# Brazilian Tax Reform: firm dynamics, informality and a special tax regime

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July 31, 2024

**Abstract**

We develop a general equilibrium model with heterogeneous firms, informal sector and a special tax regime for small firms: the Simples system. We bring the model to the data and analyze the effects of the consumption tax reform recently approved in Brazil. Simulating the reform with a measure of simplification of the tax system, we estimate a $4.5\%$ increase in GDP, with $2.7\%$ due to changes in tax rates across sectors and $1.8\%$ due to simplification of the tax system. The results can be significantly different in simulations where the informal and Simples regime are not present.

## 1 Introduction

After 30 years of discussion, the Brazilian National Congress approved the consumption tax reform in December 2023 (EC 132/2023). The approved text had significant changes compared to the one originally presented in 2019 (PEC 45/2019). The reform introduced a dual VAT, composed by the Contribution on Goods and Services (CBS), under the jurisdiction of the Federal Government, and the Tax on Goods and Services (IBS), under the shared jurisdiction of states and municipalities.

In order to estimate the effects of the tax reform, one should take into account that Brazil is a developing economy with a large informal sector and special tax regimes for small firms.

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These features play a major role as firms can, in response to changes in their tax obligations, choose to operate in a different tax regimes. For instance, a firm in Simples can be better of by operating in the general regime, if its compliance costs decreases: the firm can growth and increase productivity. On the other hand, a firm in the general regime can be better of by choosing to be in Simples or in informality, if for example, its tax rate increase and becomes more profitable to downsize.

Moreover, the reform affects differently each industry. The manufacturing sector is expected to face lower taxes, while the service sector is expected to face higher taxes. This potentially leads to opposite aggregate effects: firms in manufacturing tend to be larger and more productive, while service firms can escape more easily to informality or Simples.

In this paper, we develop a general equilibrium model to investigate the effects of the tax reform approved. The model builds on Ulyssea (2018) and is similar to Alvarez et al. (2023) in considering the choice of the fiscal regime made by the firms. However, differently from these papers, we take into account moer than one sector of economic activity and input-output linkages, as Coşar et al. (2016) and Dix-Carneiro et al. (2024) . Firms can operate in the formal standard, informal or Simples system. Firms in the informal sector don't comply with taxes and regulations, but, similarly to De Paula and Scheinkman (2010), face an upper bound for their number of employees, after which they are caught by the fiscal authority and close its activities. Firms in Simples also face lower taxes and compliance costs, but are revenue-constrained, which limits its size.

# 2 Institutional Background

## 2.1 Tax Reform

The Brazilian tax system is often referred to as a "madhouse." According to the World Bank's 2020 Doing Business report, Brazil ranks 184 out of 190 countries for ease of paying taxes. The estimated time a business needs annually to comply with tax legislation is approximately 1,500 hours, highlighting the system's complexity. Despite firms often having an oversized tax division to ensure compliance, tax litigation amounts to about 75% of GDP[1].

A proposal for consumption tax reform aimed at addressing these issues has been under debate for a long time, finally gaining approval in December 2023. Two previous attempts in

[1] see *Contencioso Tributário no Brasil* (2020)

recent years failed to pass [2], but the third attempt was approved by Congress in December 2023 (EC nº132/2023). This reform consolidates five different consumption taxes into a dual VAT system—one federal and the other shared between states and municipalities. This change shifts the taxation of goods and services from the origin to the destination, aligning with standard VAT systems.

The original proposal presented in 2019 recommended a single VAT rate across all economic activities, with no exceptions, estimating the tax rate to be around 25%. However, significant changes were made before approval, including reductions in tax rates for several economic sectors. The current maximum standard tax rate, etipulated by the congress, is 26.5%. The differentiated tax rates are proportional to the standard rate; for example, health and education services will pay 40% of the standard rate, while some food items are exempt. Recently, meats and other products were added to the exemptions list.

A few studies tried to estimate the impact of the tax reform, all of which find positive effects. Delalibera et al. (2024) use a firm production network model and find that unifying the tax rates and eliminating cumulative taxes lead to an increase of 7.9% of GDP and 1.8% of welfare, although the estimated revenue-neutral tax rate was only 6.99% and with no exemptions, which is below the 25% rate in the original proposal. Oliveira (2023) develops a Ricardian model with region-sector units, useful to analyze regional aspects of the reform. The paper builds on Caliendo et al. (2019) and find a positive effect of 2.39% in GDP. When simulating the first proposal of the reform, with a unique tax rate, the effect increases to 5.75%. Domingues and Cardoso (2020) find a positive effect on GDP of 4.14%. None of this papers, however, consider informality or Simples, which is the main advantage of our model.

## 2.2 The Simples system

In order to increase formalization of micro and small firms, the first version of the Simples tax regime (Sistema Integrado de Pagamento de Impostos e Contribuições das Microempresas e Empresas de Pequeno Porte) was enacted in 1996. Aiming at reducing and simplifying the tax obligations for these firms, the system unified 6 federal taxes at reduced rates for eligible sectors of economic activity. In this first version, states and municipalities had the option to adhere to the system. In 2006, a second version of the Simples (Simples Nacional) was approved. In this version, the main state and municipalities taxes (ICMS and ISS, respectively) were collected

[2] PEC nº 175/1995 and PEC nº 233/2008, both of which were not approved.

through the system by firms that chose to adhere to the system.

After Brazil's redemocratization, preferential treatment of small businesses was set in the constitution, "with the goal of incentivizing them through the simplification of their administrative, tax, pension and credit obligations, or through the elimination or reduction of such obligations by law". The reasons stated for the introduction of Simples in 1996 were to comply with the Federal Constitution's article 179, deal with informality, and to address unemployment by favoring small businesses

The Simples initiative can expand the tax revenues by helping small firms to become formal and to growth, as the tax rates for Simples are progressive but smaller than for firms in other tax regimes. On the other hand, tax incentives can generate large firm size distortions, worsening the misallocation of resources in the economy and leading to adverse effects on aggregate productivity

Monteiro and Assunção (2012) and Fajnzylber et al. (2011) use reduced form approaches to analyze the effects of the Simples. Piza et al. (2016) revisits both identification strategies, showing that the impacts of the Simples are ambiguous. Matsumoto (2021) also uses a reduced-form approach to study the effects of Simples on firm outcomes. Our primary goal is not to analyze the impact of Simples. Alvarez et al. (2023) used a structural model to estimate those effects.

We are interested in analyzing the effects of the consumption tax reform when explicitly modeling the Simples regime as a choice made by firms, as it is an important feature in response to changes in the tax structure. That is, changes both in the formal standard taxes and in Simples affect firm's decision on where to operate. It is not clear what the net effect of the tax reform is, and using our quantitative model helps to answer this question.

# 3 Data

In this section we will describe the data sources we use, which are used to calibrate and estimate the model's parameters, as we explain with more detail in Sections 5.1 and 5.2.

The main dataset we use to observe firm's characteristics is RAIS (Relação Anual de Informações sociais), an annual matched employer-employee admnistrative dataset that covers all formal firms in the Brazilian economy. The data contains worker and firm's information, such as education, wages, number of employees and if the firm chose the Simples system in a given

year. Although firms in Simples are formal (they have a tax registry number - CNPJ), in this paper we will label firms in three groups:

- Formal: firms that have tax registry and are not in Simples system
- Simples: firms that have tax registry and are in Simples system
- Informal: firms that don't have tax registry.

Figure 1 displays the firm-size distribution (in log) for Simples and Formal firms, for agriculture, industry and service sectors. In all three sectors, the distribution of Formal firms is right-skewed relatively to Simples firms. Table 1 shows summary statistics. As expected, firms in Simples are smaller on average and have smaller dispersion. We don't observe in RAIS firms revenue or value added.

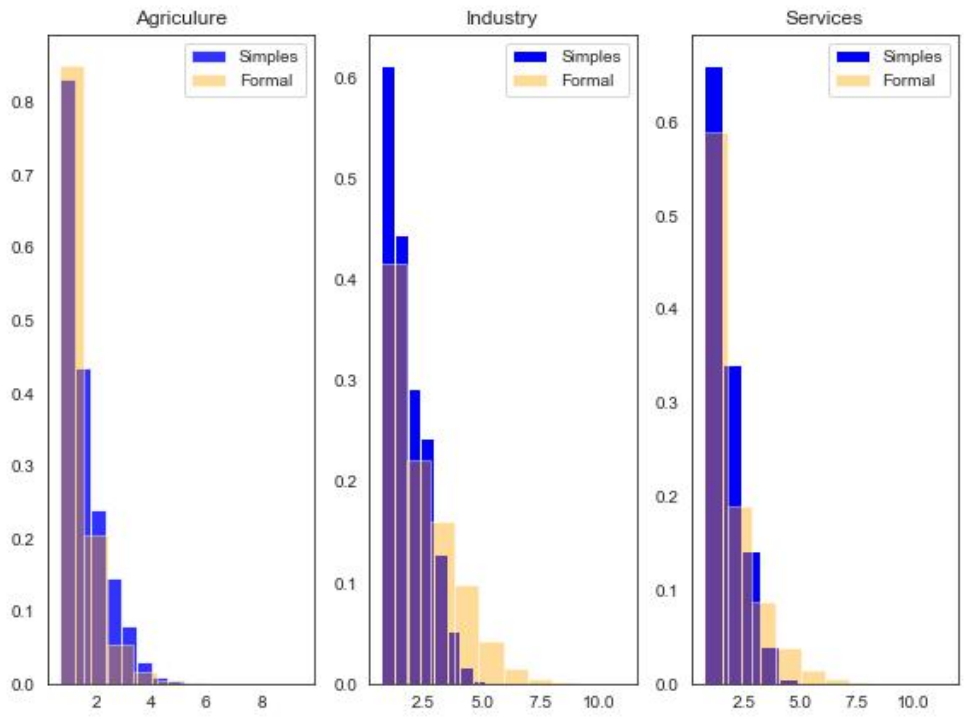


Figure 1: Distribution - log number of workers

To compute after-tax reform tax rates we use IBGE Input-Otput tables and the Supply and Uses Tables. We apply the tax rates proportion of the standard rate as in the law approved for each product and transform into a tax rate for each sector, by using their market shares. In order to account for informality, we use the informal value-added share for each sector as computed in Torezani, n.d. Also from IBGE, we use *Demografia das empresas e estatísticas de*

*empreendedorismo, 2016*. To compute the share of tax revenues coming from Simples we use data from the tax authority (PIS and Cofins revenues, by economic activity and fiscal regime).

| **Firm size** | **Tax regime** | **Agriculture** | **Manufacturing** | **Services** |
|---|---|---|---|---|
| *mean* | Formal | 5.68 | 52.72 | 24.69 |
| | Simples | 6.47 | 8.15 | 6.01 |
| *standard dev.* | Formal | 59.56 | 404.68 | 315.45 |
| | Simples | 15.89 | 12.41 | 17.44 |
| *median* | Formal | 2.00 | 6.00 | 2.00 |
| | Simples | 3.00 | 4.00 | 3.00 |
| *p75* | Formal | 4.00 | 25.00 | 9.00 |
| | Simples | 6.00 | 9.00 | 7.00 |
| *p90* | Formal | 8.00 | 82.00 | 30.00 |
| | Simples | 14.00 | 19.00 | 13.00 |

Table 1: Summary statistics for the firm size distribution

# 4 The model

In this section we develop a general equilibrium model, similar to Ulyssea, 2018, but augmented with more sectors of activity, intermediate goods linkages, and the Simples tax regime. There are $J$ sectors of economic activity $j = 1, \ldots, J$. The first sector is populated by homogeneous representative firms, all of them operating in the formal regime.

In the remaining sectors, $j = 2, \ldots, J$, firms produce a homogeneous good, but are heterogeneous in its productivity $z$. Additionally, firms chose in which fiscal regime $s \in \{F, I, S\}$ to operate. They can choose to be formal ($F$), informal ($I$) or in the Simples regime ($S$). Labor and product markets are competitive, and firms in each sector, independently of its fiscal regime, face the same prices.

## 4.1 Production

For each sector $j$, incumbent firms use the same production technology $q_j(z, \ell, \iota)$, where $z$ is firm productivity, $\ell$ is the labor input, and $\iota$ is an aggregate of intermediate goods $\iota_{jk}$, that represents intermediates goods that a firm in sector $j$ buys from sector $k$. We assume Cobb-Douglas functional forms for the production function and inputs aggregate:

$$q_j(z, \ell, \iota) = z\ell^{\alpha_j}\iota^{\theta_j} \tag{1}$$

$$\iota_j(\iota_{j1}, \ldots, \iota_{jJ}) = \prod_{k=1}^{J} {\iota_{jk}}^{\lambda_{jk}} \tag{2}$$

with $0 < \alpha_j, \theta_j, \lambda_{jk} < 1$ and $\sum_{k=1}^{J} \lambda_{jk} = 1$. We assume $\alpha_j + \theta_j < 1$. This is as the span-of-control model (Lucas, 1978).

Let $p_j^\iota$ be the intermediate inputs index for sector $j$, defined as $p_j^\iota = \frac{\sum_{k=1}^{J} p_k \iota_{jk}}{\iota_j}$. Then the optimal choice for composition of intermediate inputs imply that:

$$i_{jk} = \lambda_{jk}\frac{p_j^\iota \iota_j}{p_k} \quad \text{and} \quad p_j^\iota = \prod_{k=1}^{J}\left(\frac{p_k}{\lambda_{jk}}\right)^{\lambda_{jk}}$$

and, conditional on prices, the optimal choice of $\iota_j$ defines the choices for $\iota_{jk}$, for $k = 1, \ldots, J$.

Formal firms must comply with sector specific taxes and regulations. Firms in Simples must also comply with taxes, but face reduced tax rates compared with formal firms. Additionally, there is a maximum amount of revenues allowed to firms operating in the Simples regime.

Informal firms avoid taxes, but we assume that they face an upper bound for their number of employees. We follow De Paula and Scheinkman, 2010, which assume such a bound for output in their model. This is a simplified way of modelling informality costs, by considering that the probability of detection by government's officials is $100\%$ for firms above this threshold and zero below it.[3]

[3]Ulyssea, 2018 assumes informality costs that rise exponentially with firm size. His estimated parameters imply an informality cost function that is very close to a strict upper bound for firm size. We have experienced with a similar exponential function in the first version of our model also. However, imposing an employment upper bound from the beginning has improved substantially the numerical performance of our solution algorithm.

Current profit function for a firm in sector $j$ and fiscal regime $s$ is given by

$$\pi_{js}(z) = \max_{\ell} \left\{ (1 - \tau_{js}^{Y}) \text{VA}_j(z, \ell) - (1 + \tau_s^{W}) w\ell \right\} \tag{3}$$

subject to

$$\begin{cases} \ell \leq \bar{\ell}^I, & \text{for} \quad s = I \\ p_j q_j(z, \ell, \iota) \leq \bar{R}_j^S, & \text{for} \quad s = S \end{cases} \tag{4}$$

where $\tau_{js}^{Y}$ is the value-added tax rate, and $\tau_{js}^{W}$ is the payroll tax rate, and $\text{VA}_j(z, \ell)$ represents the value-added function, which is simply

$$\text{VA}_j(z, \ell) = \max_{\iota_{j1}, \ldots, \iota_{jJ}} \left\{ p_j q_j(z, \ell, \iota_j(\iota_{j1}, \ldots, \iota_{jJ})) - \sum_{k=1}^{J} p_k \iota_{jk} \right\} \tag{5}$$

If the firm is in the informal regime, we have that $\tau_{jI}^{Y} = 0$ and $\tau_I^{W} = 0$, while if the firm is in the formal or Simples regime, both taxes are positive, $\tau_{jF}^{Y} > \tau_{jS}^{Y} > 0$ and $\tau_{jF}^{W} > \tau_S^{W} > 0$. Labor choices are bounded from above in informal firms by an employment cap $\bar{\ell}^I$. Moreover, if the firm operates in the Simples regime, it faces the additional restriction that its revenue must be limited to a revenue cap $\bar{R}_j^S$.

## 4.2 Productivity distribution

For the stochastic process for the productivity, we must specify the distribution of the signal $G$ and the produtivity shock $F$. As in Ulyssea, we assume $G$ is a Pareto distribution:

$$G_j(\nu \leq x) = \begin{cases} 1 - \left(\frac{x_m^j}{x}\right)^{\xi_j}, & \text{if } x \geq x_m^j \\ 0, & \text{if } x < x_m^j \end{cases}$$

After firms receive the signal, there is a productivity shock $\varepsilon$, which we assume is an i.i.d. lognormal with mean zero and variance $\sigma_j^2$. Then, the productivity $z$ is the product of $\nu$ and $\varepsilon$, which is a Pareto-Lognormal random variable. This distribution has three parameters, $x_m^j, \xi_j$ and $\sigma_j^2$ for each setor.

## 4.3 Entry

In each period and sector $j$, $M_j$ firms are possible entrants. Before entry, firms observe only a signal $\nu_j \sim G_j$ of its actual productivity[4] $z_j$ and pay a cost $E_{js}$ to enter the market. We

[4]G has support in $(0, \infty)$, finite moments and i.i.d.

assume that for each sector $j$, $E_{jF} > E_{jS} > E_{jI}$, which reflects that formal firms face higher costs to enter the market, such as bureaucratic procedures. Likewise, Simples firms face legal constraints to enter the market, but have a simplified tax system.

After entry occurs, firms actual productivity is drawn from a distribution $F_j(z_j|\nu_j)$, which we assume to be continuous in $z_j$ and $\nu_j$ and decreasing in $\nu_j$, which means that $\nu_j$ and $z_j$ are positively correlated. After productivity is realized, it remains constant and firms face an exogenous exit probability $\kappa_{js}$. This formulation of the entry process produces an overlap in the distribution of productivities across different fiscal regimes, which is observed in the data. The value function is given by

$$V_{js}(z) = \frac{\pi_{js}(z)}{\kappa_{js}}$$

Let $V^e_{js}(\nu)$ the expected value of a firm with signal $\nu_j$. That is, before entry decision is taken. Then

$$V^e_{js}(\nu_j) = \int V_{js}(z) dF(z|\nu)$$

The firm chooses its fiscal regime $s$ if

$$V^e_{js}(\nu_j) - E_{js} \geq \max_{s' \neq s} \{V^e_{js'}(\nu_j) - E_{js'}, 0\}$$

For instance, a firm in sector $j$ with signal $\nu_j$ will choose to be formal if its expected gains are higher in the formal regime, that is,

$$V^e_{jF}(\nu_j) - E_{jF} \geq \max\{V^e_{jS}(\nu_j) - E_{jS}, V^e_{jI}(\nu_j) - E_{jI}, 0\} \tag{6}$$

If entry in the three regimes is positive, then

$$V^e_{jI}(\bar{\nu}_{jI}) = E_{jI}$$

$$V^e_{jS}(\bar{\nu}_{jS}) - E_{jS} = V^e_{jI}(\bar{\nu}_{jS}) - E_{jI}$$

and

$$V^e_{jF}(\bar{\nu}_{jF}) - E_{jF} = V^e_{jS}(\bar{\nu}_{jF}) - E_{jS}$$

where $\bar{\nu}_{js}$ is the lowest level of the signal such that the firm in sector $j$ and regime $s$ enters the market.

## 4.4 Equilibrium

We assume there is a representative household that owns firms, supplies labor inelastically and derives utility from consuming the final goods. The utility function is assumed to be a standard

Cobb-Douglas $U(C_1, \ldots, C_J) = C_1^{\zeta_1} \cdot \ldots \cdot C_J^{\zeta_J}$. The government collects taxes from firms and transfers it directly to the household. We consider only stationary equilibria, so that prices and quantities stay constant over time. Household income is then given by $I = w\bar{L} + \sum_j \Pi_j + T$, where $\bar{L}$ is labor supply and $T$ represents government's transfers. $\Pi_j$ represents total profits from sector $j$, net of compliance costs, $M_{jI}E_{jI} + M_{jS}E_{jS} + M_{jF}E_{jF}$, where

$$M_{jI} = [G(\bar{\nu}_{jS}) - G(\bar{\nu}_{jI})]M_j$$

$$M_{jS} = [G(\bar{\nu}_{jF}) - G(\bar{\nu}_{jS})]M_j$$

and

$$M_{jF} = [1 - G(\bar{\nu}_{jF})]M_j$$

which represents the mass of entrants of sector $j$ in each fiscal regime. If we denote by $\mu_{js}$ the mass of firms that survive in sector $j$ and fiscal regime $s$, in a stationary equilibrium the size of each fiscal regime stays constant over time, which translates into

$$\mu_{js} = \frac{1 - F_z(\bar{z}_{js})}{\kappa_{js}} M_{js} \tag{7}$$

where $F_z(\bar{z}_j^s)$ is the unconditional probability that a firm dies in sector $j$ and fiscal regime $s$. The definition of equilibrium is the following:

**Definition 4.1.** *A competitive stationary equilibrium is a set of prices and allocations such that*

1. *Labor and goods market clears.*
2. *Zero profit conditions holds: $z_{js} \geq \bar{z}_{js}$ where $\bar{z}_{js}$ is such that $\pi_{js}(\bar{z}_{js}) = 0$*
3. *For each sector, fiscal regime size is constant over time (equation 7)*

# 5 Estimation

In this section, in order to perform counterfactual analysis, we estimate our model so that it reproduces features of the brazilian economy reflected in the data.

First we calibrate some parameters externally, i.e., directly from the data sources available or from the literature. Then, we estimate the rest of the parameters using a Simulated Minimum Distance (SMD) estimator.

We consider three production sectors in our model, agriculture, manufacturing, and services. Sector $j = 1$ is agriculture. In order to reduce the number of parameters to estimate, and

considering that the relevant definition of formal and informal firms may be different for this sector, we do not model firm heterogeneity and regime choices in agriculture. We assume that productivity $z$ is the same for all firms in this sector, and all firms are formal.[5]

Sector $j = 2$ is manufacturing, including other typically large scale activities with low informality, such as extractive industries (mining, oil) and public utilities (water, gas, electricity). This is the numeraire good in the model, so that $p_2 = 1$.

Sector $j = 3$ is services, including construction. We exclude from services the real state sector, because imputed rents constitute a great part of their GDP, and governmental activities (public administration, public education and health).

## 5.1 External calibration

In this section, we describe the model's parameters that are computed directly from data or borrowed from the literature. First, we use the values for payroll tax rates of the formal sector from Ulyssea, 2018. We take the value for the payroll tax rates for simples used by Alvarez et al., 2023. We assume the same payroll taxes for all sectors.

The production function parameters, $\alpha_j$ and $\theta_j$ come directly from IBGE data, the 2015 Input-Output tables and Supply and Use tables.

For the Simples compliance costs, we use Matsumoto, 2021, which estimate that Simples firms pay about 50% of formal firms in order to comply with tax obligations. From Matsumoto, 2021 also, we use the ratio of about 65% for his estimated production tax ratios in Simples and standard formal firms.

We also impose that the ratio of the informal to formal compliance costs are the same as in Ulyssea, 2018.

For the revenue cap in Simples, we use the estatutory value of R$ 3,600.000 in terms of the mean annual wage: from IBGE, the mean monthly wage in 2015 was R$ 2480. We use the informal labor share (45%) and, following Gomes et al., 2020, multiply informal wages by 12 and formal wages by 13.33 (additional thirteenth % monthly salary every year plus one-

[5] In agriculture, land owners are allowed by the law to hire many formal workers without constituting a company, which is the criteria to define a formal firm in the other sectors. Our main database for formal firms, RAIS, only comprises firms registered as legal entities, that are identified by a number, the CNPJ. However, employment and other data sources point to a high degree of informality in agriculture. We assume that the ratio between tax collection and value added is the value added tax in this sector before the reform.

third of a monthly salary as vacation allowance), which gives us an annual mean wage of $w = 31574 = 2480 \times (12 \times 0.45 + 13.33 \times 0.55)$. So the revenue limit parameter is set to $R/w = \frac{3{,}600.000}{31{,}574} = 114$.

We set the employment upper bound of five employees for informal firms using as reference the ECINF survey (Pesquisa de Economia Informal Urbana), form IBGE. The last edition of this survey of informal firms, from 2003, focus on informal production units with five or less employees.

For the exit rates in the formal sector, we use IBGE (*Demografia das empresas e estatísticas de empreendedorismo, 2016*).

Table 2 shows the externally calibrated parameters of the model

| **Parameter** | **Description** | **Value** | **Source** |
|---|---|---|---|
| $\tau_f^W$ | Payroll tax (formal) | 0.375 | Ulyssea (2018) |
| $\tau_s^W$ | Payroll tax (Simples) | 0.175 | Alvarez, Pessoa and Portela (2023) |
| $\theta_1$ | Intermediate goods share, agriculture | 0.22 | IBGE |
| $\theta_3$ | Intermediate goods share, manufacturing | 0.48 | IBGE |
| $\theta_2$ | Intermediate goods share, services | 0.26 | IBGE |
| $\alpha_1$ | Labor share, agriculture | 0.37 | IBGE |
| $\alpha_2$ | Labor share, manufacturing | 0.34 | IBGE |
| $\alpha_3$ | Labor share, services | 0.47 | IBGE |
| $\bar{\tau}_s^Y/\bar{\tau}_f^Y$ | Simples/Formal mean production tax | 0.65 | Matsumoto (2021) |
| $E_s/E_f$ | Simples/Formal compliance cost ratio | 0.5 | Matsumoto (2021) |
| $E_i/E_f$ | Informal/Formal compliance cost ratio | 0.47 | Ulyssea(2018) |
| $\bar{R}^S/w$ | Simples revenue cap | 114 | Statutory |
| $\bar{\ell}^I$ | Informal employment cap | 5 | ECINF survey |
| $\kappa_{f,1}$ | Exit rate, agriculture | 0.15 | IBGE |
| $\kappa_{f,2}$ | Exit rate, manufacturing | 0.13 | IBGE |
| $\kappa_{f,3}$ | Exit rate, services | 0.16 | IBGE |

Table 2: External Calibration

## 5.2 Internal Calibration

The remaining parameters are estimated through a Simulated Minimum Distance estimator. The procedure is as follows: we use the model to compute, for the given remaining parameter $\phi$, moments related to firms and consumers that we also observe in the data. Then, we use an algorithm to search for an optimal parameter $\hat{\phi}$ that minimizes the distance between the observed data moments and the model's moments, so that our model approximately reproduces the real data. Formally, we compute

$$\hat{\phi} = \arg\min_{\phi}(m(\phi) - \hat{m})' W (m(\phi) - \hat{m})$$

| Parameter | Description | Agriculture | Manufacturing | Services |
|---|---|---|---|---|
| $E_{f,j}$ | Compliance cost (formal) | - | 9 | 6 |
| $\kappa_{i,j}$ | Informal exit probability | - | 0.27 | 0.16 |
| $\kappa_{s,j}$ | Simples exit probability | - | 0.13 | 0.16 |
| $\sigma_j$ | Post-entry productivity shock | - | 0.17 | 0.53 |
| $\xi_j$ | Pre-entry Pareto shape parameter | - | 4.8 | 4.34 |
| $\zeta$ | Consumption share | 0.05 | 0.40 | 0.55 |
| $\tau_f^Y$ | Value-added tax rate | - | 0.48 | 0.14 |
| $\tau_s^Y$ | Simples value-added tax rate | - | 0.20 | 0.10 |
| $A_1$ | Agriculture TFP | 950 | - | - |

Table 3: *Sector-specific Parameters*

where $\phi$, are the remaining parameters, $m(\phi)$ are the moments generated by the model and $\hat{m}$ are the data moment. $W$ is a positive semi-definite matrix that sets relative weights to the moments that we target.

For sources of the data moments used, $\hat{m}$, see Table **??** in Appendix A. We now discuss some concerns related to identification and how the parameters left to estimate can identify such moments.

The parameters of the productivity process, more precisely, the shape of the Pareto distribution and the variance of the post-entry shock are determined by the moments of firm size distribution in each fiscal regime. The tax rates for formal and Simples regimes are determined by the ratio of indirect taxes to value added by sector, and by the share of tax revenues from Simples in two federal taxes, PIS and COFINS. These parameters also influence the size of each regime.

| **Moment** | | ***Model*** | | ***Data*** |
|---|---|---|---|---|
| *Value-added share* | | ***Agriculture*** | ***Manufacturing*** | ***Services*** |
| | *Model* | *7.5%* | *27%* | *66%* |
| | *Data* | *7%* | *23%* | *70%* |
| *Value added per worker (relative to manufacturing)* | | | | |
| | *Model* | *-* | *100%* | *66%* |
| | *Data* | *-* | *100%* | *62.1%* |
| *Share of indirect taxes over value added* | | | | |
| | *Model* | *4.9%* | *43%* | *12%* |
| | *Data* | *4.9%* | *49%* | *9.4%* |
| *Share of informality in value added* | | | | |
| | *Model* | *-* | *3.7%* | *15%* |
| | *Data* | *-* | *3.3%* | *15%* |
| *Share of Simples in indirect taxes revenue* | | | | |
| | *Model* | *-* | *5.76%* | *11.3%* |
| | *Data* | *-* | *1.8%* | *8.9%* |

Table 4: *Model fit - Targeted Moments*

We display the parameter values and model fitin Tables 3 and 4, respectively. Table 5 shows the fit for the untargeted moments.

| **Moment** | | | ***Model*** | ***Data*** |
|---|---|---|---|---|
| *Mean firm size, employees by firm, formal and Simples* | | | 133 | 23 |
| *Mean firm size, formal and Simples (relative to manufacturing)* | | | | |
| | *Model* | - | *1* | *2.82* |
| | *Data* | - | *1* | *2.55* |
| *Share of firms with 1 to 5 employees (formal and Simples)* | | | | |
| | *Model* | - | *50%* | *60%* |
| | *Data* | - | *45%* | *62%* |
| *Firm Size Pareto Shape Parameter (6 or More Employees)* | | | | |
| | *Model* | - | *1.15* | *0.847* |
| | *Data* | - | *0.60* | *0.836* |
| *Sector size (share by sector of the number of formal and Simples firms)* | | | | |
| | *Model* | - | *9.5%* | *90.5%* |
| | *Data* | - | *11%* | *89%* |

Table 5: *Model fit - Untargeted Moments*

# 6 Counterfactual Analysis

In this section, we use the estimated model to assess the effects of the tax reform. We simulate how the tax rates would change across sectors and analyze firm's behaviour in a steady-state equilibrium under different sets of assumption. We are not observing transition dynamics.

First, we use the maximum tax rate allowed in the law, which is 26.5%. As a robustness, we compute the revenue-neutral tax rate, which preserves the same indirect tax over GDP ratio observed before the tax reform, which is 31.5%. This value is above what other studies find and the congress approved as the maximum allowed tax rate. The robustness results concerning this tax rate are displayed in Appendix.

In our main specification, we assume that the compliance costs of the formal firms will decrease and be equal to the compliance costs of Simples. This is a proxy for the reduction in compliance costs related to simplification of the system, as Brazilian main tax system is very complicated and the tax reform is expected to address this issue. Matsumoto, 2021 use IBGE's surveys to compute compliance costs, including accounting and legal costs, for both regimes. He finds that these costs are about $50\%$ lower in Simples.

| *Tax Reform* | *Before* | *After* | |
|---|---|---|---|
| *Variable* | | *Keep compliance* **cost** | *Lower compliance cost* |
| Main tax rate | 48.7% | 26.5% | 26.5% |
| GDP | 100 | 102.7 | 104.5 |
| Indirect taxes / GDP | 19.6% | 17.0% | 17.2% |
| Informal GDP / GDP | 11.1% | 11.9% | 11.5% |
| Simples GDP / GDP | 11.6% | 14.3% | 13.2% |

Table 6: Aggregate effects of the tax reform

We present our main results in Table 9. There is an increase of 4.5% in GDP when we change the tax structure and reduce formal firm's tax compliance burden, which is expressed as a reduction in compliance costs (third column). In the last column, we only change the sector's tax rates, but we keep the compliance cost constant. Note that there is a 2.7% increase in GDP in this scenario. This means that if we decompose the total GDP gain of 4.5% from the tax reform, changing the tax rates accounts for a 2.7% increase and reducing the tax compliance costs account for the remaining 1.8%.

In addition, we see that in both scenarios we observe a small increase in informality and in Simples, as measured by its participation in GDP. By keeping the formal firm's compliance costs constant, we observe a smaller reduction in informality and a larger increase in Simples. This is expected, as more firms will choose the formal sector when facing a reduction in compliance costs for this regime.

Table 10 shows the new tax rates and the effects of the reform for each sector, for the main scenario with reduction in tax compliance costs. We see an increase in the tax rate for manufacturing and a decrease for services, which leads the share of indirect taxes in the manufacturing sector to decrease by 21.6 p.p. and in the service sector to increase by 5.3 p.p. Note that there is a large increase in the Simples value-added share for the service sector, with a small increase in informality, That is, in a scenario of increased tax burden in services, firms that would not enter in the formal regime anymore would prefer the Simples regime and informality.

In manufacturing, the value-added shares of both informality and Simples decrease, which means that more firms prefer the formal regime. As consequence, we see an increase in the value-added of manufacturing sector of 26.6% and a decrease of the service sector of 4.1%. The agregate effect is an increase of 4.5% of GDP, which goes in line with the recent studies analyzing the tax reform. Unlike other studies, our findings indicate that not all economic

| Variable | Agriculture | Manufacturing | Services |
|---|---|---|---|
| **Tax rates** | | | |
| *before tax reform* | 4.88% | 48.7% | 14.3% |
| *after tax reform* | 2.7% | 22.3% | 23.2% |
| **Indirect taxes / VA** | | | |
| *before tax reform* | 4.9% | 43.3% | 11.7% |
| *after tax reform* | 2.7% | 21.7% | 17% |
| **Informal value-added share** | | | |
| *before tax reform* | 0% | 3.72% | 15.4% |
| *after tax reform* | 0% | 2% | 16.6% |
| **Simples value-added share** | | | |
| *before tax reform* | 0% | 12.5% | 12.6% |
| *after tax reform* | 0% | 4.6% | 18.2% |
| **Simples indirect taxes share** | | | |
| *before tax reform* | 0% | 5.76% | 11.3% |
| *after tax reform* | 0% | 4.2% | 11.2% |
| **Value-added share** | | | |
| *before tax reform* | 7.5% | 26.7% | 65.8% |
| *after tax reform* | 7.5% | 26.6% | 65.9% |
| **Change in value-added** | | | |
| *after tax reform* | - | 26.6% | -4.1% |

Table 7: Sectoral effects of the tax reform, reducing formal compliance costs

activities benefit from the reform, even though our classification of economic activities is not too granular.

In a second set of counterfactuals, we first remove Simples from the model while maintaining informality, and then we remove both Simples and informality. These scenarios were simulated by keeping the main tax rate of 26.5% after reform, as before, and the same values for the remaining parameters in each scenario. The compliance costs of the formal regime are again reduced by half, which is the corresponding compliance costs for Simples firms in the main scenario.

We display the results in Table 8, and we compare them to the results in table 9. First of all,

if the Simples tax system simply didn't exist, more firms would directly choose to be informal, as before the reform informality corresponds to 11.1% of GDP in the baseline scenario, and 15.5% in the scenario without Simples. Besides this, note that by only removing Simples, the effects of the reform on GDP are higher. We see, however, an increase in informality in this version (1.3 p.p),

However, in the scenario without the reduction of tax compliance entry costs (last column), without Simples the GDP gains after reform are samller to the gains with Simples. Nonetheless, the tax system simplification effect is much stronger in an environment without Simples.

Now, if both Simples and informality are not present, results change a lot. In the scenario without reduction in tax compliance entry costs, GDP rises $4.1\%$, almost the increase of $4.5\%$ from the model with Simples and informality.

In the scenario with reduction in compliance costs, the GDP increase is very high, 21%, *versus* 4.5% with Simples and informality. Both informality and Simples favors the operation of many firms that would not exist in a world whiteout these alternative production regimes. In this case, reduction in tax compliance would have a much stronger effect on GDP.

We also note that, if we disregard Simples (or Simples and informality) in the model, the tax rates necessary to have a revenue-neutral reform are below the baseline case.

| ***Tax reform*** | ***Before*** | ***After*** | |
|---|---|---|---|
| ***Variable*** | | ***Lower compliance cost*** | ***Keep compliance cost*** |
| Main tax rate | 48.7% | 26.5% | 26.5% |
| *Without Simples* | | | |
| Indirect taxes / GDP | 19.9% | 17.5% | 17.2% |
| Informal GDP / GDP | 15.5% | 16.8% | 18.3% |
| GDP | 100 | 105.7 | 102.7 |
| *Without Simples and informality* | | | |
| Indirect taxes / GDP | 22.8% | 21.4% | 21.4% |
| GDP | 100 | 121 | 104.1 |

Table 8: Aggregate effects of the tax reform, without Simples and without Simples and informality, and reducing compliance costs

# 7 Conclusion

We developed and quantified a model to analyze the effects of the tax reform approved in Brazil. By bringing informality and the Simples tax regime in the choice set of firms, we have new insights on the effects of the reform that were not considered in other papers in the literature. In particular, the tax regime choice plays an important role in understanding how firms will operate in response to the changes in the tax structure.

In particular, we see that the Simples share on GDP responds positively to the change in the tax rate of a given sector. This fact lead to important policy implications: first, firms choosing the Simples regime face a constraint to growth, which leads to misallocation. Second, by not considering the firms' responses to changes in the tax system, government's revenues can be significantly lower than is expected. That is clear when we shutdown the Simples and informality from the model, since the main tax rate in order to keep government's revenue constant should be lower than if we have Simples and informality. If we don't consider these choices made by firms, GDP increase is also overestimated.

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# Appendix

# A Model Solution

In this section we describe the algorithm used to find the model solution. First, given the model's parameters and prices, we compute for each firm (in each sector) the productivity grid.

**Proposition A.1.** *For any sector $j = 1, \ldots, J$ and tax regime $s = \{F, I, S\}$, productivity $z$, prices $w, p_j$, and employment choices $\ell_j(z)$ for incumbent firms are related by:*

$$z = (1 - \alpha_j - \theta_j) \log \ell_j(z) - \Theta_j$$

$$\textit{for} \quad \Theta = \omega + (I - \Lambda) \log p, \qquad \log p = [\log p_1, \ldots, \log p_J]',$$

$$\omega = \begin{bmatrix} (1-\theta_1)\left\{\log \alpha_1 (1-\tau^Y_{1,s}) - \log(1+\tau^W_s) w\right\} + \theta_1 \left\{\log \theta_1 + \sum_k \lambda_{1k} \log \lambda_{1k}\right\} \\ \vdots \\ (1-\theta_J)\left\{\log \alpha_J (1-\tau^Y_{J,s}) - \log(1+\tau^W_s) w\right\} + \theta_J \left\{\log \theta_J + \sum_k \lambda_{Jk} \log \lambda_{Jk}\right\} \end{bmatrix}$$

$$\Lambda = \begin{bmatrix} \theta_1\lambda_{11} & \theta_1\lambda_{12} & \cdots & \theta_1\lambda_{1J} \\ \theta_2\lambda_{21} & \theta_2\lambda_{22} & \cdots & \theta_2\lambda_{2J} \\ \vdots & \vdots & \ddots & \vdots \\ \theta_J\lambda_{J1} & \theta_J\lambda_{J2} & \cdots & \theta_J\lambda_{JJ} \end{bmatrix}$$

Then we compute the policy functions, that is, the labor and intermediate inputs demand function for each firm. In agriculture ($j = 1$) there is no heterogeneity, while in the remaining sectors the policy functions depend on productivity $z$.

The labor demand for formal and Simples firms is given by

$$\ell_j(\tau^W_s, \tau^Y_{js}, w) = \left[ \left(\frac{\theta_j}{p_\iota}\right)^{\theta_j} \left(\frac{\alpha_j (1-\tau^Y_{js})}{(1+\tau^W_s)\cdot w}\right)^{1-\theta_j} \cdot p_j \cdot z_j \right]^{\frac{1}{1-\alpha_j-\theta_j}}$$

For informal firms the labor demand is simply $\ell(0, 0, w)$.

Intermediate inputs is given by

$$\iota = \left(\frac{p_j}{p_\iota} \cdot \theta_j \cdot z_j \cdot \ell_j^{\alpha_j}\right)^{\frac{1}{1-\theta_j}}$$

where $p_\iota$ is the intermediate input price index

With these quantities, we compute the profit and value functions for each firm. The firm's decision on which regime to enter is then made based on the highest expected value function.

# B Additional Couterfactuals

We display the tables relative to the computed tax rate that maintains the same tax burden before and after the reform. The value found is 31.5%, which is much higher than the maximum allowed in the law.

| ***Tax Reform*** | ***Before*** | ***After*** | |
|---|---|---|---|
| ***Variable*** | | ***Lower compliance* cost** | ***Keep compliance cost*** |
| Main tax rate | 48.7% | 31.5% | 31.5% |
| GDP | 100 | 103.5 | 102.3 |
| Indirect taxes / GDP | 19.6% | 19.6% | 19.4% |
| Informal GDP / GDP | 11.1% | 10.5% | 10.7% |
| Simples GDP / GDP | 11.6% | 19.4% | 20.0% |

Table 9: Aggregate effects of the tax reform

Note that the GDP gains are considerably smaller (1 p.p) when we reduce the compliance costs. We see also a small decrease of informality instead of an increase as before. The sectoral effects are displayed in Table 10, which are similar to the ones found with the tax rate of 26.5%.

| Variable | Agriculture | Manufacturing | Services |
|---|---|---|---|
| **Tax rates** | | | |
| *before tax reform* | 4.88% | 48.7% | 14.3% |
| *after tax reform* | 3.4% | 27.2% | 27.5% |
| **Indirect taxes / VA** | | | |
| *before tax reform* | 4.9% | 43.3% | 11.7% |
| *after tax reform* | 3.4% | 26.2% | 18.8% |
| **Informal value-added share** | | | |
| *before tax reform* | 0% | 3.72% | 15.4% |
| *after tax reform* | 0% | 2.3% | 14.9% |
| **Simples value-added share** | | | |
| *before tax reform* | 0% | 12.5% | 12.6% |
| *after tax reform* | 0% | 5.9% | 27.1% |
| **Simples indirect taxes share** | | | |
| *before tax reform* | 0% | 5.76% | 11.3% |
| *after tax reform* | 0% | 4.5% | 15.1% |
| **Value-added share** | | | |
| *before tax reform* | 5.6% | 26.7% | 65.8% |
| *after tax reform* | 5.6% | 26.5% | 66% |
| **Change in value-added** | | | |
| *after tax reform* | - | 27% | -4.7% |

Table 10: Sectoral effects of the tax reform, reducing formal compliance costs