



FEDERAL UNIVERSITY OF CEARÁ
DEPARTMENT OF ECONOMICS
POSTGRADUATION PROGRAM IN ECONOMICS
DOCTORAL DEGREE IN ECONOMICS

MARCUS ANTONIO FERREIRA ARARIPE

**ESSAYS ON LABOR INCOME TAX EVASION AND ITS RELATIONSHIP WITH
INCOME INEQUALITY AND SPATIAL DISTRIBUTION OF PUBLIC GOODS IN
BRAZIL**

FORTALEZA

2025

MARCUS ANTONIO FERREIRA ARARIPE

ESSAYS ON LABOR INCOME TAX EVASION AND ITS RELATIONSHIP WITH INCOME
INEQUALITY AND SPATIAL DISTRIBUTION OF PUBLIC GOODS IN BRAZIL

Thesis submitted to the Postgraduation Program
in Economics of Federal University of Ceará,
as a partial requirement for obtaining the title
of Doctor in Economics. Concentration Area:
Economics

Advisor: Prof. Dr. Márcio Veras Cor-
rêa

Co-advisor: Prof. Dr. Frederico Augusto
Gomes de Alencar

FORTALEZA

2025

Dados Internacionais de Catalogação na Publicação
Universidade Federal do Ceará
Sistema de Bibliotecas
Gerada automaticamente pelo módulo Catalog, mediante os dados fornecidos pelo(a) autor(a)

- F1e FERREIRA ARARIPE, MARCUS ANTONIO.
Essays on Labor Income Tax Evasion and Its Relationship with Income Inequality and the Spatial Distribution of Public Goods in Brazil / MARCUS ANTONIO FERREIRA ARARIPE. – 2025.
80 f. : il. color.
- Tese (doutorado) – Universidade Federal do Ceará, Faculdade de Economia, Administração, Atuária e Contabilidade, Programa de Pós-Graduação em Economia, Fortaleza, 2025.
Orientação: Prof. Dr. Márcio Veras Corrêa.
Coorientação: Prof. Dr. Frederico Augusto Gomes de Alencar.
1. Tax Evasion. 2. Laffer Curve. 3. Labor Income Taxation. 4. General Equilibrium. 5. Public Goods and Services. I. Título.

CDD 330

MARCUS ANTONIO FERREIRA ARARIPE

ESSAYS ON LABOR INCOME TAX EVASION AND ITS RELATIONSHIP WITH INCOME
INEQUALITY AND SPATIAL DISTRIBUTION OF PUBLIC GOODS IN BRAZIL

Thesis submitted to the Postgraduation
Program in Economics of Federal University
of Ceará, as a partial requirement for
obtaining the title of Doctor in Economics.
Concentration Area: Economics

Approved on:

EXAMINATION BOARD

Prof. Dr. Márcio Veras Corrêa (Advisor)
Federal University of Ceará (UFC)

Prof. Dr. Frederico Augusto Gomes de
Alencar (Co-advisor)
Federal University of Ceará (UFC)

Prof. Dr. Marcelo Aarestrup Arbex
University of Windsor

Prof. Dr. Guilherme Diniz Irffi
Federal University of Ceará (UFC)

Dr. João Luís Brasil Gondim
Brazilian Federal Revenue Service (RFB)

À minha família,

Com profunda gratidão por terem estado ao meu lado durante toda essa jornada. Vocês são minha maior conquista!

ACKNOWLEDGEMENTS

Fazer o doutorado enquanto trabalhava em tempo integral foi, sem dúvida, o maior desafio da minha vida. Essa caminhada exigiu esforço constante, disciplina, e principalmente o apoio de pessoas fundamentais, a quem sou imensamente grato.

Ao Prof. Dr. Márcio Veras Corrêa, meu orientador, agradeço pela orientação segura, pela confiança no meu trabalho e pela liberdade intelectual que me permitiu desenvolver esta tese com autonomia, mas sempre com respaldo técnico e acadêmico. Estava sempre presente nos momentos difíceis.

Ao Prof. Dr. Frederico Augusto Gomes de Alencar, meu coorientador, agradeço pela escuta atenta, pelas contribuições e pelo acompanhamento contínuo ao longo desta jornada.

Agradeço profundamente à minha esposa Lidiana, pela paciência, compreensão e apoio incondicional. Sua presença constante, mesmo nos momentos de silêncio, cansaço e dificuldades, foi essencial para que eu não desistisse.

Aos meus filhos, Guilherme e Samuel, que tantas vezes abriram mão do meu tempo em nome de um sonho, deixo meu amor e gratidão. São vocês que dão sentido a tudo isso.

Aos meus pais e irmãos, agradeço pelo apoio incondicional. Mesmo nas minhas ausências, vocês foram presença — em valores, apoio e incentivo. Esta conquista também é de vocês.

Aos colegas da Receita Federal do Brasil e à própria instituição, minha gratidão pelo apoio direto e indireto, pela convivência que me inspira, e por tornar possível a conciliação entre a vida profissional e a pesquisa acadêmica.

A todos vocês, minha sincera gratidão por terem caminhado comigo na etapa mais desafiadora — e transformadora — da minha trajetória.

“Tax evasion, to a large extent, is a policy choice.”

(Gabriel Zucman)

ABSTRACT

This thesis explores the determinants of labor income tax evasion and its relationship with income inequality, tax policy, and public goods provision in Brazil. In the first part, a dynamic heterogeneous-agent model is developed to analyze how income inequality affects tax evasion and the labor income Laffer curve. Results show that evasion is highly concentrated among the richest deciles. The second part introduces a spatial dimension with endogenous location choices and region-specific public goods. Calibrated to data from the city of Fortaleza, the model shows that increasing the provision or relative weight of public goods reduces tax evasion, but with modest effects and economic tradeoffs, including lower GDP and total tax revenues. The thesis shows that both income and regional inequality significantly shape tax compliance, highlighting the limits of redistribution through public goods alone in reducing evasion.

Keywords: Tax Evasion. Laffer Curve. Labor Income Taxation. General Equilibrium. Public Goods and Services

RESUMO

Esta tese explora os determinantes da sonegação do imposto de renda sobre o trabalho e sua relação com a desigualdade de renda, a política tributária e a provisão de bens públicos no Brasil. Na primeira parte, desenvolve-se um modelo dinâmico com agentes heterogêneos para analisar como a desigualdade de renda afeta a sonegação e a curva de Laffer do imposto sobre a renda. Os resultados mostram que a evasão está fortemente concentrada entre os decis mais ricos. A segunda parte introduz uma dimensão espacial com escolhas endógenas de localização e provisão de bens públicos específicos por região. Calibrado com dados de Fortaleza, o modelo mostra que o aumento da provisão ou do peso relativo dos bens públicos reduz a sonegação, embora com efeitos modestos e custos econômicos, incluindo queda do PIB e da arrecadação total. A tese demonstra que tanto a desigualdade de renda quanto a desigualdade regional influenciam significativamente o comportamento de conformidade tributária, evidenciando os limites da redistribuição via bens públicos como instrumento isolado para reduzir a evasão.

Palavras-chave: Sonegação Fiscal. Curva de Laffer. Tributação sobre a Renda do Trabalho. Equilíbrio Geral. Bens e Serviços Públicos

LIST OF FIGURES

Figure 1 – Extended Laffer Curve - Benchmark Model	42
Figure 2 – Laffer Curve Components	42
Figure 3 – Laffer Curve Components - Deciles 8, 9 and 10	44
Figure 4 – Laffer Curve - Per Labor Income Decile	45

LIST OF TABLES

Table I – Model Parameters	39
Table II – Key Statistics: Data and Benchmark Economy.	40
Table III – Tax Evasion Distribution	46
Table IV – Tax Evasion Distribution per Probability and Penalty	47
Table V – Elasticity ι : Sensitivity Test	48
Table VI – Model Parameters - Preferences, Technology, Productivity and Tax Policy . .	66
Table VII – Model Parameters - Public Goods	67
Table VIII – Key Statistics: Models and Economy.	68
Table IX – Decile Tax Evasion Distribution	68
Table X – Regional Tax Evasion Distribution	69
Table XI – Variation in Tax Evasion and Aggregate Economic Variables by Λ	70
Table XII – Regional Tax Evasion by Λ	71
Table XIII – Variation in Relative Prices, Tax Evasion and Aggregate Economic Variables by Φ	72
Table XIV – Variation in Relative Prices, Tax Evasion and Aggregate Economic Variables by Λ and g^2/g^1	73
Table XV – Regional Tax Evasion by Λ and g^2/g^1	73

LIST OF SYMBOLS

a	Agent's wealth
c	Private consumption
\bar{c}^j	Composite consumption (private + public) in region j
C	Aggregate private consumption in the economy
e	Fraction of labor income tax evaded
E	Expectation operator
ε	Idiosyncratic productivity shock
g^j	Public goods and services in region j
G	Government public expenditure
H^j	Housing consumption in region j
I	Aggregate investment
l	Labor supply of the household
L	Aggregate labor supply in the economy
M	Total government monitoring cost
n_j	Number of households in region j
p	Probability of audit
P^j	Housing price in region j
r	Interest rate (return on savings)
t	Time index
$T(y_t)$	Labor income tax function
τ_a	Capital income tax rate
τ_c	Consumption tax rate
$u(\cdot)$	Utility function
V^j	Indirect utility of living in region j
w	Wage rate
y_t	Labor income at time t

Y	Aggregate output (GDP)
ζ	Elasticity of substitution between public and private goods
η	Disutility weight on tax evasion
ϕ	Frisch elasticity of labor supply
γ	Coefficient of relative risk aversion
δ	Capital depreciation rate
$\delta_0, \delta_1, \delta_2$	Parameters of the labor income tax function
Λ	Share of public spending allocated to public goods
Φ	Private consumption share in utility aggregator

CONTENTS

1	INTRODUCTION	15
2	LAFFER CURVE IN BRAZIL: THE TAX EVASION EFFECT	19
2.1	Introduction	19
2.2	The Economy	26
2.2.1	<i>Preferences</i>	27
2.2.2	<i>Tax Code and Households' Budget Constraints</i>	28
2.2.3	<i>Households' and the Firms' Problems</i>	29
2.2.4	<i>Wealth Distribution</i>	31
2.2.5	<i>Tax Authority and the Economy's Resource Constraint</i>	32
2.2.6	<i>The Stationary Equilibrium</i>	33
2.3	Labor Market Laffer Curve and the Tax Gap	33
2.4	Quantitative Analysis	36
2.4.1	<i>Model Calibration and Parameter Selection</i>	37
2.4.2	<i>Results</i>	40
2.5	Discussion	48
3	THE INFLUENCE OF THE PROVISION OF PUBLIC GOODS AND SERVICES ON TAX EVASION	50
3.1	Motivation and Research Questions	50
3.2	The Model	55
3.2.1	<i>Household Behavior and Preferences</i>	56
3.2.2	<i>Taxation Structure and Household Constraints</i>	57
3.2.3	<i>Optimization Problems of Agents</i>	59
3.2.4	<i>Regional Decisions</i>	60
3.2.5	<i>Stationary Distribution</i>	61
3.2.6	<i>Tax Authority and the Economy's Resource Constraint</i>	61
3.2.7	<i>Definition of Equilibrium</i>	62
3.3	Quantitative Experiments and Policy Simulations	63
3.3.1	<i>Model Calibration and Empirical Targets</i>	64
3.3.2	<i>Simulation Results and Policy Evaluation</i>	68
3.4	Summary of Findings and Policy Implications	74
4	CONCLUSION AND FUTURE WORKS	76

REFERENCES 78

1 INTRODUCTION

This thesis examines the determinants, distribution and consequences of labor income tax evasion in Brazil from the standpoint of macroeconomic theory. Tax evasion is a great challenge for fiscal policy, especially in developing countries where enforcement capacity is limited and perceptions of fairness and reciprocity between taxpayers and the state are often weak. In Brazil, this situation is no different. The argument for not paying taxes is often based on the fact there is no effective return on them. In other words, the perception is that you pay a lot and receive only a little. Nonpayment of taxes has a multiplier effect. With the decrease in tax revenue, the government tends to increase the tax rate and may end up increasing tax evasion. This dynamic creates a vicious cycle that has been widely discussed in the literature on tax compliance. When governments respond to falling revenues by raising tax rates, they risk further eroding compliance incentives. On the one hand, higher statutory tax rates increase the arithmetic potential for revenue. On the other hand, they also raise the private benefits of concealment and, in many cases, intensify perceptions of unfairness. In developing countries, where enforcement is weaker and administrative capacity is limited, the marginal cost of taxation may therefore rise sharply as taxpayers adjust both their labor supply and their willingness to comply. This interplay between taxation, enforcement, and compliance underpins the well-known Laffer curve logic: beyond a certain point, attempts to raise rates can paradoxically reduce revenue. This is one of the effects that I intend to study in this thesis. At the same time, Brazil has a deep income inequality and stark regional disparities in the provision of public goods. These features make the country an ideal case for analyzing how tax evasion emerges as a behavioral response to enforcement constraints and incentives.

The choice of this research topic is motivated by the impact of tax evasion on the effectiveness and fairness of the tax system. Tax evasion not only limits the state's ability to fund essential public goods and services but also affects the credibility of tax institutions and contributes to the reproduction of inequality. In the context where enforcement actions are insufficient and public services are unequally distributed, tax compliance becomes a function not just of deterrence and penalties, but also of the perception of return on taxes paid. So it is crucial to understand tax evasion as a dynamic and multifaceted phenomenon.

The primary objective of this thesis is to analyze and quantify the impact of labor income tax evasion on tax collection efficiency and income distribution, as well as its relationship with regional disparities. More specifically, it aims to (i) measure how tax evasion impacts

the labor income Laffer curve and alters the revenue-maximizing tax rate; (ii) examine how evasion behavior is distributed across income groups and linked to enforcement parameters; and (iii) explore whether and how differences in public goods provision across regions influence compliance decisions. Two dynamic general equilibrium models are built and calibrated to address these questions.

The object of investigation is the endogenous decision to evade labor income taxes, modeled as part of rational household behavior in response to tax policy, audit risk, penalties, and access to public goods. In both models, households are heterogeneous, facing idiosyncratic labor productivity shocks. They choose their labor supply, savings, consumption, and the fraction of tax income not reported to tax authorities. In the second model, agents also choose where to live, taking into account regional differences in public goods and services quantity and housing costs. These behavioral choices are embedded in a general equilibrium framework.

This dynamic creates a vicious cycle that has been widely discussed in the literature on tax compliance. When governments respond to falling revenues by raising tax rates, they risk further eroding compliance incentives. On the one hand, higher statutory tax rates increase the arithmetic potential for revenue. On the other hand, they also raise the private benefits of concealment and, in many cases, intensify perceptions of unfairness. In developing countries, where enforcement is weaker and administrative capacity is limited, the marginal cost of taxation may therefore rise sharply as taxpayers adjust both their labor supply and their willingness to comply. This interplay between taxation, enforcement, and compliance underpins the well-known Laffer curve logic: beyond a certain point, attempts to raise tax rates can paradoxically reduce revenue.

I analyze and quantify the impact of labor income tax evasion on tax collection efficiency, as well as its relationship with income distribution and regional disparities in Brazil. The results indicate that evasion is highly concentrated among the wealthiest income groups, with the top decile alone accounting for more than 65% of individual labor income tax revenues but also for the largest share of tax evasion. This concentration implies that the effectiveness of progressive taxation is significantly undermined in a highly unequal society. At the aggregate level, the model shows that tax evasion accounts for more than half of the potential labor income tax revenues in Brazil, approximately 3% of GDP, placing the country to the right of the peak of the Laffer curve. Thus, current labor income taxation is not only inefficient in revenue terms but also inequitable in its incidence.

Beyond the income dimension, this thesis demonstrates that regional disparities in the provision of public goods play a critical role in compliance. The spatial model calibrated for Fortaleza reveals that households in wealthier regions, which already enjoy higher levels of public goods and services, are also those with higher rates of tax evasion. Policy simulations show that increasing the provision or relative importance of public goods reduces evasion, but only modestly, and at the cost of lower GDP, consumption, and total tax revenues. The analysis therefore highlights the limits of relying exclusively on public good provision as a strategy to foster compliance.

Taken together, these results underscore the circular relationship between tax evasion, inequality, and public goods provision. Higher inequality leads to a concentration of evasion among the rich, which reduces revenues and weakens redistribution. Lower revenues, in turn, restrict the government's ability to expand or improve public goods, reinforcing perceptions of unfairness and further eroding tax morale. This feedback loop illustrates why Brazil's combination of high inequality, regional heterogeneity, and limited enforcement capacity creates structural barriers to effective taxation. By quantifying these mechanisms, this thesis contributes to a better understanding of how tax policy interacts with inequality and spatial disparities, and why reforms must simultaneously address enforcement, redistribution, and public service delivery in order to break the cycle.

The thesis is organized into four chapters, including this introduction. Chapter 2 develops a dynamic general equilibrium model with incomplete markets and endogenous tax evasion. The model extends the classic heterogeneous-agent framework by introducing enforcement features and an evasion choice. It is calibrated to Brazilian macro and micro data (2019) and used to construct the labor income Laffer curve, both in aggregate and by income decile. The results quantify the size of Brazil's labor income tax gap and identify the income groups most responsible for lost tax revenue. The chapter also explores how audit probability and penalty severity affect tax compliance and discusses the implications for an optimal tax design.

Chapter 3 expands the analysis by incorporating a spatial dimension into the model. Here, the economy consists of two regions with distinct levels of public goods and services provision. Households not only choose how much to work, consume, save and evade, but also where to reside, based on regional differences in amenities. Public and private consumption are combined into a single utility index. The model is calibrated using data from Fortaleza, a

Brazilian city with pronounced regional inequalities. Policy experiments examine how changes in the allocation or intensity of public spending affect tax compliance and economic variables.

Chapter 4 concludes the thesis, showing the main findings and reflecting on their broader implications for tax policy in Brazil. It also discusses the limitations of the modeling framework and suggests directions for future research. By combining agents' heterogeneity with evasion choice and spatial inequality in a unified quantitative framework, this thesis offers a novel contribution to the study of tax evasion.

2 LAFFER CURVE IN BRAZIL: THE TAX EVASION EFFECT

The chapter is structured into five main sections. Section 2.1 presents the main research question, presents key empirical findings, and explains the motivation for studying the labor income Laffer curve in the context of Brazil. It also summarizes the main contributions and presents a brief review of the related literature on tax evasion and income taxation.

In Section 2.2, the general equilibrium model used in the analysis is described. It incorporates heterogeneous households, incomplete markets, and imperfect taxation on labor income. The section also details households' preferences, the structure of taxation, the government's enforcement mechanism, and the behavior of firms. It further defines the conditions for a stationary equilibrium.

Section 2.3 explains how the labor income Laffer curve is constructed and decomposed into three key effects: arithmetic, economic, and tax evasion. It introduces the concept of the tax gap and provides the theoretical foundations for analyzing how tax evasion affects labor income tax collection. The section also disaggregates the Laffer curve by income groups.

In Section 2.4, the model is calibrated for the Brazilian economy. I simulate the Laffer curve both with and without tax evasion and evaluate the cost of evasion across income groups. The results show the distributional nature of tax compliance and suggest significant efficiency and equity gains from reforming tax policy and enforcement strategies.

The final section summarizes the main findings and policy implications. It shows the importance of considering household heterogeneity and the concentration of tax evasion among higher-income groups. The results highlight the need for more effective enforcement and structural reforms to improve the efficiency and equality of the Brazilian tax system.

2.1 Introduction

In this chapter I study the impact of tax evasion on the empirical Laffer curve for Brazil. I build a standard Bewley-Huggett-Aiyagari model, with distortionary consumption, capital income and labor income tax rates and a tax audit policy conducted by the national tax authority. The government imposes a progressive taxation policy on labor income and collects taxes to fund public expenditures and tax enforcement measures. Agents are heterogeneous in their wealth endowments and labor productivity. They decide their working hours and the proportion of labor income taxes to evade. Households caught evading taxes face penalties, with

finer proportional to the amount of unpaid taxes. Agents can also save and obtain personal loans from financial intermediaries. However, they also face a financial borrowing constraint that restricts indebtedness. There is a representative firm that rents labor and capital to produce a final consumption good, and households face idiosyncratic productivity shocks¹.

I develop a benchmark model calibrated for Brazil, both with and without tax evasion, to quantify the size and distribution of tax evasion across labor income groups². Additionally, I simulate the empirical labor income Laffer curve for Brazil. In the scenario without tax evasion, it is well established that changes in distortionary labor income tax rates impact government tax collection through two main mechanisms: arithmetic and economic effects (Laffer (2004)). According to Laffer, the higher the tax rate, the greater the amount of tax revenue collected by the fiscal authority, a relationship he termed the arithmetic effect. However, he also identified an indirect effect that acts in the opposite direction: higher tax rates reduce the intensive margin of labor supply, consequently lowering labor income tax collection. Laffer argued that these opposing effects produce a single-peaked function, where the labor income tax rate that maximizes government revenue corresponds to the curve's peak.

When tax evasion is included, however, a third component emerges: the effect of household tax evasion on overall tax collection. The mechanism operates through the household's optimization problem. With higher tax rates, households compare the utility cost of evading (captured by the disutility parameter in the model) with the expected financial gains, which depend on the audit probability and the severity of penalties. If enforcement capacity is limited, the expected cost of being caught remains relatively small compared to the benefit of underreporting income. As a result, households optimally choose to increase the share of income not declared. This behavioral response reduces the effective tax base and lowers the government's actual revenue, even though the tax rate has increased. In other words, the evasion effect adds an additional "leakage channel" to the Laffer curve. Unlike the economic effect, which works through reduced labor supply, the evasion mechanism works through underreporting of existing labor income. Together, these two behavioral channels mean that the peak of the Laffer curve arrives earlier and at a lower level of government revenue than would be predicted by models that exclude evasion. Importantly, because higher-income households both face higher marginal rates

¹ Although I use a standard incomplete market model in this chapter, there are alternative approaches to modeling informality that consider both the intensive and extensive margins of the shadow economy, for firms and workers. For related literature, see Ulyssea (2020).

² The model without tax evasion is a straightforward extension of the general benchmark model with tax evasion, assuming that the monitoring policy fully prevents such practices.

and have greater opportunities to evade, this mechanism disproportionately affects the upper end of the income distribution, reinforcing the link between tax evasion and inequality.

The intuition can be described as follows. An increase in tax rates raises the burden on compliant taxpayers, while simultaneously increasing the potential benefits of concealment for those who choose to evade. In contexts where enforcement capacity is limited, the expected cost of evasion remains relatively low, making underreporting a rational decision for many households. This response not only reduces government revenues directly but also undermines perceptions of fairness in the tax system, which can further weaken compliance norms. As a result, higher tax rates may paradoxically lead to lower revenues and reinforce inequality, since wealthier households, who represent the largest share of the tax base, are also those with greater capacity to evade.

My benchmark model for Brazil shows that the Laffer curve is right-skewed and has an inverted U-shape, peaking at a maximum marginal tax rate of 25.33%. Compared to Brazil's current labor income tax rate of 27.50%, this finding suggests that the country is currently on the downward slope of the curve. Therefore, a reduction in the tax rate - shifting it to 25.33%, for example - would result in increased tax revenue. Furthermore, the labor income Laffer curve exhibits distinct behaviors on either side of its peak: on the left, it follows a parabolic trajectory, while on the right, it descends with a different shape. This result underscores the role of household heterogeneity in shaping the elasticity of government tax revenue in response to changes in labor income tax rates.

The calibrated version of the benchmark model successfully replicates several empirical findings for the Brazilian economy. For the consumption-to-GDP and investment-to-GDP ratios, the model yields values of 65.3% and 17.1%, closely aligned with the Brazilian economy's figures of 65.0% and 17.1%, as reported by PWT data. The government consumption-to-GDP ratio is also well aligned with the Brazilian data. Furthermore, the model accurately captures the labor income distribution across deciles, although it slightly overestimates shares for deciles 7, 8, and 9. Overall, the model provides an accurate representation of the labor income distribution across deciles, achieving a good fit with the Brazilian data.

I show the impact of incomplete markets, household heterogeneity, and tax evasion on government labor income tax collection. The main contribution lies in incorporating the three components of the aggregate Laffer curve for the Brazilian labor market into its construction and quantitatively characterizing its behavior across labor income deciles. Additionally, I also

quantify the economic cost of labor income tax evasion in an economy with imperfect tax collection, which allows tax evasion. This is important because it provides policymakers with insights into how labor income tax policies influence government revenue, highlighting the role of household heterogeneity in shaping tax efficiency. It also offers evidence to support targeted tax reforms aimed at enhancing compliance and increasing revenue without imposing excessive burdens on taxpayers.

A key contribution of this study is the disaggregated analysis of the Laffer curve by deciles of the labor income distribution in Brazil. The results reveal significant variations in tax collection patterns across income groups. For instance, while the first six deciles do not contribute to total tax revenues due to the absence of taxable income below the threshold of R\$ 28,559.70³ per year, the top deciles dominate tax collection. Specifically, the tenth decile alone accounts for more than 65% of total individual labor income tax revenue, while deciles 8 and 9 contribute 13% and 20.5%, respectively.

According to the findings, only the top three deciles lie above the aggregate Laffer curve, while the remaining deciles fall below it. Furthermore, the peaks of the segmented Laffer curves differ across income deciles: the top three deciles are located to the left of the aggregate curve's peak, placing these households on the downward slope of the aggregate labor income Laffer curve under Brazil's current tax code. Consequently, further increases in the labor income tax rate would reduce tax collection from this subset of agents.

This previous analysis is essential since it reveals the heterogeneous impact of labor income taxation across different segments of the population. By disaggregating taxpayers by income levels, it highlights how tax policies affect groups differently and identifies those most responsive to changes in tax rates. This approach also reveals variations in tax collection efficiency, compliance, and evasion across deciles, offering valuable insights for designing targeted fiscal policies that promote equity and maximize government revenue while avoiding excessive burdens on specific income groups. It does so by decomposing the Laffer curve across income deciles and comparing the relative position of each group to the aggregate curve. In practice, this means that for the same tax rate, households in different deciles generate distinct levels of effective revenue because their incentives to supply labor and to evade taxes are not identical. Lower-income groups, often below the taxable threshold, contribute little to overall revenue and have limited scope for evasion, while higher-income groups account for most of

³ Approximately US\$ 7,086.77 per year.

the tax base but also display stronger evasion responses. By quantifying these heterogeneous behaviors within the general equilibrium framework, the model makes it possible to identify which groups are located on the upward or downward segment of the Laffer curve, thereby revealing variations in efficiency, compliance, and evasion across the distribution.

The impact of tax evasion on government revenues is also an important result of this study, especially when analyzed across different economic groups. My results indicate that labor income tax evasion significantly reduces income tax collection, accounting for up to 54% of potential revenue and representing 3.11% of Brazil's GDP. This loss is not uniformly distributed: while the first two quartiles of the labor income distribution do not evade taxes due to income thresholds below the taxable minimum, the fourth quartile alone is responsible for 93% of the total tax gap, followed by 7% in the third quartile. These findings underscore the concentration of tax evasion among wealthier households, revealing significant disparities in tax compliance⁴.

This unequal distribution has important fiscal and policy implications. Because evasion is concentrated among high-income households, the government loses precisely the revenues that would otherwise contribute most to progressive redistribution and fiscal capacity. The result is a narrower fiscal space, as the state cannot rely on the largest contributors to expand public spending or reduce deficits. At the same time, the concentration of evasion at the top creates inequities in the tax system: compliant middle-income taxpayers bear a relatively higher effective burden, while wealthier groups are able to shift part of their liabilities through concealment. These dynamics explain why targeted enforcement policies, focusing on high-income groups with greater scope for evasion, are essential to both strengthen revenue efficiency and restore fairness in the tax system.

Literature Review. It is well established in the economic and public finance literature that several factors influence tax evasion and the shape of the empirical Laffer curve, both in models with representative households and in those with heterogeneous agents. One of the first attempts to develop a theoretical model of tax evasion in a representative agent economy was made by Allingham and Sandmo (1972)⁵. They built a portfolio selection problem, showing that if taxpayers are rational and risk-averse, the amount of evaded taxes varies inversely with

⁴ This result aligns with the economic literature, which consistently highlights that tax evasion is significantly higher among wealthier individuals (Alstadsaeter *et al.* (2023)).

⁵ There are several extensions to these models in the literature. They introduce heterogeneity and multiplicity in monitoring rates and different types of sanctions for households caught evading taxes. They also consider different tax rates and tax progressivity, the mutual incidence of tax avoidance and evasion, as well as alternative audit policies. See Andreoni *et al.* (1998), Slemrod and Yitzhaki (2002), Slemrod (2007), Alm (2012), Luttmer and Singhal (2014) and Slemrod (2019) for more on this.

the audit probability and the penalty imposed by the tax authority - a result consistent with my finding. According to their model, whenever the net benefits of tax evasion are positive, taxpayers will always avoid paying taxes.

In a related study, Alm (2012) argued that tax evasion is not a straightforward policy issue that can be easily solved, as many have previously suggested. He examined various dimensions of the tax evasion literature, linking theoretical approaches to empirical evidence on its measurement, underlying motivations, and potential control strategies. In turn, within a heterogeneous-agent framework, Conesa and Krueger (2006) and Conesa *et al.* (2009) developed general equilibrium models where taxpayers cannot endogenously evade a portion of their labor income taxes. The authors also explored optimal taxation and the relative advantages of taxing capital compared to other forms of taxation.

The present chapter is more directly connected to the works of Trabandt and Uhlig (2011), Holter *et al.* (2019) and Alba and McKnight (2023). Trabandt and Uhlig (2011) analyzed the shape of the labor income Laffer curve under different tax policies and across various regions. While they characterized the Laffer curve for the United States and Europe, I examine its behavior for Brazil, both in aggregate terms and across the labor income distribution. In contrast to their approach, I demonstrate how tax evasion impacts government tax revenue and quantify its economic cost for Brazil.

Holter *et al.* (2019), in turn, quantitatively assessed the effects of tax progressivity versus a flat labor income tax rate on the peak and slope of the Laffer curve within a heterogeneous-agent framework. According to their findings, transitioning the current US fiscal policy to a progressive tax system, similar to that of Denmark, would result in a substantially lower peak, while adopting a flat tax system would increase the peak of the Laffer curve by 6%. Their work highlights that household heterogeneity is a crucial factor in shaping the Laffer curve, which aligns with my findings. However, this study differs in two key aspects. First, I analyze the impact of households' financial status on Brazilian aggregate tax collection and the shape of the Laffer curve. Second, I quantitatively evaluate how the heterogeneous labor income distribution affects tax evasion, the shape of the Laffer curves, and Brazilian GDP.

Alba and McKnight (2023) evaluated the impact of a large informal sector on the Laffer curve in developing economies. They showed that the presence of an informal sector causes a leftward shift in the Laffer curve and reduces its steepness. According to the authors, this effect arises from the elasticity of substitution between the formal and informal sectors. They

argued that the higher the elasticity of substitution between these two sectors, the smaller the revenue the government can generate through changes in the tax rate. While there are similarities between their study and the present one, my approach differs in some important respects. They emphasize the role of informality by explicitly modeling the substitution between formal and informal sectors, showing how this mechanism shifts the Laffer curve leftward and reduces its steepness. In contrast, I do not model the informal sector as a separate production segment. Instead, I calibrate the benchmark model to Brazil in order to replicate its main macroeconomic and distributional facts, while treating tax evasion as an endogenous household choice within an imperfect enforcement environment. This strategy allows me to capture the fiscal consequences of underreporting directly, without requiring assumptions about the structure of informality. It also highlights the distributional nature of evasion, since the tax gap in my results is highly concentrated among high-income households. Thus, whereas Alba and McKnight (2023) attribute the shift of the Laffer curve to the size of the informal sector, my findings show that similar distortions can emerge from concentrated evasion within the formal sector, reinforcing the link between inequality and an imperfect tax policy⁶ in Brazil.

The Brazilian Tax System. The Brazilian tax system is widely recognized for its complexity and the extensive number of taxes and contributions it encompasses. The 1988 Federal Constitution established a tax structure primarily based on three pillars: income, consumption, and property taxes. This structure was designed not only to ensure a broad tax base but also to create a revenue-sharing system among the central government, states and municipalities, thereby securing both the financial autonomy and administrative independence of each level of government. Furthermore, it aimed to address regional disparities and promote the decentralization of tax revenues, enabling each Brazilian region to set its own rates and rules for certain taxes, particularly those on consumption.

As a result, in addition to national consumption taxes such as PIS, COFINS, and IPI, states and municipalities are empowered to levy their own consumption taxes, including the state-level ICMS and the municipal ISS. However, this overlapping tax authority policy also has a downside. It leads to a high overall tax burden on consumption, making the Brazilian tax system particularly burdensome for low-income households. Since consumption taxes are impersonal (i.e., they do not account for the taxpayer's income or ability to pay), this regressive structure exacerbates inequality. Consequently, lower-income agents bear a disproportionately

⁶ See Kotamaki (2017) for insights on the relationship between home production and Laffer curves, and Wu (2021) on the connection between income inequality, tax progressivity, and the tax base.

higher tax burden than higher-income individuals, reducing their purchasing power and limiting their capacity to save and invest (Lustig *et al.* (2014a), Lustig *et al.* (2014b) and Higgins and Pereira (2014)).

In contrast to consumption taxes, income tax policy in Brazil is exclusively managed by the central government. This tax is guided by the principles of generality, universality, and progressivity. The principle of generality requires that income tax be broadly applied to the entire population, while universality ensures that all sources of income are included in the tax base. Progressivity, the third principle, dictates that individuals with higher incomes should contribute a larger share of taxes. To implement progressivity, a system of marginal tax rates has been established, applying higher rates to higher income brackets after accounting for legally permitted deductions. This structure aims to enhance fairness by progressively increasing the tax burden on those with the greatest ability to pay.

However, despite being consistent with the principle of progressivity, the marginal tax rate system has a limited redistributive impact in practice. The effective tax rate does not rise as steeply as income, resulting in only moderate redistribution. For instance, a taxpayer with an annual taxable income (after deductions) of R\$ 100,000 (US\$ 24,813.90) faces an effective income tax rate of 17.06%, while someone with taxable income of R\$ 1 million (US\$ 248,139.00) faces a rate of 26.46%. This indicates that despite a tenfold increase in taxable income, the effective tax rate rises by only 55%. Consequently, the progressive nature of the tax system is limited, providing less redistributive impact than expected for such a disparity in income levels.

Furthermore, in 2019, only taxpayers with annual taxable income exceeding R\$ 28,559.70 (US\$ 7,086.77) were required to file an income tax return. This threshold excluded a significant portion of income-earning individuals from the tax system. According to the Brazilian Institute of Geography and Statistics (IBGE), the employed labor force in Brazil totaled 94.5 million people. However, the Brazilian Federal Revenue Service (RFB) reported that only 30.5 million of these individuals filed an income tax return, representing just 32.26% of the employed workforce.

2.2 The Economy

The economy operates in discrete time and is characterized by a continuum of infinitely-lived agents, a representative firm, financial intermediaries, and a tax authority that imperfectly taxes households. Agents are endowed with one unit of time and make instantaneous

decisions regarding consumption (c_t) and labor supply (l_t). They also determine next period's wealth (a_{t+1}) and the fraction of labor income taxes to evade (e_t). Households face idiosyncratic productivity shocks, and the financial market is incomplete, implying that self-insurance is the only mechanism available to mitigate these shocks. The economy includes a single risk-free financial asset, and agents are subject to a borrowing constraint.

There is a large, exogenous number of financial intermediaries, and both households and firms have free access to financial markets. Households can buy assets and obtain personal loans, while firms borrow capital. There is no aggregate uncertainty in this economy. The fiscal authority imposes taxes on households' consumption, labor income, and savings. However, due to limited monitoring capacity, the government can only partially enforce taxation. Agents are randomly monitored, and those caught evading labor income taxes are fined an amount equivalent to the evaded taxes. The representative firm combines labor and capital to produce a unique consumption good, whose price is normalized to one. The final consumption good can be either consumed or invested.

The timing of the model is as follows: At the beginning of period t , households' asset endowment is given by a_t , which follows an endogenous wealth distribution H_t . A productivity shock then occurs, after which households and firms make optimal decisions. The tax authority monitors a subset of taxpayers and punishes labor income tax evaders. These steps are repeated from $t + 1$ onward.

2.2.1 Preferences

In this economy, agents derive utility from consumption, while also incurring a disutility associated with labor and tax evasion (Sandmo (2005)⁷). Agents' preferences are represented by the following utility function:

$$E_t \sum_{t=0}^{\infty} \beta^t \left[\frac{c_t^{1-\gamma}}{1-\gamma} - \chi \frac{l_t^{1+\frac{1}{\phi}}}{1+\frac{1}{\phi}} - \eta \frac{e_t^\iota}{\iota} \right], \quad (2.1)$$

where γ , ϕ and ι are parameters related to the relative degree of risk aversion, the Frisch elasticity of labor supply, and the tax evasion elasticity, respectively. A higher ι , for instance, suggests that

⁷ Sandmo revisits the Allingham and Sandmo (1972) framework and highlights the importance of incorporating a disutility of tax evasion directly into the taxpayer's utility function. This formulation is consistent with the preference specification adopted in this thesis, as it explicitly recognizes that taxpayers may perceive evasion not only in terms of risk and penalties, but also as an action associated with additional psychological or moral costs.

agents are more likely to evade taxes as tax rates increase, amplifying the evasion response to higher taxation. The terms χ and η are positive weights associated with labor and tax evasion in the utility function.

2.2.2 Tax Code and Households' Budget Constraints

The government imposes a progressive tax rate on labor income y_t , represented by the function $T(y_t)$. There are also taxes on consumption and asset returns. Households are subject to idiosyncratic productivity shocks (ε_t) that affect their labor efficiency. Agents are randomly monitored by the tax authority, and those who choose to evade labor income taxes face a probability p of being audited and penalized. The fiscal authority's penalty policy is defined by a punishment parameter $\mathcal{T} \geq 0$. The household budget constraint is given by:

$$(1 + \tau^c)c_t + a_{t+1} - a_t[1 + (1 - \varsigma\tau^a)r_t] = \begin{cases} y_t - T(y_t)(1 + \mathcal{T}e_t), & \text{if audited} \\ y_t - T(y_t)(1 - e_t), & \text{otherwise;} \end{cases} \quad (2.2)$$

where

$$y_t = \varepsilon_t w_t l_t; \quad (2.3)$$

$$\varsigma = \begin{cases} 1, & \text{if } a_t \geq 0 \\ 0, & \text{otherwise;} \end{cases} \quad (2.4)$$

and

$$T(y_t) = \delta_0 \left[y_t - (y_t^{-\delta_1} + \delta_2)^{-\frac{1}{\delta_1}} \right]. \quad (2.5)$$

The previous expressions warrant further explanation. I begin with expression (2.2), the household budget constraint. On the right-hand side, y_t represents the agent's gross income in period t , which is then subject to taxation $T(y_t)$, as specified in expression (2.5). In the event of an audit, which occurs at probability p , the agent incurs an additional penalty proportional to the level of evasion e_t , captured by the factor $(1 + \mathcal{T}e_t)$, where \mathcal{T} represents the penalty rate. If not audited, however, the agent benefits from reduced tax obligations by a fraction $(1 - e_t)$, reflecting successful tax evasion. The term $(1 + \tau^c)c_t$, on the left-hand side, represents

the gross consumption expenditure, while a_{t+1} denotes the agent's accumulation of assets for the subsequent period. Finally, $a_t[1 + (1 - \zeta\tau^a)r_t]$ reflects the adjusted value of current assets in terms of the final consumption good, accounting for a net return of $(1 - \zeta\tau^a)r_t$. Here, τ^a represents the tax rate on asset returns, and ζ is an indicator function that distinguishes agents by financial status, under the assumption that agents do not pay taxes on personal loans.

As previously mentioned, expression (2.3) defines the household's gross income in period t , where w_t is the wage rate. The indicator function ζ , as defined in (2.4), categorizes agents based on their asset balance, distinguishing those who pay taxes on capital income from those who do not. Expression (2.5), in turn, specifies the functional form for the labor income taxation, following Gouveia and Strauss (1994) and Conesa and Krueger (2006). The parameter δ_0 scales the overall tax level, while δ_1 and δ_2 control the curvature and adjustment of the labor income threshold. More specifically, the term $(y_t^{-\delta_1} + \delta_2)^{-\frac{1}{\delta_1}}$ adjusts the taxable income base to ensure that the tax rate increases with y_t , capturing the progressive nature of the taxation scheme. Additionally, when $\delta_1 \rightarrow 0$, the function simplifies to $T_t^l(y_t) = \delta_0 y_t$, denoting a proportional tax code. For $\delta_1 > 0$, it defines a progressive tax code, with the degree of progressivity intensifying as δ_1 increases. These parameters are calibrated to the Brazilian economy.

Households face an exogenous borrowing constraint⁸:

$$a_{t+1} \geq -\Omega, \quad (2.6)$$

and the household productivity shock follows an AR(1) process with mean μ and persistence coefficient ρ :

$$\log(\varepsilon_t) = (1 - \rho)\mu + \rho \log(\varepsilon_{t-1}) + v_t, \quad (2.7)$$

where $v_t \sim \mathcal{N}(\mu_v, \sigma_v^2)$ ⁹.

2.2.3 Households' and the Firms' Problems

Agents maximize the utility function (2.1), given prices, initial household endowments, and the tax code, subject to constraints defined by expressions (2.2) through (2.7). The solution to the household's maximization problem is characterized by the following conditions:

⁸ From (2.6), if $\Omega = 0$, the household is not allowed to borrow. For any other value of Ω , the household may borrow up to that exogenous amount.

⁹ It is important to note that, although expression (2.7) is identical for all agents, its realization is specific to each individual.

$$\chi_t^{\frac{1}{\phi}} = \frac{c_t^{-\gamma}}{(1 + \tau_t^c)} \left[\varepsilon_t w_t l_t - \frac{\partial T(\varepsilon_t w_t l_t)}{\partial l_t} + (1 - p - \mathcal{T}p) e_t \frac{\partial T(\varepsilon_t w_t l_t)}{\partial l_t} \right]; \quad (2.8)$$

$$\eta e_t^{1-1} = \frac{c_t^{-\gamma}}{(1 + \tau_t^c)} (1 - p - \mathcal{T}p) T(\varepsilon_t w_t l_t); \quad (2.9)$$

$$\frac{c_t^{-\gamma}}{(1 + \tau_t^c)} = \beta E_t \left[\frac{c_{t+1}^{-\gamma}}{(1 + \tau_{t+1}^c)} [1 + (1 - \zeta \tau_{t+1}^a) r_{t+1}] \right] + \Psi_t; \quad (2.10)$$

$$a_{t+1} = a_t + (1 - \zeta \tau_t^a) r_t a_t + \varepsilon_t w_t l_t - T(\varepsilon_t w_t l_t) + (1 - p - \mathcal{T}p) e_t T(\varepsilon_t w_t l_t) - (1 + \tau_t^c) c_t; \quad (2.11)$$

$$\Psi_t [a_{t+1} + \Omega] = 0, \quad \Psi_t \geq 0; \quad (2.12)$$

$$a_{t+1} \geq -\Omega, \quad \Omega \geq 0 \quad c_t > 0, \quad 0 \leq l_t \leq 1, \quad 0 \leq e_t \leq 1; \quad (2.13)$$

where:

$$\frac{\partial T(\varepsilon_t w_t l_t)}{\partial l_t} = \delta_0 \varepsilon_t w_t \left(1 - \frac{(\varepsilon_t w_t l_t)^{-1}}{(1 + \delta_2 (\varepsilon_t w_t l_t)^{\delta_1})^{\frac{1}{\delta_1} + 1}} \right)$$

and $T(\varepsilon_t w_t l_t)$ is given by (2.5).

Equations (2.8) and (2.9) describe the optimal household choices regarding hours of work and labor income tax evasion, respectively. The subsequent expression corresponds to the consumption Euler equation, while the remaining two represent the household's budget constraint and the complementary slackness condition.

The first two expressions demonstrate that the audit rate and the severity of penalties imposed by the fiscal authority directly influence agents' decisions regarding working hours and optimal tax evasion levels¹⁰. In the next section, I quantitatively examine these results and assess the impact of agents' optimal choices on the labor market Laffer curve.

The representative firm operates in a perfectly competitive final goods market, combining labor (L_t) and capital (K_t) according to the following production technology:

$$Y_t = K_t^\alpha L_t^{1-\alpha} \quad (2.14)$$

¹⁰ Tax evasion occurs only if the net benefits derived from evasion are positive. To ensure a more meaningful problem, we assume henceforth that $(1 - p - \mathcal{T}p)T(y_t) > 0$.

where $\alpha \in (0, 1)$. The profit maximization problem is as follows:

$$\Pi = \max_{K_t, L_t > 0} \{Y_t - (r_t + \delta)K_t - w_t L_t\}, \quad (2.15)$$

where $0 < \delta < 1$ is the capital depreciation rate. The optimal capital and labor demand functions are given by:

$$r_t = \alpha \left(\frac{L_t}{K_t}\right)^{1-\alpha} - \delta, \quad (2.16)$$

$$w_t = (1 - \alpha) \left(\frac{K_t}{L_t}\right)^\alpha. \quad (2.17)$$

2.2.4 Wealth Distribution

To characterize the law of motion of the wealth distribution, I assume that H_0 and H_t represent the initial and period t wealth distributions, respectively. Let $a \in Z = [a_l, a_h] \subset \mathbb{R}^+$ denote the household's wealth endowment at time t . I assume that \mathcal{Z} is a σ -algebra in Z and H is a probability measure defined on the measurable space (Z, \mathcal{Z}) . Here, H represents the cross-sectional wealth distribution among agents. Specifically, for any $V \subset Z$, with $V \in \mathcal{Z}$, $H(V)$ describes the mass of households with wealth defined in Z . Additionally, let F_t denote the distribution of labor productivity ε_t , where ε_t follows a log-normal distribution driven by a stochastic process with persistence ρ , as defined in (2.7). Therefore, a non-stationary transition probability function P_t is defined as follows:

$$P_t(a, l, V) = \text{Prob}[a_{t+1} \in V | a_t = a, l_t = l, \varepsilon_t \sim F]. \quad (2.18)$$

The function $P_t(a, l, V)$ represents the probability that an agent with wealth a , labor state l , and productivity ε , distributed according to F , will have wealth within the set V at time $t + 1$. The law of motion of the wealth distribution is then expressed as:

$$H_{t+1} = \int \int P_t(a, l, V) H_t(da, dl). \quad (2.19)$$

which characterizes the evolution of the wealth distribution H_t as it adjusts according to wealth, labor status, and productivity dynamics across households.

2.2.5 Tax Authority and the Economy's Resource Constraint

Let Σ denote the support of the household productivity shock. The fiscal authority finances its consumption (\mathcal{G}) and the tax audit policy (\mathcal{M}) through taxes on consumption, labor and asset returns. The government budget constraint is expressed as follows:

$$\begin{aligned} \iiint [T(\varepsilon_t w_t l_t) - (1 - p - \mathcal{T} p) e_t T(\varepsilon_t w_t l_t) + \tau_t^c c_t] J_t(da, dl, d\varepsilon) \\ + \iiint_{\mathbb{S}} \tau_t^a r_t a_t J_t(da, dl, d\varepsilon) = \mathcal{G}_t + \mathcal{M}_t, \end{aligned} \quad (2.20)$$

where $\mathbb{S} = \Sigma \times [0, a_h] \times \mathbb{R}_+$ represents the mass of non-indebted agents in the economy and $J_t(da, dl, d\varepsilon)$ denotes the joint distribution of wealth, labor state and household productivity. Let \mathbb{D} represent the subset of households with financial debts in the economy. The economy's resource constraint is:

$$Y_t = C_t + G_t + K_{t+1} - (1 - \delta)K_t, \quad (2.21)$$

where:

$$K_t + \iiint_{\mathbb{D}} a_t J_t(da, dl, d\varepsilon) = \iiint_{\mathbb{S}} a_t J_t(da, dl, d\varepsilon), \quad (2.22)$$

$$L_t = \iiint \varepsilon_t l_t J_t(da, dl, d\varepsilon), \quad (2.23)$$

$$C_t = \iiint c_t J_t(da, dl, d\varepsilon), \quad (2.24)$$

$$G_t = \mathcal{G}_t + \mathcal{M}_t = \mathcal{G}_t + \mathcal{C} \frac{\iiint \mathcal{I} J_t(da, dl, d\varepsilon)}{\iiint J_t(da, dl, d\varepsilon)}, \quad (2.25)$$

and \mathcal{I} is an indicator function that takes the value 1 if the household of type (a, l, ε) is monitored by the tax authority and 0 otherwise. The term \mathcal{C} represents the cost of the audit policy borne by the tax authority, with $\mathcal{M} = \mathcal{C} p$.

2.2.6 The Stationary Equilibrium

I now define the stationary equilibrium for this economy.

Given an exogenous borrowing limit Ω , a stationary competitive equilibrium is characterized by:

- (i) The tax authority's set of policy instruments $(T, \tau^a, \tau^c, \mathcal{T}, \mathcal{G}, \mathcal{M})$;
- (ii) A price system (w, r) of wages and interest rates;
- (iii) Households' allocations (c, a, l, e) ;
- (iv) A joint distribution $J(a, l, \varepsilon)$ with marginal distributions for wealth, $H(a, l)$, and productivity, $F(\varepsilon)$;

such that:

- I. The households' and firms' optimal allocations are characterized by expressions (2.8) – (2.13) and (2.16) – (2.17), respectively;
- II. The joint distribution $J(a, l, \varepsilon)$ remains constant over time;
- III. The government budget constraint and the economy's resource constraint, (2.20) and (2.21), respectively, are satisfied;
- IV. The wage rate and the economy's interest rate satisfy the market clearing conditions (2.22) and (2.23);
- V. The aggregate consumption of households and the government are given by (2.24) and (2.25), respectively.

The steady-state equilibrium is unique. Moreover, it can be shown that the economy converges to this steady-state equilibrium from any initial condition (Antunes *et al.* (2008)).

2.3 Labor Market Laffer Curve and the Tax Gap

Having characterized the decentralized steady-state equilibrium of the benchmark economy, I now utilize the equilibrium expressions derived in the previous section to quantitatively construct the steady-state labor income Laffer curve for Brazil. This curve theoretically relates labor income tax revenue to the labor income tax rate and is characterized by:

$$\begin{aligned}
 LC(a, l, \varepsilon; w, r) &= \int \int \int [(1 - e)T(\varepsilon wl)] J(da, dl, d\varepsilon) \\
 &= \int \int \int (1 - e) \delta_0 \left[(\varepsilon wl) - [(\varepsilon wl)^{-\delta_1} + \delta_2]^{-\frac{1}{\delta_1}} \right] J(da, dl, d\varepsilon). \quad (2.26)
 \end{aligned}$$

It is important to note that, although the equation above does not explicitly depend

on the audit probability (p) or the penalty rate (\mathcal{T}), the evasion choice (e) is itself a function of these parameters. In other words, p and \mathcal{T} do not enter the aggregate expression for tax revenues directly, but they shape household behavior through the first-order condition for evasion. Higher values of p or \mathcal{T} increase the expected cost of underreporting and therefore reduce the optimal level of e , which in turn raises effective tax compliance. Consequently, the position and shape of the Laffer curve are indirectly but significantly influenced by probability and penalty parameters.

According to Laffer (2004), a tax change impacts the labor income Laffer curve through two distinct mechanisms: one directly influences tax revenue, while the other has an indirect effect. These mechanisms are referred to as the arithmetic effect and the economic effect, respectively. I expand this analysis by introducing a third mechanism: the impact of tax evasion on labor income tax collection. Consider an increase in labor income tax rates. According to Laffer, higher labor income tax rates directly increase government revenue, a relationship he attributes to the arithmetic effect. This effect can be analyzed by evaluating how changes in tax rates influence tax revenue, keeping all other variables constant. In the context of the benchmark model, this corresponds to adjusting the policy parameter δ_0 in expression (2.26) while holding the other terms fixed¹¹.

The second mechanism, the economic effect, captures the indirect impact of higher tax rates on government revenue through changes in household labor supply decisions. Laffer suggests that a higher labor income tax rate reduces the net return on labor, leading to an endogenous decrease in l ¹². Assuming the substitution effect dominates the income effect, this results in a reduction in labor income tax revenue¹³.

Finally, beyond the arithmetic and economic effects traditionally emphasized in the literature, this thesis identifies and quantifies an additional impact on the Laffer curve through changes in households' optimal tax evasion decision, e , within $LC(a, l, \varepsilon; w, r)$. Within the household problem, higher labor income tax rates increase the relative gains from concealment, leading households to optimally allocate more income to evasion, as characterized in expressions

¹¹ It is important to note that, unlike a flat tax rate policy, where the relationship between tax rate changes and tax collection is relatively straightforward, my model incorporates a more complex tax structure defined by δ_0 , δ_1 , and δ_2 . These parameters introduce varying degrees of progressivity in the tax policy, creating different levels of tax burden distortion across the economy.

¹² Laffer argued that the interaction of these two effects gives rise to an inverted U-shaped curve. To the left of its peak, increases in the tax rate lead to higher tax revenue for the fiscal authority. However, beyond this maximum point, further increases in the tax rate result in lower tax revenue due to a reduction in agents' labor supply.

¹³ This effect is also referred to in the macroeconomic literature as the tax wedge. It captures the inefficiency introduced in the labor market when a tax is levied, creating a discrepancy between pre-tax and post-tax wage rates and distorting optimal labor supply decisions Hall (1997).

(2.8) – (2.11). This mechanism directly reduces effective tax revenues collected by the fiscal authority and shifts the Laffer curve leftward compared to models without evasion. Highlighting this mechanism (evasion effect) constitutes a key contribution of this thesis, as it shows that revenue-maximizing tax rates are lower once evasion is taken into account, and that the incidence of this adjustment is unevenly distributed across the income distribution.

In the next section, I quantitatively assess the contribution of these three impacts of a tax change on government labor income tax collection. To do so, I calibrate and numerically solve the benchmark model, deriving the Laffer curve both with and without tax evasion. This approach enables me to isolate the first two effects proposed by Laffer from the additional impact of tax evasion on the Laffer curve, allowing for a clearer assessment of each factor's role.

Let $TG(a, l, \varepsilon; w, r)$ represent the difference between the fiscal authority's total labor income tax collection with and without tax evasion. It follows that:

$$TG(a, l, \varepsilon; w, r) = LC(a, l, \varepsilon; w, r)^{NE} - LC(a, l, \varepsilon; w, r), \quad (2.27)$$

where

$$LC(a, l, \varepsilon; w, r)^{NE} = \int \int \int \delta_0 \left[(\varepsilon w l) - \left[(\varepsilon w l)^{-\delta_1} + \delta_2 \right]^{-\frac{1}{\delta_1}} \right] J(da, dl, d\varepsilon), \quad (2.28)$$

is the government's labor income tax collection with no evasion (NE). From the two previous expressions, it can be observed that in an economy with a zero labor income tax rate, households would retain all income derived from their labor, leading to zero government tax revenue from labor income. Conversely, in an economy where 100% of labor income is taxed by the government, agents would have no incentive to work, resulting in zero government tax revenue. Laffer argued that, because the curve relating the labor income tax rate to tax revenue is continuous and differentiable, Rolle's Theorem guarantees the existence of a tax rate that maximizes labor income tax revenue.

A key feature of the benchmark model is that changes in labor income tax rates influence the fiscal authority's tax revenue differently across the wealth and productivity distributions. This occurs because both labor supply (l) and the evasion decision (e) are functions of household state variables (a, ε), where a denotes assets and ε the idiosyncratic productivity shock. As shown in the first-order conditions, wealthier and more productive households face stronger incentives to evade, while lower-income households contribute little to total revenue due to their limited taxable base. These heterogeneous responses are then aggregated in expression (2.26), which makes clear that the shape of the Laffer curve is determined not only by average behavior,

but by the distribution of labor supply and evasion across the population. This framework enables me to assess how variations in labor income taxation shape the labor income Laffer curve for different cohorts of agents. The labor income Laffer curve for each labor income decile D_i is defined as:

$$LC_{D_i}(a, l, \varepsilon; w, r) = \int_a \int_l \int_{\varepsilon w l \in D_i(\varepsilon w l)} (1 - e) \delta_0 \left[(\varepsilon w l) - \left((\varepsilon w l)^{-\delta_1} + \delta_2 \right)^{-\frac{1}{\delta_1}} \right] J(da, dl, d\varepsilon); \quad (2.29)$$

for $i = 1, \dots, 10$. Additionally, to evaluate the distribution of tax evasion among households, we quantitatively derive the distribution of tax evasion across quartiles of the labor income distribution, Q_j , as follows:

$$TG_{Q_j}(a, l, \varepsilon; w, r) = \int_a \int_l \int_{\varepsilon w l \in Q_j(\varepsilon w l)} \delta_0 \left[(\varepsilon w l) - \left((\varepsilon w l)^{-\delta_1} + \delta_2 \right)^{-\frac{1}{\delta_1}} \right] J(da, dl, d\varepsilon) \\ - \int_a \int_l \int_{\varepsilon w l \in Q_j(\varepsilon w l)} (1 - e) \delta_0 \left[(\varepsilon w l) - \left((\varepsilon w l)^{-\delta_1} + \delta_2 \right)^{-\frac{1}{\delta_1}} \right] J(da, dl, d\varepsilon); \quad (2.30)$$

where $j = 1, \dots, 4$.

2.4 Quantitative Analysis

In this section I present the quantitative implications of my model. To do this, I calibrate our benchmark model to match key characteristics of the Brazilian economy in 2019. Next, to examine the impact of the labor income tax rate on tax collection, we simulate the empirical Laffer curve for the Brazilian economy (equation 2.26). Additionally, I derive the labor income Laffer curves for each decile of the labor income distribution (equation 2.29) and compare them to the aggregate curve to determine their relative positions¹⁴. I then derive the Laffer curve under the assumption that the tax authority has the ability to completely eliminate tax evasion (equation 2.28). Subsequently, I compare these two numerical Laffer curves to calculate the cost of tax evasion for Brazil (equation 2.27)¹⁵. This procedure is repeated for each quartile of the labor income distribution, as outlined in equation 2.30.

¹⁴ The concept of relative position refers to the following: according to Laffer: At a given labor income tax rate, an economy may be at the peak of the curve or on either the upward-sloping or downward-sloping segment of the aggregate Laffer curve. I analyze whether the aggregate Laffer curve and those for labor income deciles align on the same segment, evaluating whether households across different deciles exhibit similar responses to changes in the tax rate and their corresponding impact on tax collection.

¹⁵ This amount is commonly referred to in the literature as the tax gap. It is calculated as the difference between the taxes owed by agents and the amount of taxes not voluntarily paid (Slemrod (2007) and Alstadsaeter *et al.* (2019)). Since the concepts of tax gap and tax evasion are closely related in the model, I use the terms interchangeably.

I employ the endogenous grid method (Carroll (2006), and Barillas and Fernández-Villaverde (2007)) to numerically implement the model, both with and without tax evasion. The basic premise of this method is straightforward: starting with an initial guess for the interest rate, I solve the system of nonlinear equations, expressions (2.8) – (2.13), that characterize the model’s equilibrium. The optimal values of the control variables are obtained from the Cartesian product of the discretized state variables. This numerical procedure is performed for each combination of state variables. At every iteration, the household’s budget constraint is verified, and in the case of models with tax evasion, it is also ensured that the omitted value of labor income lies within the range of acceptable values. This process is repeated until the equilibrium becomes stationary.

The main challenge in the numerical implementation of the benchmark model lies in simultaneously managing three distinct convergence procedures. First, optimal policy convergence is achieved by comparing norms at the end of each numerical iteration. Second, solving the system of nonlinear equations relies on a carefully selected set of initial guesses to accelerate the convergence process. Otherwise, the numerical solution becomes significantly slower. Finally, ensuring the stationary solution requires balancing the interest rate with the supply and demand for capital in the economy.

2.4.1 Model Calibration and Parameter Selection

The model is calibrated to annual frequency, with parameters related to the borrowing constraint (Ω), disutility of work (χ), and tax evasion multiplier (η) defined to be consistent with target moments describing the Brazilian economy. These moments include total credit as a percentage of GDP, labor force participation, and total tax collection as a percentage of GDP. The calibrated values of the model parameters are summarized in Table I and each of these parameters is discussed in turn below¹⁶.

According to the Brazilian Central Bank (BCB), the household credit-to-GDP ratio in Brazil is 27.31%¹⁷. To replicate this ratio in the model, I calibrated the household borrowing constraint so that the aggregate stock of household debt corresponds to the observed share of GDP. This procedure yields a borrowing limit of 0.1881 relative to steady-state income, ensuring consistency between the model’s implied debt levels and the empirical credit-to-GDP ratio.

¹⁶ The calibrated parameters of the model are presented in the Benchmark Model column of Table I.

¹⁷ Relatório de Economia Bancária - calendar year 2019, from the BCB.

The parameter related to the disutility of work (χ) is calibrated taking into account $L = 1/3$. Accordingly, I set χ to 56.41. Finally, based on data from the Brazilian tax authority, the tax evasion multiplier (η) is defined to align the model with total tax collection as a percentage of GDP, reported as 2.64%. I set η to 0.185 in the benchmark model¹⁸.

To calibrate the parameters related to the Brazilian tax policy, specifically those associated with the labor income tax function (δ_0 , δ_1 , and δ_2), I use public data released by the Brazilian Federal Revenue Service (RFB). The parameter δ_0 is set to match Brazil's current maximum marginal individual tax rate, which is 27.5%. Parameters δ_1 and δ_2 are jointly calibrated to ensure that the ratio of individual income tax to declared taxable income equals 0.1018. Consistent with the Brazilian tax code, the numerical model and parameter values reflect the requirement that only households earning more than R\$ 28,559.70 in labor income are obligated to file tax returns. The cost of the audit policy is normalized to $\mathcal{C} = 1$, and the discount factor (β) is set to 0.9673 to align with Brazil's capital-to-output ratio for 2019. Additionally, the capital depreciation rate (δ) is calibrated to match the ratio of aggregate investment to GDP ($I/Y = 17.15\%$) in Brazil, as reported by the Penn World Table (PWT).

I also calibrate the relative degree of risk aversion (γ) and the Frisch elasticity of labor supply (ϕ) based on information that is exogenous to the model and consistent with empirical studies in the literature, particularly those focusing on the Brazilian economy Castro *et al.* (2011). To obtain the capital share (α), I use the relationship $\alpha = (r + \delta)K/Y$. The consumption tax rate (τ_t^c) is also exogenously calibrated. I use the effective tax rates for Brazil, as calculated by Almeida *et al.* (2017), and set the consumption tax rate in the model to $\tau_t^c = 21.75\%$. To match 0.53% of total tax on capital investments as a percentage of GDP, the calibrated value of the tax rate on capital gains is $\tau_t^a = 9.28\%$. Finally, the elasticity parameter ι is fixed at 2.0, ensuring that utility remains a convex function of tax evasion.

I set $\mu = 0$ and normalize the mean of the household productivity shock to $\mu_v = 0$. Following Conesa *et al.* (2009), I assume a persistence term for the productivity shock of 0.98. The labor income process is then discretized. The parameters ρ and σ_v are derived for seven different realizations of the productivity shock, using a scale parameter of 3. This calibration ensures that the numerical distribution of income is consistent with Brazil's Gini index of 0.544 (Antunes and Cavalcanti (2013)).

The fine imposed by the government on tax evasion is set at 150% of the amount of

¹⁸ Grandes Números do IRPF 2020 - calendar year 2019, from the RFB.

Table I – Model Parameters

Parameters	Benchmark Model	Target	Source
Preferences			
β : Intertemporal Discount	0.96730	$K/Y = 2.43$	IPEA
Ω : Borrowing Constraint	0.18805	$Cred/Y = 27,31\%$	BCB and IBGE
γ : Risk Aversion	1.3	-	Castro <i>et al.</i> (2011)
ϕ : Frisch elasticity	1.0	-	Castro <i>et al.</i> (2011)
χ : Multiplier	56.4064	$L = 1/3$	Conesa <i>et al.</i> (2009)
η : Multiplier	0.185	$IT^l/Y = 2.64\%$	RFB and IBGE
ι : Elasticity of tax evasion	2.0	Fixed	-
Technology			
α : Capital Share	0.2231	$r = 2.12\%$	BCB and IBGE
δ : Capital Depreciation	0.0706	$I/Y = 0.1715$	PWT 10.0
Productivity			
ρ_ε : Shock Persistency	0.98	-	Conesa <i>et al.</i> (2009)
σ_v^2 : Variance of Shocks	0.0451	$Gini = 0.544$	IBGE
r_ε : Scale Factor	3.0	-	Tauchen (1986)
Tax Policy			
δ_0 : Maximum marginal tax rate	0.275	-	RFB
δ_1 : Progressivity parameter	0.52	$IT^l/Income = 10.18\%$	RFB
δ_2 : Scale parameter	0.27	$IT^l/Income = 10.18\%$	RFB
τ_r^a : Capital Income Tax Rate	0.0928	$IT^a/Y = 0.53\%$	RFB and IBGE
τ_r^c : Consumption Tax Rate	0.2175	-	Almeida <i>et al.</i> (2017)
\mathcal{T} : Tax Penalty	1.5	-	RFB
p : Audit Rate	0.0274	-	RFB

Notes: BCB - Banco Central do Brasil - Brazilian Central Bank.

IBGE - Instituto Brasileiro de Geografia e Estatística - Brazilian Institute of Geography and Statistics.

IPEA - Instituto de Pesquisa Econômica Aplicada - Institute of Applied Economic Research.

RFB - Secretaria Especial da Receita Federal do Brasil - Brazilian Federal Revenue Service.

Source: Author.

unpaid taxes¹⁹. Accordingly, I calibrate the fine parameter to $\mathcal{T} = 1.50$ ²⁰. For the probability of being audited, various alternatives have been proposed in the literature²¹. In this study, I adopt the ratio of the total number of audited taxpayers to the total number of taxpayers in the economy. According to the Brazilian Federal Revenue Service (RFB), in 2020 approximately 2.74% of filed tax returns were retained for further inspection and enforcement. Consequently, I set the tax audit rate in the model to $p = 2.74\%$.

Table II presents the key target statistics for the Brazilian economy alongside the corresponding outcomes from my calibrated benchmark model in stationary equilibrium. The results indicate that the model matches the Brazilian economy fairly well in several dimensions. In particular, it accurately replicates the Brazilian consumption, investment and government

¹⁹ This value is based on the standard *ex-officio* fine of 75%, as provided in Law 9,430/96, which increases by 100% in cases involving tax evasion, fraud, or collusion, as defined in Law 4,502/64.

²⁰ This value is also consistent with the literature on tax evasion. See Fullerton and Karayannis (1994) and references therein.

²¹ See Chu *et al.* (2021), Hori *et al.* (2023), and references therein for more details.

expenditures to GDP ratios. Moreover, the calibrated model is consistent with the proportion of the economically active population that declares income tax, as well as with the observed Brazilian income distribution.

Table II – Key Statistics: Data and Benchmark Economy.

Variables	Benchmark Model	Brazilian Economy	Source
Consumption over GDP (C/Y)	65.33%	64.99%	
Investment over GDP (I/Y)	17.07%	17.15%	PWT 10.0
Government Expenditures over GDP (G/Y)	17.60%	18.35%	
Consumption Tax over GDP (CT/Y)	14.21%	14.25%	STN ⁱ
% EEAP that declares tax income ⁱⁱ	31.22%	32.26%	RFB ⁱⁱⁱ
Taxable Labor Income over GDP ($Income/Y$)	26.1%	25.9%	RFB ⁱⁱⁱ
Income Distribution			
Decile 1	0.9%	0.8%	
Decile 2	1.9%	2.1%	
Decile 3	2.5%	3.1%	
Decile 4	3.9%	4.2%	
Decile 5	5.2%	5.4%	IBGE ^{iv}
Decile 6	6.1%	6.8%	
Decile 7	9.1%	8.3%	
Decile 8	12.5%	10.9%	
Decile 9	17.4%	15.6%	
Decile 10	40.3%	42.8%	

Notes: ⁱ Brazilian Federal Treasury in https://sisweb.tesouro.gov.br/apex/f?p=2501:9:::9:P9_ID_PUBLICACAO:32076

ⁱⁱ The percentage of the employed economically active population that declares income tax.

ⁱⁱⁱ RFB and PNAD (National Household Survey) from the IBGE

^{iv} PNAD (National Household Survey) from the IBGE

Source: Author.

2.4.2 Results

In this section I present the main results. I begin by analyzing the outcomes of the benchmark model, computing the numerical labor income Laffer curve for the Brazilian economy. Additionally, I construct the labor income Laffer curve for each labor income decile and decompose it into three main components: the arithmetic effect, the economic effect, as proposed by Laffer, and the tax evasion effect. Finally, I simulate aggregate labor income tax evasion in Brazil and examine the tax gap across labor income quartiles, quantifying its composition and impact on the overall tax gap.

Laffer Curves. Figures 1, 2, 3 and 4 summarize the main findings on the empirical labor income Laffer curve for Brazil. Figure 1 presents the aggregate labor income Laffer curve. Figure 2 shows the aggregate components. Figure 3 presents the components across the top three deciles of the labor income distribution. Figure 4, in turn, illustrates the Laffer curve across all

labor income deciles, with a specific focus on the top three deciles.

First, consider Figure 1, which presents the numerical labor income Laffer curve. It illustrates the relationship between the labor income tax rate and the labor market tax revenue collected by the tax authority, representing the numerical counterpart of expression (2.26). It is worth noting that the curve's shape is very similar to those derived by Trabandt and Uhlig (2011) for Europe and the United States, and by Alba and McKnight (2023) for the formal labor market segment of the Brazilian economy. Consistent with these studies, the Laffer curve has an inverted U-shape. Moreover, Brazil's current labor income tax rate lies to the right and close to the peak of the Laffer curve, indicating that a reduction in the labor income tax rate would lead to higher government tax revenue.

According to Figure 1, the Brazilian labor income Laffer curve is skewed to the right, with its peak occurring at a maximum marginal tax rate of 25.33%. Comparing this rate to the maximum marginal labor income tax rate of 27.5% observed in the Brazilian economy in 2019, I find that a reduction of nearly 8% in the current maximum marginal tax rate would be necessary to reach the peak of the curve in the benchmark model. Finally, the Laffer curve exhibits two distinct behaviors. To the left of the peak, it has a parabolic shape. Beyond the peak, however, the curve descends with varying slopes, displaying some irregularity in its trajectory.

Now, consider Figure 2. Laffer argued that a change in the tax rate induces two opposing effects on aggregate tax collection, referred to as the arithmetic and economic effects Laffer (2004). The arithmetic effect occurs when an increase in the tax rate directly raises tax revenues. In contrast, the economic effect arises as higher tax rates increase the wedge between labor productivity and wage rates, leading to a reduction in labor supply, and consequently a decrease in tax collection by the fiscal authority. Since these two effects act in opposite directions, the net impact on tax revenue depends on which effect dominates. To these effects, I incorporate the evasion effect²², which further reduces the fiscal authority's labor income tax collection.

To better understand the impacts of a change on the tax rate on the labor income tax collection, consider an increase in the labor income tax rate from the initial value of a zero tax rate on the upward slope of the Laffer curve. As the marginal rate increases, the arithmetic effect dominates the aggregate tax collection. Thus, the higher the tax rate, the bigger the fiscal authority's tax revenues. However, as the labor income tax rate continues to rise, the evasion effect becomes increasingly significant, while the economic effect remains relatively constant.

²² The arithmetic, economic, and evasion effects are on a logarithmic scale in Figure 2.

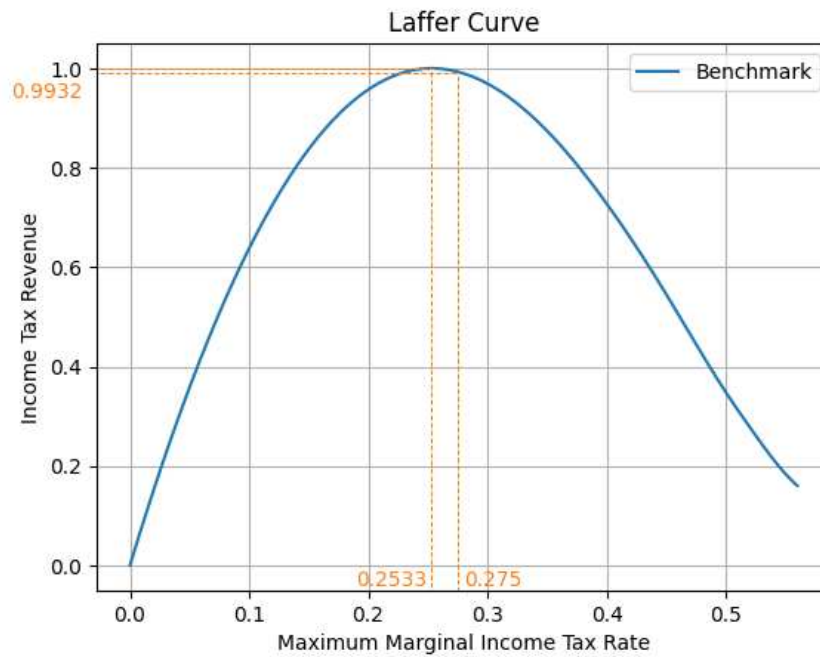


Figure 1 – Extended Laffer Curve - Benchmark Model

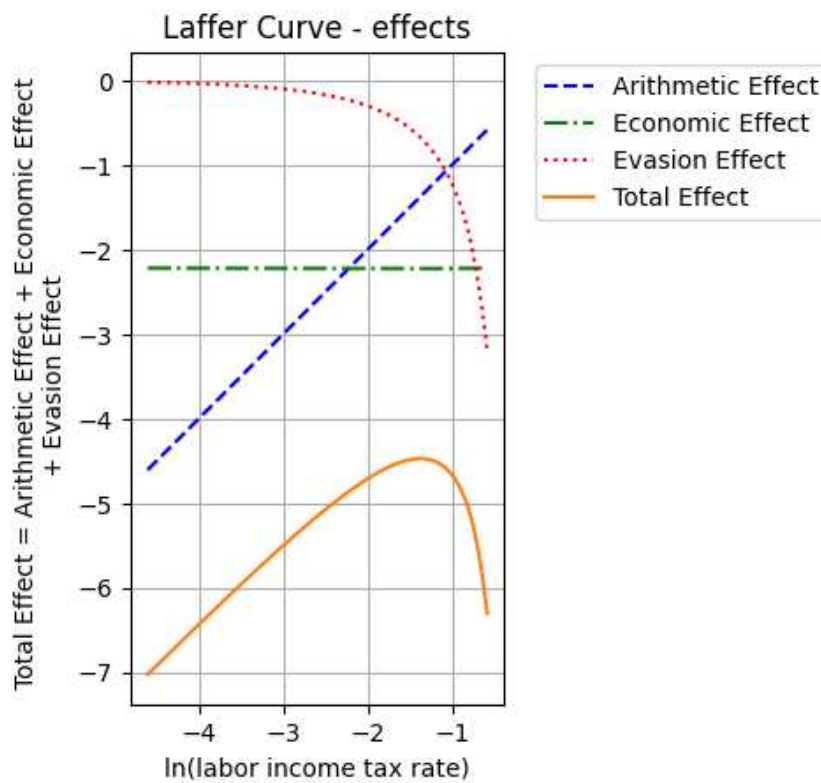


Figure 2 – Laffer Curve Components

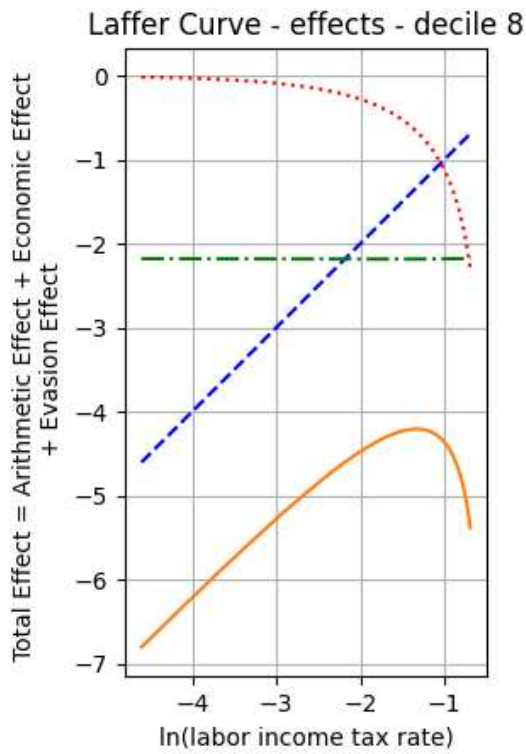
This dynamic persists until the point of maximum tax revenue is reached, corresponding to the peak of the Laffer curve. Beyond this point, the economy transitions to the downward slope of the curve, where the evasion effect dominates, leading to a reduction in aggregate tax collection as the tax rate increases further. Regarding the role of tax evasion, higher labor income tax rates amplify the relative benefits of evasion under the fiscal authority's monitoring policy. Consequently, tax evasion becomes a monotonically increasing function of the labor income tax rate, further reducing government tax revenues.

Figure 3 illustrates the components of the Laffer curve for deciles 8, 9, and 10. Note that the mechanism remains the same: as the tax rate increases, the arithmetic effect initially dominates, until the omission effect becomes the prevailing factor, while the economic effect remains nearly constant. The key difference lies in the magnitude of the economic effect, which varies across income deciles, increasing progressively from decile 8 to decile 10. This variation results in a higher peak of the Laffer curve at higher income levels. The contribution of each decile of the labor income distribution to total individual labor income tax revenue depends on the tax rate. On average, decile 10 accounts for just over 65%, followed by decile 9 with 20.5%, and decile 8 with slightly under 13%.

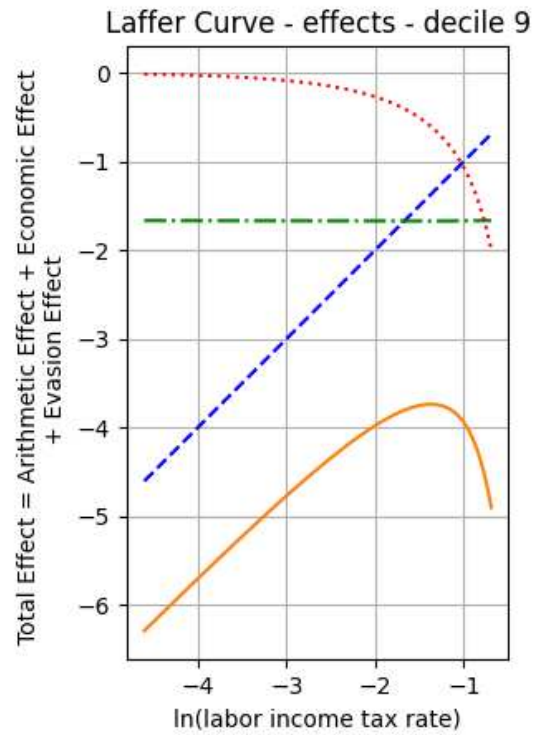
Now, consider Figure 4. Figure 4.a depicts the benchmark Laffer curve by decile of the taxable labor income distribution, alongside the average curve. Figure 4.b focuses on the Laffer curves for deciles 8, 9 and 10. Initially, the economy's average labor income Laffer curve lies below the maximum of the top three deciles. The remaining labor income deciles all fall below the peak of the average curve for the Brazilian economy²³. As a result, a given labor income tax rate corresponds to different levels of tax collection for agents in different labor income deciles. Secondly, the maximum point of each curve is not the same as the average one. Therefore, while for a group of agents, the current tax rate is to the left of the maximum, for others it is located to the right, on the downward slope of the Laffer curve. Finally, the shape of the curves also varies across deciles. For some, the curve is right-skewed and asymmetric, while for others, it exhibits a different pattern.

Tax Gap. I now compare the solutions of my numerical model, with and without tax evasion, to assess the impact of tax evasion on total tax collection in Brazil, both in aggregate terms and across subgroups of taxable labor income. Specifically, I simulate expressions (2.27) and (2.30) to obtain a numerical estimate of the income tax gap in Brazil.

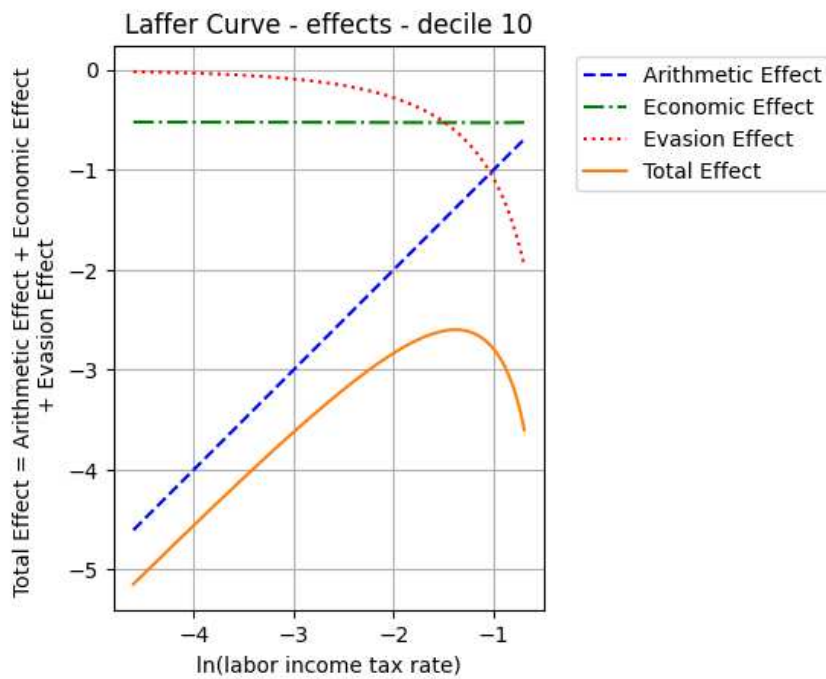
²³ The first six deciles do not have a Laffer curve, as their taxable labor income in 2019 was below R\$ 28,559.70, the minimum threshold for income taxation.



(a) Laffer Curve Components - decile 8



(b) Laffer Curve Components - decile 9



(c) Laffer Curve Components - decile 10

Figure 3 – Laffer Curve Components - Deciles 8, 9 and 10

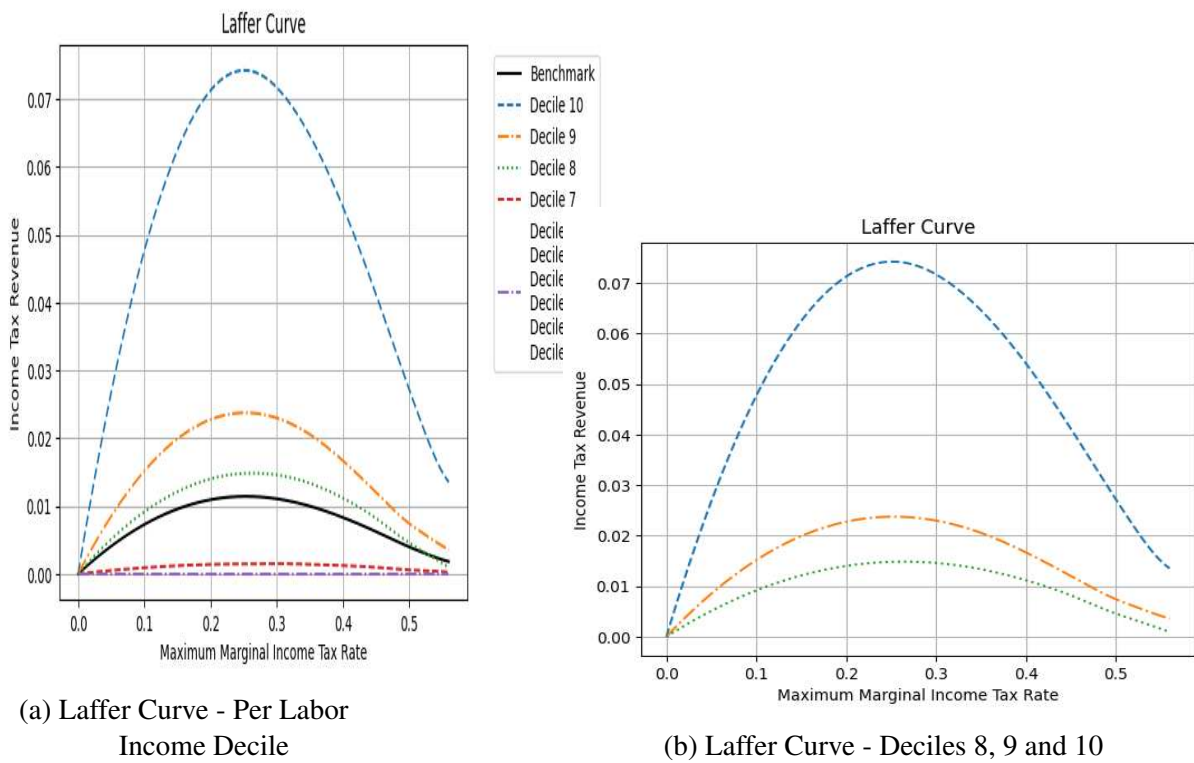


Figure 4 – Laffer Curve - Per Labor Income Decile

Estimating tax evasion poses significant challenges, primarily because individuals who engage in such practices have strong incentives to omit reporting and conceal their actions to avoid penalties, including criminal charges. Another challenge lies in the variability of tax evasion estimates, which depend heavily on the assumptions, methodologies and the weight given to the informal economy.

Initially, using aggregate data, I identify a significant tax gap in the Brazilian economy. According to the model, there is an average discrepancy of 54.08% between the labor income taxes owed and the amount actually paid by households. This gap represents 3.11% of Brazilian GDP. This finding is consistent with the literature on the tax gap in Brazil. For example, Siqueira (2004) extended the framework of Allingham and Sandmo (1972) to analyze the impact of tax evasion under two policies implemented by the RFB: strengthening the punishment system and improving audit efficiency. Household decisions regarding personal income tax evasion were assessed using audit data from 1998, though the analysis excluded any consideration of the informal economy²⁴. The findings also reveal significant variation in tax evasion across

²⁴ Accurately estimating tax evasion requires consideration of the informal economy. The Brazilian Institute of Geography and Statistics (IBGE) employs various surveys and methods, such as the PNAD, to calculate GDP and partially capture the informal economy. For example, in 2019, Brazil's informal labor market was estimated to account for 41.1% of total employment. In my model, tax evasion is driven by the calibration of the parameter η , using the declared income tax-to-GDP ratio as a target. Consequently, since GDP includes more of the informal economy, IT^l/Y decreases, leading to higher tax evasion.

Table III – Tax Evasion Distribution

Quartile	Tax Evasion per Quartile (%)	Total Tax Evasion (%)
1	0.00	0.00 (0.00%)
2	0.00	0.00 (0.00%)
3	51.74	3.65 (6.76%)
4	54.26	50.43 (93.24%)
Total		54.08 (100.00%)

Source: Author.

geographic regions, ranging from 12.47% to 33.26%, as well as by professional category, ranging from 12.53% to 33.90%. These results align with other studies, which estimate labor tax evasion rates varying from 20% to 69.9%. Additionally, a separate study estimates personal income tax evasion in several countries across Latin America and the Caribbean, with evasion rates ranging from 18.7% to 69.9%²⁵.

Table III presents the results for the quartiles of the labor income distribution in Brazil. This table highlights the effect of household heterogeneity on tax compliance. Notably, the first two quartiles report zero omission of labor income taxes²⁶. For quartiles 3 and 4, the omission rates are 51.74% and 54.26%, respectively, contributing 6.76% and 93.24% to Brazil's total tax gap. Although the tax evasion rates are similar in these two quartiles, the aggregate value of evasion is significantly higher in the fourth quartile. This finding jibes with the academic literature, which emphasizes the importance of targeting tax evasion among the wealthiest individuals to increase tax revenue (Alstadsaeter *et al.* (2023)).

Table IV presents a numerical exercise that examines tax evasion across quartiles of the labor income distribution when varying the probability of an agent being monitored and the punishment parameter. Starting from my benchmark setup with $p = 2.74\%$ and $\mathcal{F} = 1.5$, these parameters are adjusted by $\pm 20\%$. As expected, increasing the probability of monitoring reduces tax evasion, while decreasing it results in higher evasion. The same effect is observed with changes to the punishment parameter. However, tax evasion is more sensitive to changes in the probability of monitoring than to adjustments in the penalty. Specifically, a 20% increase in probability and penalty reduces tax evasion by 1.28% and 0.76%, respectively, while a 20% decrease results in increase in tax evasion of 1.26% and 0.78%. When analyzing tax evasion by quartile, quartile 3 is more responsive to changes in both probability and penalty than quartile

²⁵ See Bárcena *et al.* (2020) for personal income tax evasion estimates in various Latin American and Caribbean countries. Unfortunately, data for Brazil are not available.

²⁶ This result is primarily due to the fact that their taxable labor income did not exceed R\$ 28,559.70 in 2019, the minimum threshold required by law to pay income taxes in Brazil.

Table IV – Tax Evasion Distribution per Probability and Penalty

Probability = 3.29% (+20%) and Penalty = 1.5		
Quartile	Tax Evasion (%)	Total Tax Evasion (%)
Quartile 1	0.00%	0.00%
Quartile 2	0.00%	0.00%
Quartile 3	51.03 (-1.37%)	3.60 (-1.37%)
Quartile 4	53.57 (-1.27%)	49.79 (-1.27%)
Total		53.39 (-1.28%)
Probability = 2.19% (-20%) and Penalty = 1.5		
Quartile 1	0.00%	0.00%
Quartile 2	0.00%	0.00%
Quartile 3	52.42 (+1.31%)	3.72 (+1.91%)
Quartile 4	54.95 (+1.27%)	51.04 (+1.21%)
Total		54.76 (+1.26%)
Probability = 2.74% and Penalty = 1.8 (+20%)		
Quartile 1	0.00%	0.00%
Quartile 2	0.00%	0.00%
Quartile 3	51.31 (-0.83%)	3.63 (-0.55%)
Quartile 4	53.85 (-0.76%)	50.04 (-0.77%)
Total		53.67 (-0.76%)
Probability = 2.74% and Penalty = 1.2 (-20%)		
Quartile 1	0.00%	0.00%
Quartile 2	0.00%	0.00%
Quartile 3	52.15 (+0.79%)	3.69 (+1.10%)
Quartile 4	54.68 (+0.77%)	50.81 (+0.75%)
Total		54.50 (+0.78%)

Source: Author.

4. These results highlight that tax evasion is systematically shaped by enforcement parameters. Although the Laffer curve is presented in terms of aggregate evasion e , it should be interpreted as indirectly depending on both the monitoring probability p and the penalty parameter \mathcal{T} . In other words, changes in p and \mathcal{T} alter households' optimal evasion behavior, which in turn shifts the effective position and shape of the Laffer curve.

Sensitivity Analysis. I now assess the sensitivity of the results to the parameter values used in the benchmark model. Specifically, I examine whether the model's predictions change when an alternative calibrated value of the elasticity ι is used. As noted in the calibration section, the value of ι was chosen to ensure that utility remains a convex function of tax evasion²⁷. Since there is no reference to this utility function or its associated elasticity in the literature, I perform a test to verify the consistency of the calibrated value of ι . In the sensitivity analysis, I use two alternative values of ι , 2.1 and 1.9, which are close to the initial calibrated value of

²⁷ ι measures the sensitivity of tax evasion to changes in the tax rate. A higher value of ι indicates that tax evasion responds more strongly to variations in tax rates.

2.0. The other parameter values in the model are adjusted to ensure it continues to align with the same targets for the Brazilian economy, as listed in Table I.

Table V presents the predictions of the baseline model ($\iota = 2.0$) alongside those of the two recalibrated models ($\iota = 1.9$ and $\iota = 2.1$). The recalibrated models remain consistent with the main targets of the Brazilian economy. Notably, the percentage of the employed economically active population declaring income tax, the tax gap, and the income distribution are unaffected by variations in the calibrated elasticity ι .

Table V – Elasticity ι : Sensitivity Test

Variables	$\iota = 2.1$	$\iota = 2.0$	$\iota = 1.9$
Consumption over GDP (C/Y)	65.34%	65.33%	65.33%
Investment over GDP (I/Y)	17.06%	17.07%	17.07%
Government Expenditures over GDP (G/Y)	17.60%	17.60%	17.60%
Consumption Tax over GDP (CT/Y)	14.21%	14.21%	14.21%
% EEAP that declares tax income	31.22%	31.22%	31.24%
Tax Gap	54.08%	54.08%	54.08%
Income Distribution			
Decile 1	0.9%	0.9%	0.9%
Decile 2	1.9%	1.9%	1.9%
Decile 3	2.5%	2.5%	2.5%
Decile 4	3.9%	3.9%	3.9%
Decile 5	5.2%	5.2%	5.2%
Decile 6	6.1%	6.1%	6.1%
Decile 7	9.1%	9.1%	9.1%
Decile 8	12.5%	12.5%	12.5%
Decile 9	17.4%	17.4%	17.4%
Decile 10	40.3%	40.3%	40.3%

Source: Author.

2.5 Discussion

In this chapter, I develop an incomplete market benchmark model to quantitatively evaluate the impacts of tax evasion and labor income distribution on the shape of the numerical labor income Laffer curve and the size of the tax gap in Brazil. Alongside the traditional arithmetic and economic effects, I introduce an omission effect to capture the dynamics of the Laffer curve in the presence of tax evasion. The findings show that household heterogeneity is a critical factor for accurately quantifying both the aggregate magnitude and the distribution of tax evasion across labor income groups. According to Brazil's current tax code, some agents are situated on the downward slope of the Laffer curve, while others remain on its upward slope. I

also quantify the cost of labor income tax evasion in a large economy characterized by imperfect tax collection.

This study highlights a substantial tax gap in Brazil's economy, underscoring the need for targeted policy measures. For example, reforms could involve adjustments in the progressivity of the labor income tax, the redesign of tax brackets to reduce opportunities for concealment at higher income levels, or the implementation of differentiated enforcement strategies aimed at groups with greater evasion potential. High evasion rates among wealthier income quartiles suggest that increasing audit frequency and enforcing stricter penalties could help reduce this gap, enhancing revenue and fostering a fairer tax burden. Furthermore, the results emphasize the importance of reassessing the progressivity of Brazil's tax system. The current structure disproportionately impacts income groups, leaving room for reforms that could strengthen progressivity and address inequality more effectively. By implementing tailored fiscal policies, Brazil could reduce the tax gap while simultaneously improving revenue generation and equity outcomes.

These findings highlight the potential for strategic reforms to Brazil's tax structure and enforcement mechanisms. Tailored policies targeting high-income groups with high tax evasion rates could not only improve compliance but also promote a more equitable distribution of the tax burden, contributing to a fairer and more efficient tax system.

3 THE INFLUENCE OF THE PROVISION OF PUBLIC GOODS AND SERVICES ON TAX EVASION

This chapter is structured into five sections. Section 3.1 introduces the research question, showing the potential relationship between regional disparities in provision of public goods and services and labor income tax evasion. It also presents the main motivations behind the study and summarizes the chapter's contributions to the literature on tax compliance and spatial economics.

Section 3.2 develops the theoretical model. It extends the benchmark framework presented in Chapter 2 by incorporating a spatial dimension, allowing for differences in public goods and services provision and housing costs across two regions. In this setting, heterogeneous households choose not only how much to consume, save, work, and evade, but also where to reside. The model includes key features such as a CES aggregator between private and public consumption, location decisions based on indirect utility, and region-specific housing prices.

Section 3.3 presents the calibration strategy and discusses the quantitative results. The model is calibrated using macroeconomic and microdata for Fortaleza, Brazil. Three distinct policy dimensions are simulated: (i) increasing the share of public expenditure allocated to local public goods (Λ), (ii) shifting preferences toward public consumption (Φ), and (iii) modifying the spatial distribution of public services across regions (g^2/g^1). The section evaluates how these changes affect tax evasion, housing prices, GDP, consumption, and government revenue.

In Section 3.4, I summarize the main findings and offer insights into their implications for public policy. The results show that increasing the availability or relative weight of public goods reduces tax evasion, but with potentially adverse effects on GDP and total tax revenue. The findings suggest that improving public goods and services has a limited effect on compliance. I also discuss the tradeoffs between redistribution, compliance, and efficiency, and emphasize the importance of incorporating spatial heterogeneity into fiscal policy design.

The chapter contributes to the literature by showing how regionally differentiated public goods and services provision affects tax evasion in a general equilibrium model.

3.1 Motivation and Research Questions

Tax evasion represents a persistent and widespread concern in public finance, posing significant operational and policy challenges for tax administrations worldwide. Reducing government revenues undermines the state's capacity to fund essential public goods and services,

distorts individual and corporate decision-making, and deepens socioeconomic disparities across both income groups and geographic regions.

The economic literature has long tried to understand the factors that prompt individuals to evade taxes. Early theoretical models, such as those developed by Allingham and Sandmo (1972) and Slemrod and Yitzhaki (2002), conceptualized tax compliance as a choice under risk, where taxpayers balance the potential financial benefits of evasion against the likelihood of detection and the severity of penalties. These models emphasize the role of enforcement tools – such as audit probabilities and penalty structures – as key levers available to policymakers. Building on this foundation, subsequent research expanded these frameworks to account for taxpayer heterogeneity, progressive tax codes, audit selection mechanisms, and risk preferences.

In parallel, behavioral economists have paid attention to non-monetary determinants of tax compliance. Concepts such as tax morale, explored extensively by Frey and Torgler (2007) and reviewed by Alm (2012), show how individual attitudes toward taxation, perceptions of fairness, trust in government institutions, and social norms influence compliance decisions, often beyond what would be predicted by classical economic models. This growing body of literature reinforces the understanding that tax evasion is not driven solely by enforcement risk but also by social, psychological, and institutional factors.

Among these non-enforcement aspects, the relationship between the provision of public goods and services and tax compliance is an important but complex research frontier. The central idea is: when taxpayers perceive tangible benefits from the taxes they pay, they may feel more willing to comply. However, empirical and theoretical studies offer mixed evidence on this relationship. Cowell and Gordon (1988), for example, incorporated government expenditure into standard evasion models but assumed uniform access to public goods across taxpayers. Rablen (2010) advanced the literature by introducing reference-dependent preferences, showing that the perceived fairness between taxes paid and public goods received can influence evasion behavior. Similarly, D'Agostino *et al.* (2022) emphasized that both the quantity and quality of public spending shape taxpayer willingness to comply.

Despite these important contributions, a critical limitation remains prevalent in much of the existing research: the assumption of homogeneous access to public goods across all taxpayers. Most tax evasion models, including those of Cowell and Gordon (1988) and Rablen (2010), assume that public goods are uniformly provided, with all households having equal benefit regardless of their geographic location. This simplification, while convenient for

theoretical modeling, can be unrealistic, especially in countries with profound spatial inequalities in infrastructure and service distribution. In nations like Brazil, the geographic distribution of public goods and services is highly unequal. Access to public infrastructure and services can differ dramatically across neighborhoods within the same city. Households in wealthier areas typically have better public infrastructure and services compared to those living in poorer areas. This spatial disparity raises important and underexplored questions about whether and how the local availability of public goods affects individual tax compliance decisions.

In recent years, the study of spatial economics has offered valuable tools and theoretical insights for understanding how geography shapes economic outcomes. Eeckhout *et al.* (2014) introduced a general equilibrium model of spatial sorting and demonstrated how heterogeneous workers choose their residential locations based on local wages, housing costs, and amenities, resulting in self-selection and spatial inequality. Redding and Rossi-Hansberg (2017) summarized advances in spatial economic theory, emphasizing how commuting costs, trade frictions, and agglomeration effects jointly influence the spatial allocation of resources. Following this literature, Fajgelbaum and Gaubert (2020) developed frameworks for optimal spatial policy design, addressing how governments should adjust place-based subsidies and taxes to correct inefficiencies arising from spatial externalities. Bilal and Rossi-Hansberg (2021) viewed locations as assets with future returns driven by productivity and amenity flows, offering a dynamic perspective on urban development. Meanwhile, Diamond and Gaubert (2022) showed how spatial sorting of workers and firms intensifies both wage and welfare inequality across regions.

While these spatial economic models offer an understanding of how geography affects labor markets, firm location, and welfare outcomes, they rarely integrate tax evasion behavior into their frameworks. Likewise, models of tax evasion seldom incorporate spatial heterogeneity in public service provision or the role of housing markets and migration decisions in shaping compliance. This disconnection represents a notable gap at the intersection of public finance and spatial economics.

The present study seeks to fill this gap by developing a spatial general equilibrium model with heterogeneous households where tax evasion decisions are explicitly linked to both the level of local public goods and endogenous location choices. In this model, households decide not only how much to work, consume, save, and evade income taxes, but also where to live within an urban space divided into two distinct regions with different levels of public service

provision and housing costs.

I use the assumption that changes in the distribution of public goods and services in regions do not immediately affect the distribution of households by region. To ensure this stability in distribution, a change in relative prices between regions is necessary. In the two-region case, since it is not possible to vary both prices simultaneously, the price of the region with the most households will be chosen as the reference. This choice is justified by the greater inertia in price variations in regions with a large number of properties.

This model has several important features that, together, distinguish it from previous works:

a) Spatial distribution of public goods: the level of public service provision varies by region, affecting household utility and location choice. This assumption reflects the well-documented heterogeneity of local public service quality in Brazil, which is a central dimension of regional inequality;

b) Housing prices and spatial sorting: housing prices are calibrated to ensure stability in the distribution of households across regions. This assumption is necessary to capture the idea that, in the short run, the regional distribution of households is relatively insensitive to marginal changes in public goods provision, consistent with empirical findings in urban and regional economics;

c) Substitution between private and public consumption: households derive utility from a total consumption basket that combines private goods with locally provided public goods, modeled using a CES aggregator. This formulation captures the complementarity and/or substitutability observed in the literature, where public provision alters the marginal utility of private consumption;

d) Tax evasion as an endogenous choice: households evaluate the expected benefits and costs of evasion, taking into account not only enforcement aspects but also the quantity of local public services. This assumption is grounded in the tax morale literature, which shows that perceptions of reciprocity between taxes paid and services received are critical for compliance, and

e) Location decisions based on indirect utility maximization: households choose their current region, considering differences in public goods, housing costs, and other factors, consistent with frameworks from spatial general equilibrium models. This assumption ensures consistency with standard approaches in urban economics and captures the idea that mobility

decisions respond to relative welfare across regions.

To ensure empirical relevance, I calibrated the model using micro and macroeconomic data from Fortaleza. The city is the fourth largest in Brazil by population and ranks twelfth in terms of GDP, making it both economically significant and demographically representative. At the same time, Fortaleza displays strong socioeconomic heterogeneity across neighborhoods and pronounced disparities in the provision of public goods and services. These features make Fortaleza representative of broader challenges faced by Brazilian urban centers, while at the same time offering sufficient variation in public service provision to study how local inequality interacts with tax evasion decisions. When not available, data from Brazil are used as a proxy. The calibration employs data from 2019, thus avoiding distortions introduced by the COVID-19 pandemic. I apply the endogenous grid method (Carroll (2006) and Barillas and Fernández-Villaverde (2007)) to solve the model numerically, given the complexity arising from household heterogeneity, spatial elements, and nonlinear policy functions.

The empirical strategy focuses on several policy-relevant experiments. First, I examine the impact of increasing the share of government expenditure allocated to public goods provision (Λ) on relative prices (P^2/P^1), tax evasion rates, GDP, aggregate consumption, and overall tax revenues. Second, I explore the effects of altering the balance between private and public consumption (Φ), which can be interpreted as improving public goods quality or shifting consumption preferences. Third, I investigate how changes in the spatial distribution of public goods across regions (g^2/g^1 ratio) affect both regional and aggregate tax compliance.

The main findings reveal that increasing the provision or relative importance of public goods leads to reduced tax evasion, which is in line with the hypothesis that better public goods and services provision increases tax morale and compliance. However, these reductions are quantitatively modest, and have economic tradeoffs, including declines in GDP, private consumption, and total tax revenue. Moreover, altering the geographic distribution of public goods without increasing total provision has limited effects on overall evasion levels and economic variables, though it substantially influences housing prices.

From a policy perspective, the results indicate that relying solely on expanding public goods as a strategy to reduce tax evasion may have limited effectiveness and entail significant costs. This suggests that a more balanced approach, combining stronger enforcement measures, service improvements, and efforts to build institutional trust, may be more promising in achieving compliance gains. Moreover, the model highlights the importance of accounting

for spatial heterogeneity when designing tax and public spending policies, particularly in urban environments characterized by pronounced regional inequalities.

Nonetheless, this study has some limitations. It focuses exclusively on labor income tax evasion and does not consider other forms of noncompliance, such as VAT fraud or capital income evasion. The model also ignores political economy aspects and endogenous changes in tax morale over time. Housing prices are not endogenous, that is, they are not the result of the relationship between supply and demand for properties. Furthermore, the analysis is based on a two-region model and may not capture the full complexity of spatial dynamics in larger metropolitan areas.

In addition to this section, the paper is developed as follows. Section 2 describes the theoretical model, detailing household and firm problems, public sector budgets, and equilibrium conditions. Section 3 describes the calibration strategy, data sources, and computational methods used for numerical solution. Furthermore, it presents the results of some policy simulations, focusing on the effects of changes in Λ , Φ , and g^2/g^1 on tax evasion and economic variables. Finally, Section 4 concludes by summarizing the main findings, discussing policy implications, and proposing future research at the intersection of spatial economics and tax compliance.

3.2 The Model

The economic model evolves in discrete time and consists of an infinite number of agents, a representative firm, financial intermediaries, and a fiscal authority (government) that taxes households. Each agent living in a region $j = \{1, 2, \dots, J\}$ has one unit of time and makes decisions regarding private consumption (c_t), labor (l_t) and savings (a_{t+1}). Agents also make a strategic decision regarding income tax evasion (e_t), as well as their region of residence, which is chosen to maximize their expected utility. Additionally, they also determine housing consumption (H_t^j), which depends on the region j where the household is located.

Households face idiosyncratic productivity shocks and receive public services and goods regionally provided by the government. The financial market is incomplete, so agents rely solely on self-insurance to cope with idiosyncratic income risks. There is only one risk-free asset available, and agents face borrowing constraints. Nevertheless, households and firms have full access to financial markets, supported by a wide array of external financial intermediaries. Households can purchase assets and take out personal loans, while firms borrow to finance investment. Importantly, there is no aggregate uncertainty in the economy.

The government imposes taxes on household consumption and income derived from labor and savings. However, the fiscal authority only imposes partial labor income taxes on households due to constraints in its monitoring capabilities. Individuals found to be evading taxes on labor income are penalized with a fine proportional to the amount of tax evaded. The representative firm utilizes both labor and capital to manufacture a singular consumption good, with its price standardized to one. This consumption good can be utilized for immediate consumption or directed towards investment purposes.

A fraction of the revenue from the government tax collection is redistributed to households in the form of locally provided public goods and services. This redistribution, however, is assumed to be uneven across households. The availability of public goods and services varies across locations, and regions that offer better public services attract higher housing demand. Agents evaluate the utility of choosing a housing region. They choose the region that has the greatest indirect utility.

3.2.1 Household Behavior and Preferences

In my economic framework, households derive utility from both private consumption and housing services, while experiencing disutility from labor effort and tax evasion. I assume that overall consumption (\bar{c}_t^j) consists of a basket that combines private and publicly provided goods. Preferences are represented by the following utility function:

$$U^j(c_t, l_t, e_t, H_t^j) = \frac{(\bar{c}_t^j)^{1-\gamma}}{1-\gamma} + \xi \frac{(H_t^j)^{1-\varphi}}{1-\varphi} - \chi \frac{l_t^{1+\frac{1}{\phi}}}{1+\frac{1}{\phi}} - \eta \frac{e_t^{\iota}}{\iota}, \quad (3.1)$$

where γ , ϕ , and ι are parameters governing relative risk aversion, the inverse of the Frisch elasticity of labor supply, and the elasticity of utility with respect to tax evasion, respectively. The parameter φ governs the curvature of utility with respect to housing consumption, while the parameters ξ , χ , and η are positive preference weights associated with housing services, labor disutility, and the disutility of tax evasion, respectively.

I assume that total household consumption is represented by an Armington-type

aggregator that combines private and publicly provided goods as follows¹:

$$\bar{c}_t^j = \left[\Phi c_t^{\frac{\zeta-1}{\zeta}} + (1-\Phi) \left(g_t^j \right)^{\frac{\zeta-1}{\zeta}} \right]^{\frac{\zeta}{\zeta-1}}, \quad (3.2)$$

where Φ denotes the share of private consumption in the consumption basket, ζ is the elasticity of substitution between private and public consumption, and g_t^j represents the average public consumption specific to area j . Let (Λ) represent the percentage of public expenditure (G_t) that returns to households in the form of public goods and services. Assume that these public goods and services will be distributed across J regions, with each region having n_j households. Therefore, the total amount of public goods and services received by households must equal the total public expenditure distributed.

$$\sum_{j=1}^J n_j g_t^j = \Lambda_t n g_t \quad (3.3)$$

where $g_t = G_t/n$ and $n = \sum_{j=1}^J n_j$.

3.2.2 Taxation Structure and Household Constraints

The tax authority imposes labor income taxes denoted by $T(y_t)$ on labor income y_t . Additionally, households are subject to consumption taxes τ_t^c and capital income taxes τ_t^a . If agents decide to evade labor income taxes, they face a probability p of detection and subsequent sanction. The severity of the penalty applied by the tax authority is characterized by a punishment parameter $\mathcal{T} \geq 0$.

The budget constraint of a household residing in region j is given by:

$$(1 + \tau^c)c_t + (1 + \tau^c)P_t^j H_t^j + a_{t+1} = a_t [1 + (1 - \zeta \tau^a)r_t] + p[y_t - T(y_t)(1 + \mathcal{T}e_t)] + (1 - p)[y_t - T(y_t)(1 - e_t)] \quad (3.4)$$

¹ The aggregation function in Equation (3.2) follows an Armington-style CES specification. Its limiting cases depend on the elasticity of substitution (ζ): (i) as $\zeta \rightarrow 0$, the function converges to a Leontief form (perfect complements): $\bar{c}_t^j = \min\left(\frac{c_t}{\Phi}, \frac{g_t^j}{1-\Phi}\right)$; (ii) as $\zeta \rightarrow 1$, it becomes Cobb-Douglas: $\bar{c}_t^j = c_t^\Phi \cdot (g_t^j)^{1-\Phi}$; and (iii) as $\zeta \rightarrow \infty$, it approaches perfect substitutes (linear aggregation): $\bar{c}_t^j = \Phi c_t + (1-\Phi)g_t^j$. These transitions illustrate how the elasticity parameter governs the degree of substitutability between private and public consumption.

where

$$y_t = \varepsilon_t w_t l_t, \quad (3.5)$$

$$\zeta = \begin{cases} 1, & \text{if } a_t \geq 0 \\ 0, & \text{otherwise,} \end{cases} \quad (3.6)$$

$$T(y_t) = \delta_0 \left[y_t - \left(y_t^{-\delta_1} + \delta_2 \right)^{-\frac{1}{\delta_1}} \right], \quad (3.7)$$

and w_t denotes the wage rate and r_t represents the return on household savings, which also corresponds to the borrowing interest rate. The variable ζ is an indicator function distinguishing agents by their financial status. Personal borrowing is not subject to taxation. The function $T(y_t)$ specifies the progressive labor income tax schedule, based on Gouveia and Strauss (1984). The parameters δ_0 , δ_1 , and δ_2 govern the baseline level, marginal tax rates, and the curvature of the tax function, respectively, thereby capturing the degree of progressivity observed in the Brazilian labor income tax system.

I assume that housing prices, denoted by P_t^j , are determined in order to maintain a stable distribution of households across regions, even with changes in the distribution of public goods and services. Instead of fully endogenizing housing prices through housing market equilibrium, my approach anchors the regional allocation of housing, thus preventing artificial shifts in the spatial distribution of agents. Regions with a greater number of housing units tend to have more stable prices, which can be used as a reference for obtaining relative prices between regions.

Households face the following exogenous borrowing constraint restriction:

$$a_{t+1} \geq -\Omega. \quad (3.8)$$

Finally, the household productivity shock follows an AR(1) process with mean μ and persistence coefficient ρ :

$$\log(\varepsilon_t) = (1 - \rho)\mu + \rho \log(\varepsilon_{t-1}) + v_t, \quad (3.9)$$

where $v_t \sim \mathcal{N}(\mu_v, \sigma_v^2)$.

3.2.3 Optimization Problems of Agents

A household living in region $j \in \{1, 2, \dots, J\}$ faces a dynamic optimization problem, which can be formally represented by the following Bellman equation:

$$V_t(a_t, \varepsilon_t, g_t^j) = \max_{c_t, l_t, e_t, H_t^j, a_{t+1}} \left[U^j(c_t, l_t, e_t, H_t^j) + \beta E_t \left[V_{t+1}(a_{t+1}, \varepsilon_{t+1}, g_{t+1}^j) \right] \right], \quad (3.10)$$

subject to the budget constraint 3.4 and restrictions 3.5 - 3.9, where β is the intertemporal discount constant.

The household's optimization problem yields the following first-order and envelope conditions, which together characterize the optimal decisions on consumption, labor supply, tax evasion, housing, and savings.

The consumption choice satisfies the intertemporal condition:

$$\Phi(\bar{c}_t^j)^{-\gamma + \frac{1}{\xi}} c_t^{-\frac{1}{\xi}} = \lambda_t(1 + \tau^c), \quad (3.11)$$

where $\bar{c}_t^j = \left[\Phi c_t^{\frac{\xi-1}{\xi}} + (1 - \Phi)(g_t^j)^{\frac{\xi-1}{\xi}} \right]^{\frac{\xi}{\xi-1}}$ is the composite consumption aggregator, and λ_t is the Lagrange multiplier associated with the household's budget constraint.

Labor supply equates the marginal disutility of labor to the after-tax marginal wage income:

$$\chi l_t^{\frac{1}{\phi}} = \lambda_t \varepsilon_t w_t \left[1 - T'(y_t) (1 - (1 - p - \mathcal{T}p)e_t) \right], \quad (3.12)$$

where $T'(y_t)$ is the marginal labor income tax rate.

The incentive compatibility condition for tax evasion balances the marginal disutility of evasion with its expected marginal benefit²:

$$\eta e_t^{t-1} = \lambda_t (1 - p - \mathcal{T}p) T(y_t). \quad (3.13)$$

Housing demand is characterized by the equality of marginal utility of housing services and the effective price:

$$\xi (H_t^j)^{-\phi} = \lambda_t (1 + \tau^c) P_t^j. \quad (3.14)$$

The intertemporal Euler equation links the multiplier to the expected future marginal value of assets:

$$\lambda_t = \beta E_t \left[\frac{\partial V_{t+1}}{\partial a_{t+1}} \right]. \quad (3.15)$$

² Tax evasion occurs only if the expected benefit derived from evasion is positive: $(1 - p - \mathcal{T}p)T(y_t) > 0$.

Finally, the following envelope condition describes the marginal value of wealth:

$$\frac{\partial V_t}{\partial a_t} = \lambda_t [1 + (1 - \zeta \tau^a) r_t]. \quad (3.16)$$

The representative firm employs labor (L_t) and capital (K_t) to produce a single consumption good, whose price is normalized to one. This final good can either be used for immediate consumption or allocated to investment. The production technology is specified as follows:

$$Y_t = K_t^\alpha L_t^{1-\alpha}, \quad (3.17)$$

where $\alpha \in (0, 1)$ is the capital share. The firm's objective is to maximize profits, formulated as:

$$\max_{K_t, L_t} \{ K_t^\alpha L_t^{1-\alpha} - (r_t + \delta) K_t - w_t L_t \}, \quad (3.18)$$

where $0 < \delta < 1$ is the capital depreciation rate. Thus, I obtain the following first-order conditions:

$$r_t = \alpha \left(\frac{L_t}{K_t} \right)^{1-\alpha} - \delta, \quad (3.19)$$

$$w_t = (1 - \alpha) \left(\frac{K_t}{L_t} \right)^\alpha. \quad (3.20)$$

3.2.4 Regional Decisions

The indirect utility of an agent choosing region j is obtained by substituting the optimal household decisions c_t^* , l_t^* , e_t^* , and H_t^{j*} into the utility function.³ Formally, the indirect utility is expressed as:

$$V^j = U^j \left(c_t^*, l_t^*, e_t^*, H_t^{j*} \right). \quad (3.21)$$

If the agent contemplates a different region j' , the indirect utility $V^{j'}$ is obtained by substituting the optimal choices into the utility function:

$$V^{j'} = U^{j'} \left(c_t^{j'*}, l_t^{j'*}, e_t^{j'*}, H_t^{j'*} \right). \quad (3.22)$$

An agent optimally chooses the region j if its utility is at least as great as the j' utility, that is:

$$V^j \geq V^{j'}. \quad (3.23)$$

³ Note that housing is a local good, specific to each region and not generally tradable or accessible across all regions. Consequently, the housing choice H_t^j depends explicitly on the region j .

Otherwise, the agent chooses the region j' .

3.2.5 Stationary Distribution

Let $J_t^j(a, l, \varepsilon, g_t^j)$ denote the joint distribution of household states in region $j \in \{1, 2, \dots, J\}$ at time t , where a represents individual wealth, l denotes labor supply, ε is idiosyncratic productivity, and g_t^j corresponds to the regional level of public goods. The marginal distribution of wealth in region j is defined as:

$$\mathcal{H}_t^j(a) = \iint J_t^j(a, l, \varepsilon, g_t^j) dl d\varepsilon.$$

The aggregate wealth distribution across all regions is:

$$\mathcal{H}_t(a) = \sum_{j=1}^J \mathcal{H}_t^j(a).$$

In stationary equilibrium, the wealth distribution becomes time-invariant:

$$\mathcal{H}_{t+1}(a) = \mathcal{H}_t(a) = \mathcal{H}(a).$$

3.2.6 Tax Authority and the Economy's Resource Constraint

The tax authority collects labor income taxes ($T(y_t)$), consumption taxes (τ^c), and capital income taxes (τ^a). Total tax revenue is used to finance government consumption (\mathcal{G}_t), the tax audit policy ($\mathcal{M} = \mathcal{C}p$), and the provision of public goods ($\sum_{j=1}^J n_j g_t^j$), where \mathcal{C} is the unit cost of auditing, and p is the probability of detection. The government budget constraint is:

$$\begin{aligned} \mathcal{G}_t + \mathcal{C}p + \sum_{j=1}^J n_j g_t^j = & \iiint \left[T(\varepsilon_t w_t l_t) - (1 - p - \mathcal{T}p) e_t T(\varepsilon_t w_t l_t) \right. \\ & \left. + \tau^c (c_t + P_t^j H_t^j) \right] J_t(a_t, l_t, \varepsilon_t, g_t^j) da_t dl_t d\varepsilon_t dg_t^j \\ & + \iiint_{\mathbb{S}} \left[\tau^a r_t a_t \right] J_t(a_t, l_t, \varepsilon_t, g_t^j) da_t dl_t d\varepsilon_t dg_t^j; \end{aligned} \quad (3.24)$$

with the second integral being defined over the state space $S = [0, \infty) \times [0, 1] \times \mathbb{R}_+ \times \mathbb{R}_+$, since negative assets ($a_t < 0$) do not contribute to capital income taxes.

The economy's resource constraint guarantees that aggregate output Y_t is fully allocated across private consumption C_t , investment I_t , and total government expenditure, which

includes \mathcal{G}_t , enforcement costs $\mathcal{C}p$, and regional public goods:

$$Y_t = C_t + I_t + \mathcal{G}_t + \mathcal{C}p + \sum_{j=1}^J n_j g_t^j, \quad (3.25)$$

where C_t is aggregate private consumption, and I_t is investment. Market clearing conditions for labor and capital are:

$$L_t = \iiint \varepsilon_t l_t J_t(a_t, l_t, \varepsilon_t, g_t^j) da_t dl_t d\varepsilon_t dg_t^j, \quad (3.26)$$

$$K_t = \iiint a_t J_t(a_t, l_t, \varepsilon_t, g_t^j) da_t dl_t d\varepsilon_t dg_t^j. \quad (3.27)$$

Aggregate consumption comprises both consumption of goods and housing services:

$$C_t = \iiint [c_t + P_t^j H_t^j] J_t(a_t, l_t, \varepsilon_t, g_t^j) da_t dl_t d\varepsilon_t dg_t^j, \quad (3.28)$$

and total government spending is given by:

$$G_t = \mathcal{G}_t + \mathcal{C}p + \sum_{j=1}^J n_j g_t^j. \quad (3.29)$$

3.2.7 Definition of Equilibrium

I am now in a position to present the definition of the stationary equilibrium for this economy.

Given an exogenous borrowing limit Ω , a stationary competitive equilibrium is characterized by: (i) the tax authority's set of policy instruments $(T(y), \tau^a, \tau^c, \mathcal{T}, \mathcal{G}, \mathcal{M})$; (ii) the price system (w, r, P^j) of wages, interest rate, and housing prices; (iii) households' allocations (c, a, l, e, H) depending on the chosen region of residence; (iv) the distribution of household productivity, the distribution of provision of public goods and services, and an invariant wealth distribution $\mathcal{H}(a)$; such that:

I. the household and firm's optimal allocations are characterized by equations (3.11–3.16 and 3.19–3.20); II. the joint distribution $J(da, dl, d\varepsilon, dg)$ is constant over time; III. the government budget constraint and the economy's resource constraint, equations (3.24) and (3.25), respectively, are satisfied; IV. the wage rate and the economy's interest rate satisfy the market clearing conditions (3.26) and (3.27); V. the aggregate consumption of households and the government are given by (3.28) and (3.29), respectively; VI. the public goods and services per region (g^j) satisfies (3.3);

and VII. the region decision satisfies $V^j > V^{j'}$ for agents choosing j , and $V^{j'} \geq V^j$ for agents preferring j' , as defined in Equations (3.21) and (3.22).

The steady-state equilibrium is unique. It can also be shown that the economy converges to this steady-state equilibrium from any initial condition (Antunes *et al.* (2008)).

3.3 Quantitative Experiments and Policy Simulations

My model enables households to receive a portion of their taxes back in the form of public goods and services. The availability of these public goods and services varies depending on the geographic area where the household is located. To understand how geographic region impacts income tax evasion, I will modify the public goods and services associated with each region. This change affects both the total amount of public goods available per region and their distribution among regions while maintaining the overall quantity of public goods unchanged.

I utilize the endogenous grid method, as proposed by Carroll (2006) and Barillas and Fernández-Villaverde (2007), for the numerical implementation of the model. By employing a system of nonlinear equations that characterize the equilibrium of the model and an initial estimate of the interest rate, I derive optimal values for the control variables (c_t , l_t , a_{t+1} , e_t and H_t^j) from the Cartesian product of the discretization of state variables (a_t , ϵ_t and g_t^j). I carry out this numerical process for every combination of state variables, with each iteration involving the verification of the household's budget constraint and an additional check to ensure that the omitted value of labor income falls within an acceptable range. Also, I compare the indirect utility ($V^j(c_t, l_t, e_t, H_t^j)$) in regions 1 and 2. If ($V^1(c_t, l_t, e_t, H_t^1) > V^2(c_t, l_t, e_t, H_t^2)$), then the household chooses Region 1, otherwise Region 2. The iterative procedure continues until a stationary equilibrium is achieved.

Although simple in theory, the method is quite complex in its implementation. It starts with an initial guess of the real interest rate. From this starting point, a system of nonlinear equations based on the first-order conditions is solved. This procedure depends on initial guesses for the control variables. This process continues until the optimal policy converges. The economy is populated based on the optimal policy until I obtain the stationary solution for the model.

3.3.1 Model Calibration and Empirical Targets

I calibrate the model for the economy of Fortaleza, Brazil's fourth-largest city by population and twelfth in terms of GDP. If I lack specific data for this economy, I use data from the Brazilian economy as a proxy. The parameters are categorized into five groups: preferences, technology, productivity, tax policy, and public goods. The calibration and parameter selection for the model can be found in Tables VI and VII.

The parameters are calibrated for 2019 to exclude COVID-19 effects. With regard to preference parameters, the intertemporal discount factor (β) is adjusted based on a capital-to-GDP ratio of 2.43⁴. I derive the borrowing constraint (Ω) by examining the ratio of total personal credit to GDP, which stands at 27.31%⁵. The relative degree of risk aversion (γ and φ) and the Frisch elasticity of labor supply (ϕ) are derived from empirical studies of the Brazilian economy (Castro *et al.* (2011)). The multipliers for the disutility of work (χ) and tax evasion (η) are calibrated, respectively, taking into account $L = 1/3$, see Conesa *et al.* (2009), and the ratio of declared personal income tax to GDP is 2.64%⁶. The elasticity of tax evasion (ι) is fixed at 2.0 to ensure convexity.

In the context of technology, the capital depreciation (δ) is calculated using the formula $\delta = (I/Y)/(K/Y)$ ⁷, which represents the relationship between investment and capital. The capital share (denoted by α) can be calculated using the formula $\alpha = (r + \delta) \frac{K}{Y}$, where r is 2.12%⁸.

In order to analyze productivity parameters, I employ the method of Tauchen (1986) based on equation (3.9) with seven realizations for productivity shocks (ε). I start by setting $\mu = 0$ and normalizing the mean of the household productivity shock to $\mu_v = 0$. I assume a persistence term for the productivity shock of 0.98, as used by Conesa *et al.* (2009), and a scale parameter equal to 3. The parameter σ_v is calibrated to ensure that Fortaleza's Gini index is 0.573⁹.

The progressive taxation model for personal income tax developed by Gouveia and

⁴ IPEA - Instituto de Pesquisa Econômica Aplicada - Institute of Applied Economic Research.

⁵ BCB - Banco Central do Brasil - Brazilian Central Bank and IBGE - Instituto Brasileiro de Geografia e Estatística - Brazilian Institute of Geography and Statistics.

⁶ IBGE - Instituto Brasileiro de Geografia e Estatística - Brazilian Institute of Geography and Statistics and RFB - Secretaria Especial da Receita Federal do Brasil - Brazilian Federal Revenue Service.

⁷ From PWT 10.0, $I/Y = 17.15\%$

⁸ BCB and IBGE

⁹ IPECE - Instituto de Pesquisa e Estratégia Econômica do Ceará - Institute of Economic Research and Strategy of Ceará

Strauss (1994) includes parameters δ_0 , δ_1 , and δ_2 , which have been calibrated for the Brazilian economy. Since personal income tax in Brazil is governed at the federal level, the same tax code applies across all municipalities. The parameter δ_0 was set based on the highest marginal tax rate defined in the Brazilian tax code. Meanwhile, the parameters δ_1 and δ_2 are used to control the curvature and threshold adjustments for labor income. These parameters were calibrated to achieve an effective declared tax rate of 10.18%. It is also important to note that only taxpayers with a taxable income of R\$ 28,559.70 or more in 2019 were required to file a tax return. For the other tax policy parameters, τ_t^c was adjusted based on Almeida *et al.* (2017), and τ_t^a was calibrated to achieve a capital income tax to GDP ratio of 0.53%¹⁰. In the event of fraud or collusion, the standard penalty is 75%¹¹ in addition to a 100% increase. As a result, the total tax penalty is 150% ($\mathcal{T} = 1.50$). The probability of being audited is determined by the percentage of taxpayers with inconsistent returns, which was 2.74% in 2019, according to public data published by the Brazilian Federal Revenue Service (RFB).

Households' geographic location influences the parameters of public goods and services. I divided the city of Fortaleza into two areas: Region 2, which includes the 10 wealthiest neighborhoods¹² based on per capita income, and Region 1, which consists of the remaining neighborhoods. According to the Fortaleza municipal government, this division means that Region 1 has 87% of households ($n_1/n = 0.87$) and, consequently, Region 2 has 13% ($n_2/n = 0.13$). One of the parameters in equation (3.2), which aggregates private and public consumption, is the private consumption share (Φ). This parameter is calibrated based on the relationship between aggregate private consumption (C) and the total aggregate public and private consumption ($C + G$)¹³. The elasticity of substitution (ζ) between public and private goods was adjusted so that 13% of households chose Region 2 to live in, resulting in 87% choosing Region 1. The IBGE reported that, in 2019, Brazilian households allocated an average of 34.03% of their total consumption to housing. Therefore, I adjusted the housing utility multiplier (ξ) using $PH/C = 0.3403$ ¹⁴.

While all public expenditures can be considered as public goods and services, not all of them are consumed based on the geographic location of households. Data from the

¹⁰ RFB - 2019.

¹¹ Law 9,430/96 and Law 4,502/64

¹² Aldeota, Cocó, De Lourdes, Dionísio Torres, Fátima, Guararapes, Meireles, Mucuripe, Praia de Iracema and Varjota (IPECE).

¹³ $\Phi = C/(C + G) = 0.78$, with $C/Y = 0.6499$ and $G/Y = 0.1835$ - PWT 10.0 - Brazil.

¹⁴ $PH_t = \iiint P_t^j H_t^j J_t(da, dl, d\epsilon, dg)$.

Table VI – Model Parameters - Preferences, Technology, Productivity and Tax Policy

Parameters	Model	Target	Source
Preferences			
β : Intertemporal Discount	0.966515	$K/Y = 2.43$	IPEA
Ω : Borrowing Constraint	0.187853	$Cred/Y = 27,31\%$	BCB and IBGE
γ : Risk Aversion	1.3	-	Castro <i>et al.</i> (2011)
φ : Risk Aversion	1.3	-	Castro <i>et al.</i> (2011)
ϕ : Frisch elasticity	1.0	-	Castro <i>et al.</i> (2011)
χ : Multiplier	109.1124	$L = 1/3$	Conesa <i>et al.</i> (2009)
η : Multiplier	0.307911	$IT^l/Y = 2.64\%$	RFB and IBGE
ι : Elasticity of Tax Evasion	2.0	Fixed	-
Technology			
α : Capital Share	0.2231	$r = 2.12\%$	BCB and IBGE
δ : Capital Depreciation	0.0706	$I/Y = 0.1715$	PWT 10.0
Productivity			
ρ_ε : Shock Persistency	0.98	-	Conesa <i>et al.</i> (2009)
σ_v^2 : Variance of Shocks	0.049572	$Gini = 0.573$	IPECE
r_ε : Tauchen Scale Factor	3.0	-	Tauchen (1986)
Tax Policy			
δ_0 : Maximum Marginal Tax Rate	0.275	-	RFB
δ_1 : Progressivity Parameter	0.52	$IT^l/Income = 10.18\%$	RFB
δ_2 : Scale Parameter	0.27	$IT^l/Income = 10.18\%$	RFB
τ_t^a : Capital Income Tax Rate	0.0928	$IT^a/Y = 0.53\%$	RFB and IBGE
τ_t^c : Consumption Tax Rate	0.2175	-	Almeida <i>et al.</i> (2017)
\mathcal{P} : Tax Penalty	1.5	-	RFB
p : Audit Rate	0.0274	-	RFB

Notes: BCB - Banco Central do Brasil - Brazilian Central Bank.

IBGE - Instituto Brasileiro de Geografia e Estatística - Brazilian Institute of Geography and Statistics.

IPEA - Instituto de Pesquisa Econômica Aplicada - Institute of Applied Economic Research.

RFB - Secretaria Especial da Receita Federal do Brasil - Brazilian Federal Revenue Service.

IPECE - Instituto de Pesquisa Econômica do Ceará - Institute of Economic Research of Ceará

Source: Author.

Transparency Portal of the Municipality of Fortaleza allowed me to identify the following categories of public expenditure related to geographic location: public safety, urban planning, sanitation, and energy. According to this source, these categories accounted for 17.46% of total

Table VII – Model Parameters - Public Goods

Parameters	Benchmark Model	Target	Source
Public Goods			
Φ : Private Consumption Share	0.78	$C/(C + G) = 0.78$	PWT 10.0
ζ : Substitution Elasticity	1.0406	$n_2/n = 0.13$	PMF
ξ : Housing Multiplier	3.00	$PH/C = 0.3403$	IBGE
Λ : Public Good Partition	0.1746		PMF
P^1 : Housing Price - Region 1	130.7	ITBI Tax Base	PMF
P^2 : Housing Price - Region 2	184.3	ITBI Tax Base	PMF
$g^1/(\Lambda g)$: Ratio Public Consumption - Region 1	0.8819	IPTU Tax Base	PMF
$g^2/(\Lambda g)$: Ratio Public Consumption - Region 2	1.7903	IPTU Tax Base	PMF

Notes: PMF - Prefeitura Municipal de Fortaleza - Fortaleza Municipal Government.

IBGE - Instituto Brasileiro de Geografia e Estatística - Brazilian Institute of Geography and Statistics.

Source: Author.

public expenditure in Fortaleza in 2019. Therefore, the parameter (Λ), which represents the percentage of public expenditure that is returned to households as public goods and services, is set at 0.1746. The tax base (TB) for the urban property tax (IPTU) is calculated based on several factors, including the types of urban infrastructure present on the street. I assume that the ratio of public goods and services between two areas is proportional to the ratio of their average IPTU tax bases per square meter. According to data from the municipal government, the ratio $TB_2/TB_1 = 2.03$. Using the relationships $n_1/n = 0.87$, $n_2/n = 0.13$, $(g^2/\Lambda g)/(g^1/\Lambda g) = TB_2/TB_1 = 2.03$ and Equation (3.3), I derived $g^2/\Lambda g = 1.7903$ and $g^1/\Lambda g = 0.8819$. This ensures that the total amount of public goods and services received by households equals the total public expenditure distributed.

In Brazil, there is a municipal tax on real estate transfer transactions known as the ITBI (Imposto de Transmissão de Bens Imóveis). Its tax base is the market price of the property being transferred; specifically, it reflects the amount that the property would likely sell for under typical market conditions on a given date. I use the average ITBI tax base (market value) in a particular area as a proxy for housing costs in that region. This measure is a reasonable proxy because the ITBI is levied on property transactions, and therefore, it reflects updated market valuations reported at the time of sale. It is important to note that the cost of housing is linked to rental prices, which are, in turn, proportional to the property's market value as indicated by the

ITBI tax base. Data from real estate agencies indicated that the average annual rental price per square meter in Fortaleza in 2019 was about 5% of the average market value per square meter. This information, along with data from the municipal government of Fortaleza regarding the ITBI tax base for regions 1 and 2, allows me to determine $P^1 = R\$130.7/m^2$ and $P^2 = R\$184.3/m^2$.

3.3.2 Simulation Results and Policy Evaluation

After calibrating the model to the target values, I obtained results related to several key economic statistics, which are summarized in Table VIII. These results indicate that the model produces values consistent with important economic metrics.

Table VIII – Key Statistics: Models and Economy.

Variables	Model	Economy	Source
Consumption over GDP (C/Y)	65.31%	64.99%	
Investment over GDP (I/Y)	17.08%	17.15%	PWT 10.0
Government Expenditures over GDP (G/Y)	17.62%	18.35%	
Consumption Tax over GDP (CT/Y)	14.20%	14.25%	STN ⁱ
% EEAP that declares tax income ⁱⁱ	30.12%	32.26%	RFB ⁱⁱⁱ
Taxable Labor Income over GDP ($Income/Y$)	25.58%	25.90%	RFB ⁱⁱⁱ

Notes: ⁱ Brazilian Federal Treasury in https://sisweb.tesouro.gov.br/apex/f?p=2501:9:::9:P9_ID_PUBLICACAO:32076

ⁱⁱ The percentage of the employed economically active population (EEAP) that declares income tax.

ⁱⁱⁱ RFB and PNAD (National Household Survey) from the IBGE

Source: Author.

Table IX shows the distribution of tax evasion by income decile and each decile's share of total tax evasion. There is no tax evasion up to the sixth decile. This is because only taxpayers with an annual income of R\$ 28,559.70 or more are required to report income tax. The tax evasion increases with each decile, indicating that higher incomes are associated with greater levels of tax evasion. It is also possible to verify that, while tax evasion by decile has the same magnitude, the contribution of each decile to overall tax evasion varies significantly.

Table IX – Decile Tax Evasion Distribution

Decile	Tax Evasion by Decile (%)	Total Tax Evasion (%)
1-6	0.00	0.00 (0.00%)
7	48.01	0.05 (0.09%)
8	51.10	5.84 (10.36%)
9	55.26	11.10 (19.69%)
10	57.59	39.38 (69.86%)
Total		56.37 (100.00%)

Source: Author.

Table X – Regional Tax Evasion Distribution

Region	Tax Evasion by Region (%)	Total Tax Evasion (%)
1	52.59	14.06 (24.94%)
2	57.75	42.31 (75.06%)
Total		56.37 (100.00%)

Source: Author.

There is a high concentration of tax evasion among the highest income groups, with the 10th and 9th deciles accounting for almost 90% of total tax evasion. This is a result of higher tax evasion rates among individuals with higher incomes.

Table X illustrates the distribution of tax evasion across the two regions into which the city of Fortaleza is divided. As noted, Region 2, which encompasses the wealthiest neighborhoods, has a higher housing cost, typically only affordable for higher-income households. Region 2 has a tax evasion rate of 57.75%, slightly over 5 percentage points than the tax evasion rate in Region 1 (52.59%). Regarding total tax evasion, Region 2 is responsible for 75%, three times the share of Region 1. Comparison of Tables IX and X, shows similarity between Region 2 and decile 10. This is because most of the households that make up Region 2 belong to the 10th decile. This also explains why tax evasion is higher in Region 2. This pattern underscores a key mechanism in the model: tax evasion is not uniformly distributed across space, but is concentrated in areas where wealthier households reside and where the potential tax base is larger. In Region 2, higher incomes create stronger incentives and opportunities to evade, while the concentration of such households amplifies the aggregate effect. In contrast, Region 1 contains mostly middle and lower income households with limited taxable income and fewer opportunities to conceal it, which explains their smaller contribution to total evasion despite similar individual propensities. The comparison between Regions 1 and 2, therefore, mirrors the broader distributional result that the richest decile drives the majority of the tax gap, highlighting how spatial inequality and income inequality reinforce each other in shaping compliance outcomes.

To analyze how tax evasion is affected by the availability of public goods in a specific region, I adjusted the percentage of public expenditure allocated to households in the form of public goods and services, denoted as (Λ). In our initial calibration, this value was set at 17.46%. Since G constitutes 17.62% of GDP, the amount designated for public goods and services is approximately 3% of GDP. I modified the parameter (Λ) to the following values: 0.25, 0.50, 0.75, and 1.00. Additionally, I calibrated the relative price (P^2/P^1) to ensure that 13% of households are located in Region 2 while 87% are in Region 1. As previously stated, with the change in the

Table XI – Variation in Tax Evasion and Aggregate Economic Variables by Λ

Λ (%)	P^2/P^1	Tax Evasion (%)	Y	C	G	C/Y (%)	G/Y (%)
17.46	1.4100	56.37	0.4301	0.2809	0.0758	65.31	17.62
	(ref)	(ref)	(ref)	(ref)	(ref)	(ref)	(ref)
25.00	1.4077	55.50	0.4270	0.2787	0.0754	65.27	17.66
Var.%	-0.16%	-1.54%	-0.72%	-0.79%	-0.53%	-0.06%	0.23%
50.00	1.4030	53.83	0.4209	0.2745	0.0746	65.22	17.72
Var.%	-0.50%	-4.51%	-2.14%	-2.28%	-1.58%	-0.14%	0.57%
75.00	1.4001	52.88	0.4174	0.2721	0.0741	65.19	17.75
Var.%	-0.71%	-6.19%	-2.95%	-3.13%	-2.24%	-0.18%	0.74%
100.00	1.3980	52.20	0.4149	0.2704	0.0738	65.17	17.79
Var.%	-0.85%	-7.40%	-3.53%	-3.74%	-2.64%	-0.22%	0.96%

Source: Author.

distribution of public goods and services, a significant change in the distribution of households between regions is not expected in the short term. Furthermore, since Region 1 has almost 7 times the number of households as Region 2, greater inertia in the change in its price is expected. Therefore, we kept P^1 stable and calibrated P^2 to obtain $n_1/n_2 = 0.87/0.13$. Relative prices remained virtually unchanged in this process. However, I found a high sensitivity of n_1/n_2 in relation to P^2/P^1 . Small changes in relative prices can cause significant shifts in the distribution of households across regions. This demonstrates the significant challenge involved in implementing the endonization of prices by region. It is essential to clarify that I only adjusted the quantity of goods and services made available, without altering the relationship between the goods and services in the two regions. The implication is that the exercise isolates the effect of changes in the overall level of public provision, while holding constant the relative composition between regions. This ensures that differences in tax evasion responses can be attributed to the scale of public goods rather than to shifts in their spatial distribution pattern. Specifically, even with the increases of g^1 and g^2 , the relationship $g^2/g^1 = 2.03$ remained unchanged¹⁵.

Table XI shows the result of the variation of Λ on relative prices (P^2/P^1), tax evasion, GDP (Y), aggregate consumption (C), government expenditure (G), and the ratios C/Y and G/Y . The relationship between these variables for each change of Λ value, and the default value of 17.46% is also shown. A decrease in tax evasion can be observed with the increase in Λ . Starting from a distribution of 3.08% of GDP, I adjusted this distribution to 4.42%, 8.86%, 13.31% and 17.79% of GDP. These changes resulted in reduction of tax evasion by 1.54%, 4.51%, 6.19%, and

¹⁵ With the endogenous prices and the possibility of migration between regions, there is a change in the relationship of public goods per region (g^2/g^1). As shown below, this change has a significant impact on relative prices, creating a feedback effect.

Table XII – Regional Tax Evasion by Λ

Λ (%)	Region	Tax Evasion (%)	Total Evasion	Total Evasion Share (%)
17.46	1	52.59	14.06	24.94
	2	57.75	42.31	75.06
25.00	1	51.74	13.86	24.98
	2	56.87	41.64	75.02
50.00	1	50.09	13.34	24.78
	2	55.19	40.49	75.22
75.00	1	49.16	13.08	24.73
	2	54.22	39.80	75.27
100.00	1	48.50	12.89	24.70
	2	53.54	39.31	75.30

Source: Author.

7.40%. Thus, a significant change (578%) in the goods and services made available is necessary to achieve a decrease of less than 8% in tax evasion. Additionally, there were decreases in GDP, C , and G of 3.53%, 3.74%, and 2.64%, respectively. This caused the C/Y ratio to remain practically constant, accompanied by a slight increase in the G/Y ratio.

Table XII illustrates how tax evasion varies by region as the quantity of public goods consumed changes. It also shows the region's share of total tax evasion. Region 2 always has a greater incidence of tax evasion and total tax evasion. When the consumption of public goods increases, both regions experience a reduction in tax evasion, but their share of total tax evasion remains practically constant. This can be explained by the fact that g^1 and g^2 increase in the same proportion ($g^2/g^1 = 2.03$).

Tables XI and XII show that to achieve a significant reduction in tax evasion, a substantial portion of public expenditure as a percentage of GDP must be allocated to public goods and services. Equation (3.2) shows that total consumption is a composition of private and public consumption. If public consumption is significantly lower than private consumption, even with some degree of substitution between them, total consumption will be little influenced by public consumption. This situation is aggravated by a high share of private consumption (Φ).

Table XIII depicts how reducing Φ affects tax evasion, the relative price between regions 2 and 1, GDP, aggregate consumption (C), government expenditure (G), and the ratios of C/Y and G/Y . Lowering Φ increases the share of public consumption within total consumption. This can be practically achieved by improving the quality of public goods and services, which would encourage households to reduce their private consumption in favor of these public offerings.

Table XIII – Variation in Relative Prices, Tax Evasion and Aggregate Economic Variables by Φ

Φ (%)	P^2/P^1	Tax Evasion (%)	Y	C	G	C/Y (%)	G/Y (%)
78.00	1.41	56.37	0.4301	0.2809	0.0758	65.31	17.62
	(ref)	(ref)	(ref)	(ref)	(ref)	(ref)	(ref)
50.00	2.70	55.71	0.4170	0.2723	0.0739	65.30	17.72
Var.%	91.49%	-1.17%	-3.05%	-3.06%	-2.51%	-0.02%	0.57%
25.00	6.28	49.22	0.3814	0.2479	0.0689	65.00	18.07
Var.%	345.39%	-12.68%	-11.32%	-11.75%	-9.10%	-0.48%	2.55%

Source: Author.

Starting from the current value of Φ (78%), I adjusted its value to 50% (same share between public and private consumption) and 25% (predominance of public consumption). Once again, relative prices were calibrated to ensure that Region 2 has 13% of households. A significant change can be observed in relative prices with variations of Φ . From the moment that public consumption has a greater weight in total consumption, the region that holds more public goods ($g^2/g^1 = 2.03$) becomes more attractive. Tax evasion decreases, being more pronounced (almost 13%) when public consumption prevails. This leads to reductions of GDP (more than 11%), C (almost 12%), and G (9%). With the increase in the share of public consumption in total consumption, there is a discouragement of private consumption. Since most of the GDP comes from household consumption, there is a reduction in its value. On the other hand, even with a reduction in tax evasion, there is a corresponding decrease in G and, consequently, in total tax revenue. Since the most significant weight is from taxes on consumption, a reduction in private consumption reduces taxation on consumption, which is not offset by the reduction of income tax evasion.

So far, I maintained a constant relationship between public consumption in the regions. Any increase in public consumption has been attributed to an increase in government expenditures available for public goods and services. This shows that public consumption has risen steadily in both regions. Now, I consider a scenario in which Region 2 experiences an increase in the supply of residences without any change in the total population (n remains constant). I assumed a change in the number of households from 13% to 20%. Consequently, I expected a decrease in relative prices between the two regions. When there is no change in the total quantity of public goods in each region, the average public consumption in Region 2 decreases, while it increases in Region 1. Therefore, I can express this mathematically as follows: $g^{1*} = g^1(0.87/0.80) = 0.9591\Lambda g$ and $g^{2*} = g^2(0.13/0.20) = 1.1637\Lambda g$. The ratio of public consumption between the two regions is then calculated as $g^{2*}/g^{1*} = 1.2133$.

Table XIV – Variation in Relative Prices, Tax Evasion and Aggregate Economic Variables by Λ and g^2/g^1

Λ (%)	g^2/g^1	P^2/P^1	Tax Evasion (%)	Y	C	G	C/Y (%)	G/Y (%)
17.46	2.0300	1.4100	56.37	0.4301	0.2809	0.0758	65.31	17.61
	1.2133	1.1009	56.13	0.4293	0.2803	0.0756	65.30	17.62
Var.%	-40.24%	-21.91%	-0.43%	-0.19%	-0.21%	-0.26%	-0.02%	0.06%
100.00	2.0300	1.3980	52.20	0.4149	0.2704	0.0738	65.16	17.78
	1.2133	1.0981	51.96	0.4141	0.2698	0.0737	65.16	17.79
Var.%	-40.24%	-21.49%	-0.46%	-0.19%	-0.22%	-0.14%	0.00%	0.06%

Source: by authors.

Table XV – Regional Tax Evasion by Λ and g^2/g^1

Λ (%)	g^2/g^1	Region	Tax Evasion (%)	Total Evasion (%)	Total Tax Evasion Share (%)
17.46	2.0300	1	52.59	14.07	24.95
		2	57.75	42.31	75.05
	1.2133	1	51.44	8.46	15.07
		2	57.06	47.67	84.93
100.00	2.0300	1	48.50	12.90	24.70
		2	53.54	39.31	75.30
	1.2133	1	47.33	7.78	14.98
		2	52.87	44.18	85.02

Source: Author.

To understand how variations in Λ (the proportion of public goods distributed) and the ratio of public good provision between regions g^2/g^1 affect relative prices, aggregate economic variables, and tax evasion, I constructed Table XIV. The parameter Λ is set to the current value (17.46%) and the maximum possible value (100.00%). For each value of Λ , I use two values for g^2/g^1 : 2.0300 and 1.2133. As expected, there is a reduction in relative prices. There is also a subtle reduction in tax evasion, with virtually no changes in aggregate economic variables. This behavior is observed for each value of Λ . It can be concluded that, regardless of the value of Λ , the distribution of public goods across regions has minimal influence on tax evasion and virtually no impact on aggregate economic variables. However, it plays a crucial role by altering relative prices.

I now evaluate how the variation of g^2/g^1 affects tax evasion by region, as shown in Table XV. A more equal distribution of resources leads to a reduction in tax evasion across each region. With an increase in the supply of residences in Region 2, there is an influx of immigrants from Region 1. There is a tendency for this immigration to be carried out by the wealthiest households, who, on average, have a higher tax evasion rate. As these households leave, Region

1 experiences a decrease in its tax evasion levels. On the other hand, the households moving into Region 2 generally have a lower average tax evasion rate than those already residing there. As a result, this immigration ultimately leads to a reduction in tax evasion in Region 2 as well. Regarding total tax evasion, households leaving Region 1 hold a substantial portion of the region's total tax evasion. With immigration, total tax evasion decreases in Region 1, while it increases in Region 2. This makes the total tax evasion share across regions even more unequal. Once again, this situation occurs regardless of the value of Λ .

3.4 Summary of Findings and Policy Implications

There is a widespread perception that one reason for tax evasion is that taxpayers who pay their taxes either do not receive the benefits of those taxes or do not perceive they do. To explore this idea, I developed a model in which each household makes decisions regarding consumption, labor, savings, tax evasion, and housing across two city regions. Each region offers a specific level of public goods and services and has housing costs that are proportional to the availability of those public goods. The decision of which region to live in depends on the total indirect utility (V^j). If ($V^1 > V^2$), the household will choose Region 1; otherwise, they will choose Region 2.

My model analyzed a consumption basket in which households consume both private and public goods, based on a ratio defined by the private consumption share (Φ). The results revealed a striking similarity between the top income decile (decile 10) and Region 2 in terms of tax evasion. This similarity arises because Region 2 primarily consists of households with higher incomes.

Maintaining a constant ratio of public goods distributed across regions (g^2/g^1), increasing the proportion of public spending allocated to public goods (Λ) leads to a decrease of tax evasion while keeping each region's share of tax evasion nearly constant. This decrease is more relevant when the significance of the distribution is higher, and it is consistently accompanied by a reduction in GDP, aggregate consumption (C), and the total amount of taxes collected (G), since there is some degree of substitution between public and private consumption. While distributing more public goods results in lower income tax evasion, it also comes at the cost of decreased economic activity, lower consumption, and reduced tax revenue. Ultimately, the reduction in income tax evasion does not compensate for the decrease in consumption tax revenue resulting from the reduction in overall consumption.

The decrease in Φ has similar effects: a decline in tax evasion, GDP, C, and G. However, this also leads to an increase in relative prices. As the share of public consumption increases, the region that offers more public goods becomes more attractive, which causes an increase in prices in that region. Furthermore, the reduction in Φ diminishes the importance of private consumption within total consumption, which discourages private spending, reduces economic activity (since household consumption is the largest component of GDP), and ultimately leads to decreased revenue, as taxes on consumption contribute significantly to tax collection.

When I keep Λ constant and decrease the ratio of g^2/g^1 , I observe a slight decrease in tax evasion and stability in the overall economic variables. The most significant effects are a reduction in the ratio of P^2/P^1 and an increase in the inequality of regional participation in total tax evasion.

Thus, there are two ways to reduce tax evasion: increase the availability of more public goods (increasing Λ) and increase the share of public consumption in total consumption (decreasing Φ). Since significant adjustments to Λ and Φ are hard to achieve, tax evasion remains little influenced by changes in them in practice.

4 CONCLUSION AND FUTURE WORKS

This thesis highlights two distinct but interrelated questions about tax evasion: its relationship with income inequality and its response to the provision of public goods and services. Using two dynamic general equilibrium models, I analyzed the role of both income and spatial heterogeneity in shaping labor income tax compliance in the Brazilian context.

I quantified how income inequality affects the efficiency and structure of labor income taxation through the Laffer curve. I found that tax evasion in Brazil is highly concentrated among the top income deciles, especially the 9th and 10th, which together account for nearly 90% of total evasion. An increase in the tax rate tends to increase tax evasion. This situation has a fundamental tax tradeoff: progressive tax systems face greater efficiency losses in unequal economies, especially where enforcement is limited. In practical terms, it becomes harder to simultaneously tax the rich and raise revenue without increasing tax evasion.

Afterward, I introduced spatial heterogeneity by dividing an urban economy into two regions with distinct levels of public goods and housing costs. I showed that tax evasion is not only associated with tax policy but also with geographic location. The wealthiest region, which concentrates high-income households, also has the largest share of tax evasion. Simulations revealed that increasing the overall provision of public goods reduces tax evasion, but only moderately, and at the cost of lower GDP, consumption, and tax revenue. Reducing the preference for private consumption, thereby increasing the weight of public goods in household utility, also lowers evasion, but with significant economic contraction. The variation of the spatial distribution of public goods had minimal aggregate effects, but led to housing price shifts, highlighting the indirect role of spatial segregation in shaping tax compliance. These results suggest that public goods matter for tax compliance, but their impact is constrained by economic tradeoffs. Increasing public service quality or quantity alone is insufficient to produce large compliance gains, particularly when private consumption dominates preferences.

Several limitations of this work should be acknowledged. First, the model does not incorporate enforcement mechanisms such as audit probabilities or penalties as endogenous policy instruments. Second, I abstract from non-labor income, self-employment, and informal labor, which are crucial in many developing economies. Third, although spatial heterogeneity was introduced, the housing market was modeled with a single fixed price, limiting the feedback between public services, location, and affordability.

As future research, one possibility is to treat housing prices as endogenous, allowing

market-clearing conditions to determine regional price differences. This would enable richer modeling of spatial sorting, affordability constraints, and exclusion effects due to uneven public goods provision. Another possible extension is to consider the government's enforcement strategy as endogenous, such as increasing the likelihood of higher-income households being audited. Additionally, I can incorporate behavioral elements, such as fairness perceptions or tax morale. This would allow a more complete analysis of taxpayer behavior beyond pure cost-benefit logic.

In summary, the findings of this thesis point to the structural and spatial constraints that shape tax compliance in Brazil. Inequality, both income-based and geographic, undermines taxing capacity. By exploring the interplay of redistribution, incentives, and compliance, this thesis opens several paths for future empirical and theoretical work at the intersection of tax policy and inequality.

REFERENCES

- ALBA, C.; MCKNIGHT, S. Laffer curves in emerging market economies: The role of informality. **Journal of Macroeconomics**, Elsevier, v. 72, n. 103411, 2023.
- ALLINGHAM, M. G.; SANDMO, A. Income tax evasion: a theoretical analysis. **Journal of Public Economics**, Elsevier, v. 1, n. 3-4, p. 323–338, 1972.
- ALM, J. Measuring, explaining, and controlling tax evasion: Lessons from theory, experiments, and field studies. **International Tax and Public Finance**, Springer, v. 19, n. 1, p. 54–77, 2012.
- ALMEIDA, V.; DIVINO, J. A.; GADELHA, S. R. B.; aO, A. M. Alíquotas tributárias efetivas médias para a economia brasileira: Uma abordagem macroeconômica. **Revista Brasileira de Economia**, FGV, v. 71, n. 2, p. 153–175, 2017.
- ALSTADSAETER, A.; JOHANNESSEN, N.; ZUCMAN, G. Tax evasion and inequality. **American Economic Review**, American Economic Association, v. 109, n. 6, p. 2073–2103, 2019.
- ALSTADSAETER, A.; JOHANSEN, N.; HENRY, S.; ZUCMAN, G. Tax evasion and tax avoidance. **Journal of Public Economics**, Elsevier, v. 206, n. 104587, 2023.
- ANDREONI, J.; ERARD, B. r.; FEINSTEIN, J. Tax compliance. **Journal of Economic Literature**, American Economic Association, v. 36, n. 2, p. 818–860, 1998.
- ANTUNES, A.; CAVALCANTI, T. The welfare gains of financial liberalization: Capital accumulation and heterogeneity. **Journal of the European Economic Association**, European Economic Association, v. 11, n. 6, p. 1348–1381, 2013.
- ANTUNES, A.; CAVALCANTI, T.; VILLAMIL, A. Computing general equilibrium models with occupational choice and financial frictions. **Journal of Mathematical Economics**, Elsevier, v. 44, p. 553–568, 2008.
- BÁRCENA, A.; CIMOLI, M.; GARCÍA-BUCHACA, R.; TITELMAN, D.; PÉEZ, R. **Panorama Fiscal de América Latina y el Caribe**. [S.l.], 2020.
- BARILLAS, F.; FERNÁNDEZ-VILLAVARDE, J. A generalization of the endogenous grid method. **Journal of Economic Dynamics and Control**, Elsevier, v. 31, n. 8, p. 2698–2712, 2007.
- BILAL, A.; ROSSI-HANSBERG, E. Location as an asset. **Econometrica**, v. 89, n. 5, p. 2459–2495, 2021.
- CARROLL, C. D. The method of endogenous gridpoints for solving dynamic stochastic optimization problems. **Economics Letters**, Elsevier, v. 91, n. 3, p. 312–320, 2006.
- CASTRO, M. R.; GOUVEA, S. N.; MINELLA, A.; SANTOS, R. C.; SOUZA-SOBRINHO, N. F. **SAMBA: Stochastic Analytical Model with a Bayesian Approach**. [S.l.], 2011.
- CHU, J.; FISMAN, R.; TAN, S.; WANG, Y. Hometown ties and the quality of government monitoring: Evidence from rotation of chinese auditors. **American Economic Journal: Applied Economics**, American Economic Association, v. 13, n. 3, p. 176–201, 2021.

- CONESA, J. C.; KITAO, S.; KRUEGER, D. Taxing capital? not a bad idea after all! **American Economic Review**, American Economic Association, v. 99, n. 1, p. 25–48, 2009.
- CONESA, J. C.; KRUEGER, D. On the optimal progressivity of the income tax code. **Journal of Monetary Economics**, Elsevier, v. 53, n. 7, p. 1425–1450, 2006.
- COWELL, F. A.; GORDON, J. P. F. Unwillingness to pay: Tax evasion and public good provision. **Journal of Public Economics**, Elsevier, v. 36, n. 3, p. 305–321, 1988.
- D'AGOSTINO, E.; BENEDETTO, M. A. D.; SOBBRIO, G. A model of tax evasion and taxpayers' perception about public goods provision. **Journal of Public Finance and Public Choice**, Birstol University Press, v. 37, n. 2, p. 275–283, 2022.
- DIAMOND, R.; GAUBERT, C. Spatial sorting and inequality. **Annual Review of Economics**, v. 14, p. 795–819, 2022.
- EECKHOUT, J.; PINHEIRO, R.; SCHMIDHEINY, K. Spatial sorting. **Journal of Political Economy**, v. 122, n. 3, p. 554–620, 2014.
- FAJGELBAUM, P. D.; GAUBERT, C. Optimal spatial policies. **Journal of Economics**, v. 135, n. 2, p. 959–1036, 2020.
- FREY, B. S.; TORGLER, B. Tax morale and conditional cooperation. **Journal of Comparative Economics**, v. 35, n. 1, p. 136–159, 2007.
- FULLERTON, D.; KARAYANNIS, M. Tax evasion and the allocation of capital. **Journal of Public Economics**, Elsevier, v. 95, n. 2, p. 257–278, 1994.
- GOUVEIA, M.; STRAUSS, R. P. Effective federal individual income tax functions: an exploratory empirical analysis. **National Tax Journal**, The National Tax Association, v. 47, n. 4, p. 317–339, 1994.
- HALL, R. Macroeconomic fluctuations and the allocation of time. **Journal of Labor Economics**, The University of Chicago Press, v. 15, n. 1, p. 223–250, 1997.
- HIGGINS, S.; PEREIRA, C. The effects of brazil's high taxation and social spending on the distribution of household income. **Public Finance Review**, v. 42, n. 3, p. 346–367, 2014.
- HOLTER, H.; KRUEGER, D.; STEPANCHUK, S. How do tax progressivity and household heterogeneity affect laffer curves? **Quantitative Economics**, Wiley, v. 10, p. 1317–1356, 2019.
- HORI, T.; MAEBAYASHI, N.; MORIMOTO, K. Tax evasion and optimal corporate income tax rates in a growing economy. **Macroeconomic Dynamics**, Cambridge University Press, v. 27, n. 2, p. 743–769, 2023.
- KOTAMAKI, M. Laffer curves and home production. **Nordic Tax Journal**, De Gruyter, v. 1, p. 59–69, 2017.
- LAFFER, A. B. The laffer curve: Past, present, and future. **The Heritage Foundation Publications**, Elsevier, v. 1765, p. 1–16, 2004.
- LUSTIG, N.; PESSINO, C.; SCOTT, J. R. The impact of taxes and social spending on inequality and poverty in argentina, bolivia, brazil, mexico, peru, and uruguay: Introduction to the special issue. **Public Finance Review**, Sage Journals, v. 42, n. 3, p. 129–141, 2014.

- LUSTIG, N.; PESSINO, C.; SCOTT, J. R. The impact of taxes and transfers on inequality in Argentina, Brazil, and Mexico. **The World Bank Economic Review**, v. 28, n. 1, p. 287–303, 2014.
- LUTTMER, E.; SINGHAL, M. Tax morale. **Journal of Economic Perspectives**, American Economic Association, v. 28, n. 4, p. 149–168, 2014.
- RABLEN, M. D. Tax evasion and exchange equity: A reference-dependent approach. **Public Finance Review**, Sage, v. 38, n. 3, p. 282–305, 2010.
- REDDING, S. J.; ROSSI-HANSBERG, E. Quantitative spatial economics. **Annual Review of Economics**, v. 9, p. 21–58, 2017.
- SANDMO, A. The theory of tax evasion: A retrospective view. **National Tax Journal**, The University of Chicago Press, v. 58, n. 4, p. 643–663, 2005.
- SIQUEIRA, M. L. **Um modelo econômico para análise da evasão fiscal do imposto sobre a renda no Brasil**. Phd Thesis (PhD Thesis) — Departamento de Economia, PIMES, Universidade Federal de Pernambuco, Recife, 2004.
- SLEMROD, J. Cheating ourselves: The economics of tax evasion. **Journal of Economic Perspectives**, American Economic Association, v. 21, n. 1, p. 25–48, 2007.
- SLEMROD, J. Tax compliance and enforcement. **Journal of Economic Literature**, American Economic Association, v. 57, n. 4, p. 904–954, 2019.
- SLEMROD, J.; YITZHAKI, S. Tax avoidance, evasion, and administration. In: AUERBACH, A. J.; FELDSTEIN, M. (Ed.). **Handbook of Public Economics**. Cambridge, MA: Elsevier, 2002. v. 3, chap. 22, p. 1423–1470.
- TAUCHEN, G. Finite state Markov-chain approximations to univariate and vector autoregressions. **Economics Letters**, Elsevier, v. 20, n. 2, p. 177–181, 1986.
- TRABANDT, M.; UHLIG, H. The Laffer curve revisited. **Journal of Monetary Economics**, Elsevier, v. 58, n. -, p. 305–327, 2011.
- ULYSSEA, G. Informality: Causes and consequences for development. **Annual Review of Economics**, Elsevier, v. 12, n. 1, p. 525–546, 2020.
- WU, C. More unequal income but less progressive taxation. **Journal of Monetary Economics**, Elsevier, v. 117, p. 949–968, 2021.