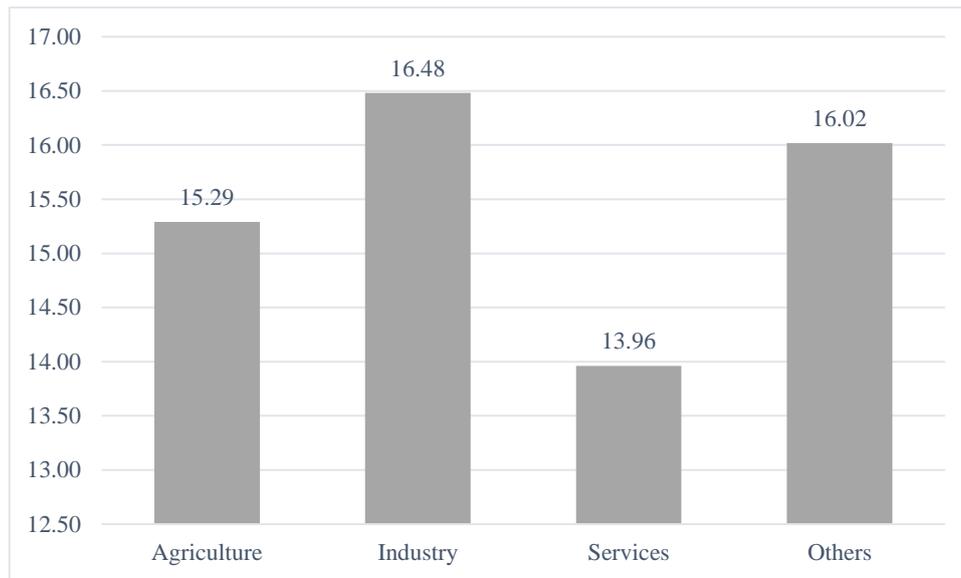


Source: Research results.

Based on this result, it is possible to state that the representative Brazilian worker has a maximum tolerance for paying taxes, and this tolerance corresponds to the working hours dedicated to taxes when the tax rate reaches 35.2% of the weekly labor supply. Figure 4 shows the values of this tolerance calculated for the four economic activities considered in this study. The results demonstrate that industrial workers have the greatest tolerance for paying taxes, agreeing to increase their weekly labor supply until taxes represent approximately 16.5 hours of work per week.

On the other hand, the results show that workers in the service sector have the lowest tolerance for paying taxes, corroborating the results in Figure 3. At this tolerance, taxes represent approximately 14 hours of work per week, which corresponds to approximately 86% of the maximum tolerance for paying taxes in the industry. This result demonstrates that if the Brazilian government deems it necessary to increase the tax rate on labor, then this increase should occur heterogeneously across economic activities to minimize potential revenue losses that occur if the current rate is to the right of the optimal rate on the Laffer curve.

Figure 4 - Maximum tolerance for paying taxes on weekly working hours.



Source: Research results.

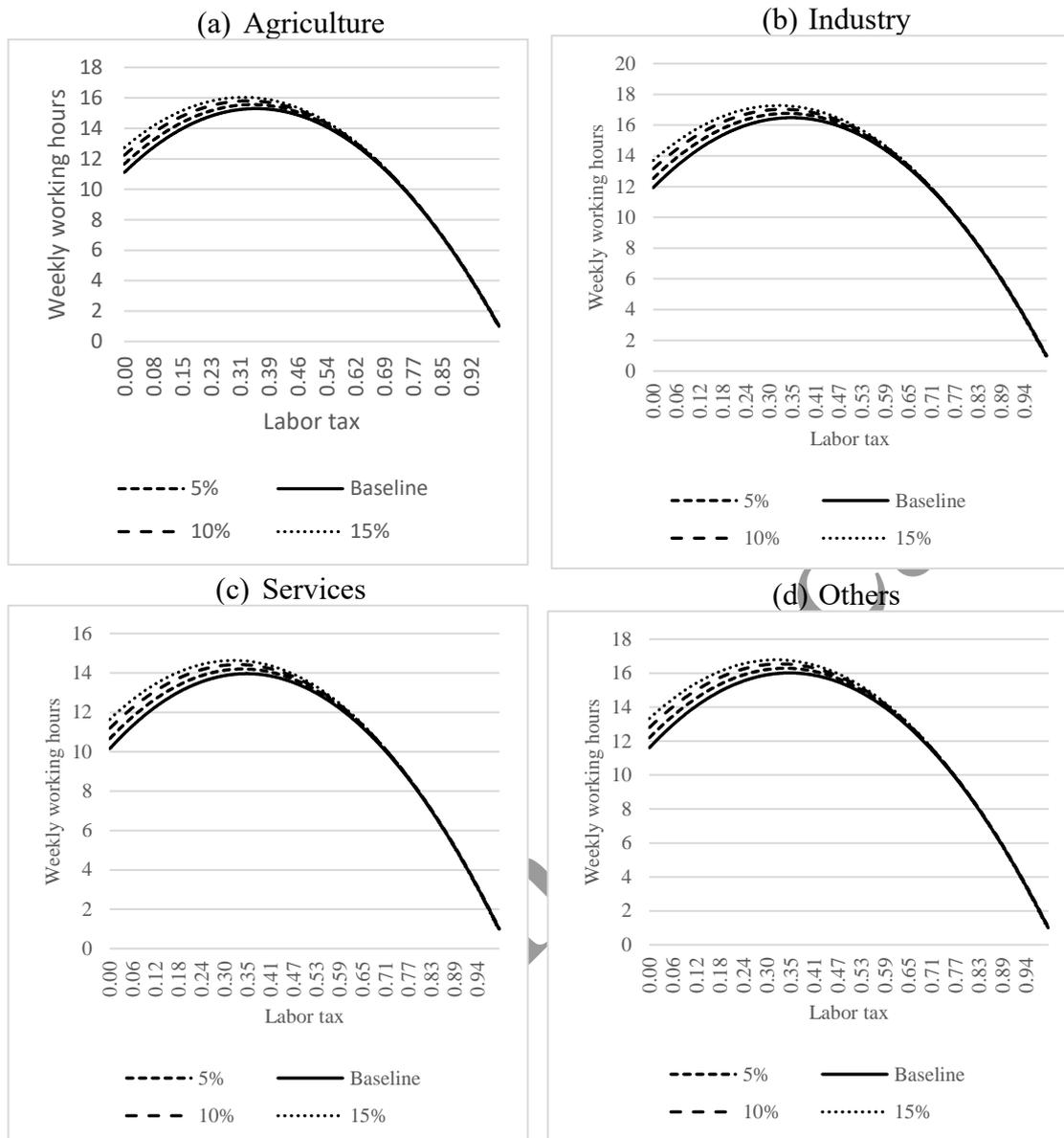
In addition to these findings, it is important to highlight that possible changes in the modeled economy can change both the willingness of agents to pay taxes and the government's tax revenue. To demonstrate how this process can occur, Figure 5 shows the changes in the sectoral Laffer curves resulting from a positive shock in the income elasticity of taxation. This procedure aims to simulate what happens to the Laffer curves when the Brazilian government experiences an increase in the sensitivity of tax revenue to workers' income gains.

The results show that as the income elasticity of taxation increases, the Laffer curves become slightly more asymmetric to the right, implying a reduction in the optimal tax rate. This result is as expected, given the restriction imposed in Equation 19. Although positive shocks to ϵ marginally reduce the optimal rate, increases in tax revenue will occur whenever there is a positive variation in this parameter. This result provides evidence that if the government already charges a tax rate on labor equal to the optimal rate and there is still a need for revenue increases, then a solution to this problem would be to stimulate gains in the sensitivity of taxation about changes in workers' income⁴.

Note that positive shocks to the income elasticity of taxation mostly move the Laffer curves upwards in the ascending part. This result demonstrates that if the current tax rate is lower than the optimal rate, the revenue gains from increases in the tax rate are enhanced as the income elasticity of taxation increases. On the other hand, even if there are significant gains in the income elasticity of taxation, if the current tax rate exceeds the optimal rate, then the revenue losses resulting from increases in the tax burden differ little from the baseline scenario as the current tax rate moves to the right of the optimal rate. This result demonstrates that when the Brazilian government operates on the wrong side of the Laffer curve, stimulating the sensitivity of taxation concerning workers' income gains does not generate significant differences in tax revenue.

Figure 5 - Simulating a positive shock to the income elasticity of taxation: Effects on the Laffer curve.

⁴ A similar finding occurs when a positive shock is applied to the Pareto value (σ).



Source: Research results.

The results in Figure 5 also show that as ϵ increases, the vertical intercept of the Laffer curves shifts upward. This finding indicates that, in a hypothetical scenario where the State's presence in the economy is zero, workers see a greater need to provide public goods as taxation becomes more sensitive to income. Considering the functional forms of the equations that make up the optimization problem, this result is within the expected standards.

This simulation also allows us to calculate the magnitude of changes in the vertical intercept of the Laffer curves as the income elasticity of taxation increases. Table 1 shows the results of this procedure. It shows, in percentage terms, how much positive shocks in the income elasticity of taxation change the vertical intercept of the Laffer curves for the Brazilian economy compared with the baseline scenario.

According to the results, a positive shock of 5% in ϵ leads to a response greater than the magnitude of the shock in β_0 . That is, there is evidence that the vertical intercepts of the sectoral Laffer curves are elastic to increases in ϵ if these increases occur at a

magnitude of 5%. However, the intensity of this response decreases as the positive shock in the income elasticity of taxation increases. When the shock is 10%, there is already a response equivalent to the magnitude of the shock in the services sector. From this point on, the magnitude of the response of the vertical intercepts is smoothed for agriculture, industry, and other economic activities. When the shock applied in ϵ is 15%, the response obtained in β_0 becomes inelastic. That is, an increase in the income elasticity of demand of around 15% results in a proportionally lower increase in the vertical intercepts of the sectoral Laffer curves in Brazil.

This result demonstrates that Brazilian workers' perception of the need for public goods provision in a government-free economy increases as taxation becomes more sensitive to income gains. However, this relationship is not linear, since there is an optimal growth in the income elasticity of taxation at which increases in this perception will be maximum. This result suggests that although increases in the income elasticity of taxation may cause Brazilian workers to demand a greater government presence in a government-free economy, boosting the income elasticity of taxation by a sufficiently large magnitude to justify an expansion of government presence in the Brazilian economy may have the opposite effect, causing workers to reduce their willingness to forgo consumption of private goods and leisure goods to finance an expansion in the provision of public goods.

Table 1 - Change in β_0 given a positive shock at ϵ .

	Agriculture	Industry	Services	Others
5%	5.27%	5.30%	5.23%	5.29%
10%	10.07%	10.12%	10.00%	10.10%
15%	14.46%	14.54%	14.36%	14.51%

Source: Research results.

6. Concluding remarks

This study aimed to measure the optimal tax rate on the labor factor in Brazil. For this purpose, a static modeling for the Laffer curve was developed using a nonlinear programming problem. The modeling was based on the assumption that the image of the objective function is the total weekly working hours dedicated to paying taxes. The parameters required to solve the nonlinear system were calibrated according to the literature or calculated according to national data from the formal labor market. The optimization problem was segmented into four economic sectors: agriculture, industry, the service sector, and an aggregated sector with other economic activities not previously mentioned.

The results showed that, regardless of the economic activity, the optimal tax rate on the labor factor in Brazil is approximately 35.2% of the labor supply. It was also possible to conclude that even with a homogeneous sectoral tax rate, the collection changes depending on the economic activity, given that workers have different availability to pay taxes and different preferences regarding the consumption of public goods. Specifically, the results allowed us to conclude that in the industry (in services), the willingness of workers to pay taxes is higher (lower) than the willingness of workers in other economic sectors of the modeled economy.

The results also allowed us to conclude that as taxation becomes more sensitive to income, Brazilian workers agree to increase their labor supply to finance the provision

of public goods when the presence of the State in the economy is practically nil. However, any increases in the income elasticity of taxation marginally reduce the optimal rate, indicating that if the Brazilian economy is on the wrong side of the Laffer curve, any increases in the income elasticity of taxation would imply greater losses in tax revenue.

It is important to highlight any technical limitations present in this study and to emphasize that, due to these limitations, the results should be interpreted with caution. First, this study assumes that there is intersectoral homogeneity in the income elasticity of taxation and in the Pareto value, which could imply changes in the results if these parameters were calibrated individually for each economic activity. Second, the modeling focuses only on the definition of the Laffer curve, disregarding the maximizing behavior of workers and firms. This modeling may reduce the representativeness of the model concerning the real Brazilian economy. Finally, static modeling limits the representativeness of the results since it restricts economic agents make decisions focusing only on the current period. Based on these limitations, future research must seek to model the Brazilian economy in a dynamic general equilibrium approach, with parameters calibrated individually for each economic sector.

Declarations

Availability of data and materials: All the calculations were carried out in the Python language and are available in the supplementary material called “Codes.ipynb”. The calculations can also be viewed at the url <https://colab.research.google.com/drive/1YaWLnB4SfogBxRBbs7ulk6FiSyF8NgKw?usp=sharing>.

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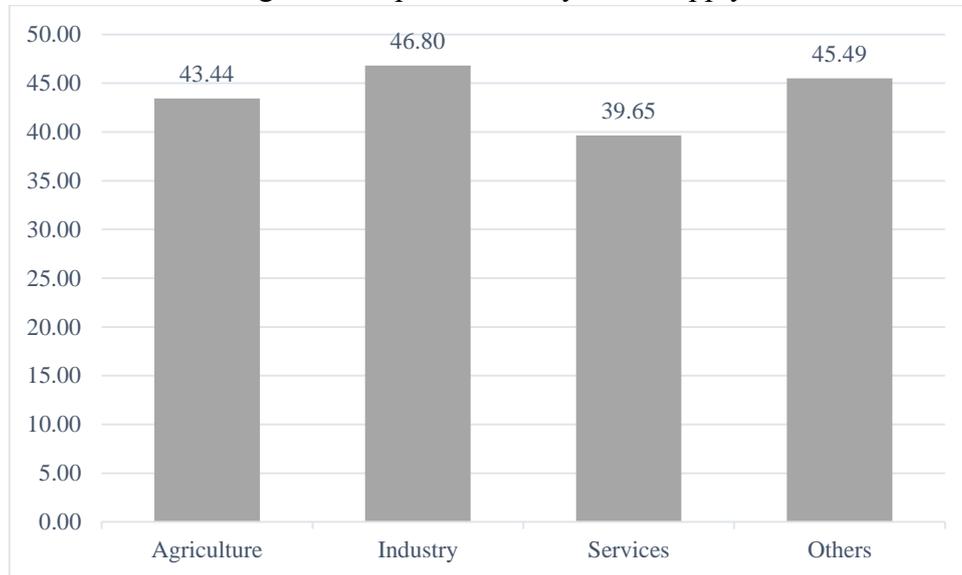
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Em construção

APPENDIX

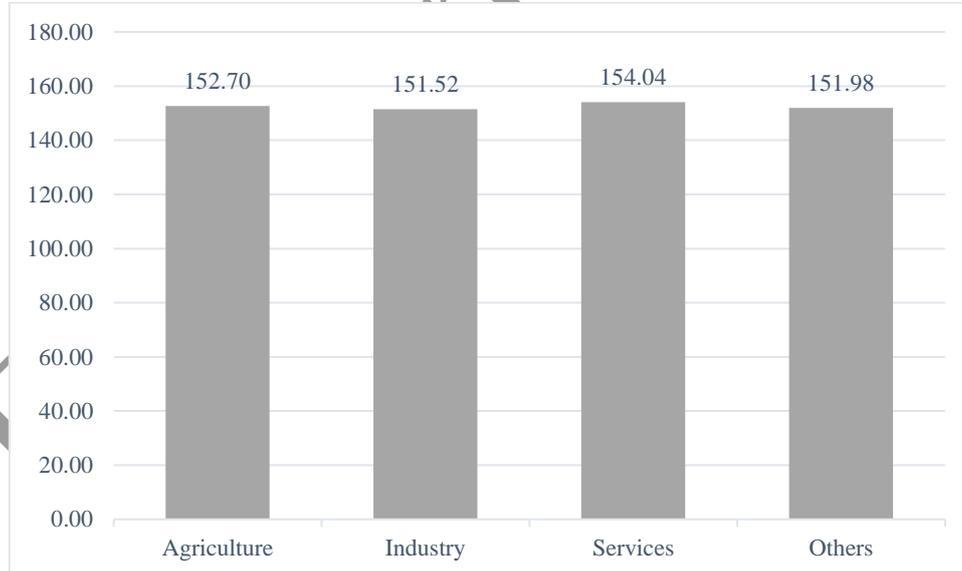
A1. Additional results

Figure 6 – Optimal weekly labor supply.



Source: Research results.

Figure 7 - Optimal weekly leisure choice.



Source: Research results.