Impacts of a Tax Elimination on Consumption of Food and Agricultural Products in Brazil

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IMPACTS OF A TAX ELIMINATION ON CONSUMPTION OF FOOD AND AGRICULTURAL PRODUCTS IN BRAZIL

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I. INTRODUCTION

In order to carry out its functions, offer services, finance its various activities, the government needs public resources. For this, according to Souza (2012), the government uses derived revenues, that is, that do not result directly from the State's activities, but rather from wealth generated by the private sector and families. This form of collection is known as taxation, where the State has the function of collecting taxes.

The 1967 Federal Constitution provided that Brazilian states should exempt essential products from the Tax on Circulation of Goods and Services, formerly ICM, however, the 1969 Constitution did not maintain such a legal provision. The edition of the 1988 Constitution does not deal with the need for exemption from tax on basic products but considers that, once goods are in the basic basket, the rates should be milder, and, on the other hand, rates greater will apply to superfluous products (Frasson, 2015).

The fact is that the configuration of the Brazilian tax system penalizes the poorest for privileging taxes on the consumption of goods and services, such as medicines, food, and clothing. According to Pintos-Payeras (2010), the poorest 10% pay, in proportion to their income, 44.5% more in taxes than the richest 10% of the Brazilian population. The tax burden affects 53.9% of the income of families receiving up to two minimum wages, while in the wealthiest families, with up to thirty minimum wages, it affects 36.6% of income. Brazil is the third country in the ranking of the highest tax burdens on goods and services, with 15.40%, a value 3.2% above the average of the constituent countries of the Organization for Economic Cooperation and Development, OECD (Gomes, 2016).

According to the 2008-2009 Family Budget Survey (POF) (IBGE, 2011) the lower the family income range, the greater part of the income is spent on food. Expenses with food items represent 16.1% of the total expenses of Brazilian families and 19.8% of consumption expenses. When the incidence in different income levels is observed, the disparity becomes more present, families with an income of up to R$830 spend 27.8% of income on food, while families with income above R$10375 commit 8.5% of income to the same expenditures. Therefore, the Brazilian tax burden may contribute to the increase in the income disparity observed between rich and poor families in the country.

Considering the Government's economic functions (resource allocation, economic stabilization, and income redistribution), the effectiveness of its current configuration to achieve these objectives is questioned, given the progressive nature of taxes. Would there be a way to mitigate the taxes of less favored families and achieve the distributive function of the government? Once the tax rate on household consumption goods, mainly food and agricultural products, is reduced, there would be economic justice. Income taxes, on the other hand, which are progressive in nature, would act in an anti-cyclical way, easing a possible economic recession.

In light of the above, this article analyzes a tax reform that eliminates ICMS[2], IPI[3] and ISS[4] in the final consumption of agricultural products and food, which constitute the largest part of the consumption of the poorest families, and thus analyzes the impact on economic welfare in Brazilian regions. In addition, it is important to analyze the impacts on GDP and government spending. The reason

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2 It is levied in each State on the first sale of goods, after that, on the movement of goods, the tax is levied only on the value-added, based on the previous transaction.

3 Collected at the source of production of the goods, it is incorporated into the price of the goods and paid by the consumer at the time of purchase. It is levied proportionally on the price of the product, at variable rates.

4 Tax on Services of any nature, of competence of the Municipalities and the Federal District, has as a generator fact the provision of services, even if these do not constitute the preponderant activity of the provider.

for this second analysis is that added to the fact that the regions have large socioeconomic differences, the ICMS is a state responsibility, so its impacts differ in each Brazilian region.

An important factor to be considered is the large taxation fortunes for the balance of government accounts. This mechanism would be less unfair to the population since it would be consistent with the economic situation of each family, so the tax burden would be consistent. It is possible to analyze a scenario where richer families transfer revenue to the government, while taxes on food and agricultural products are eliminated. The policy would reduce the inequality generated by the Brazilian tax configuration and serve as an economic stabilizer.

This study aims to analyze the redistributive nature of an agricultural and food sectors fiscal exoneration policy in the Brazilian economy. To understand the mechanism for chaining such a policy, a computable General Equilibrium Model for Brazil (PAEG) was used, analyzing three scenarios. In the first moment, the impact on the regions' welfare is analyzed considering the regional governments and the federal government, without mobility of factors between the regions, allowing the analysis of the impacts only within the regions in isolation.

In a second moment, the mobility of factors (capital and labor) is incorporated into the analysis, is possible to analyze the competition of these factors between regions. The households split into different income classes into the regions allows us to analyze the impact of simulated policy on households (from the poorest to the richest) in each region separately. The final exercise consists in considering that the higher income classes will be responsible for maintaining government activity in the economy, via cash transfer. The redistributive character of the simulated policy is then analyzed. In this third scenario, the objective is to guarantee government consumption, after the loss of income aiming at the welfare of families in the initial income classes.

I.I. Literature Review

Fiscal policy refers to the set of measures by which the government collects revenues and realizes expenditures. The government intervenes in the economy with the objective of stabilizing economic activities, stimulating growth, and improving welfare. Public intervention is summarized in the three main aspects: efficiency, equity, and stabilization. Thus, (stable) economic growth and improving welfare are public objectives, which must be achieved with equity and a fair distribution of income in society (Silva, 2015).

Rivero and Jiménez (2008) reiterate that the economic growth induced by taxation will basically depend on the effects of taxes on agents' decisions, as well as on the effects of the expenditure policies carried out with tax revenues. In principle, a reduction in taxes will boost the return on investment and, therefore, stimulate accumulation, innovation and development, thus raising the growth rate. For Myles (2009) an increase in each tax may have a significant impact on the decision of agents. However, the effects of taxation are not the same in all contexts, regions or countries, as the consequences on decisions and, in turn, on growth may differ markedly.

Therefore, to achieve an efficient taxation system, from both a social and economic perspective, it is indispensable to resort to the benefit principle so that the structure is more efficient and fairer (Além and Giambiagi, 1999). Thus, taxes should be constituted in such a way that each agent is burdened according to its capacity to sustain the tax burden. This principle allows that the use and benefits generated by the goods and services granted to society are not discriminatory and do not exclude Mochón (2007).

The government also intervenes in the economy to provide concrete information to consumers due to market failures that lead consumers to make decisions that are not ideal. While it is important to provide more information to society, taxing staple foods harms the poorest. Griffith and O'Connell (2010) highlight that taxing food reduces the welfare of those who consider it essential. Low-income families tend to spend a larger proportion of their income on food, so they end up paying a larger share of their income in taxes. Leicester and Windmejer (2010), however, see that, considering the nutritional characteristics, a tax on food fats would be regressive.

One problem with taxes targeting specific food components (e.g. fat or sugar) is that food is made up of several nutrients. Segmentation of a bad nutrient with a tax may succeed in reducing consumption levels of that nutrient, but it can have the unintended consequence of increasing consumption of another bad nutrient if they are negatively correlated. Smed, Jensen and Denver (2007) simulate the impact of a

series of taxes levied on individual nutrients and discover that they can have undesirable consequences for the demand for other nutrients. This means that a food tax is undesirable because it risks compromising the government's objectives of redistributing wealth. What matters for redistribution is not whether a particular tax is regressive or not, but the progressiveness of the tax and benefit system as a whole. If a tax is regressive, the government can compensate low-income households using other parts of the tax and benefit system (Griffith and O'Connell 2010).

Azevedo et al. (2014) carry out a specific study for Brazilian states and municipalities and conclude that a more rigid fiscal policy, measured by changes in the cyclamen-te adjusted primary balance, is not associated with an increase in inequality measures in the period 1995 to 2011. In contrast, Davoodi, Gupta and Chu (2000) and Woo et al. (2013) consider that inequality in income distribution can be explained by the level, regressiveness of taxes and government spending policies. Thus, direct taxes and social expenditures tend to improve the income distribution of the economy, while indirect taxes tend to increase inequality.

Longo and Troster (1993) highlight that a redistribution of income helps to reduce market inefficiencies. Transfers, taxes and subsidies are ways for the government to carry out its distributive function. More broadly, it is through transfers that the government stimulates the re-distribution of income and should tax those agents with higher income with higher charges, retributing resources to subsidize others with lower income.

Ball et al (2013) consider that between 1978 and 2009, tax consolidation in 17 OECD countries had significant effects on income distribution. The authors emphasize the increase in inequality, the decrease in labor (wages) in income formulation and the increase in long-term unemployment. The evidence also suggests that expenditure-based adjustments had, on average, greater distributional effects than tax-based adjustments. Using static and dynamic models for panel data, Cunha and Vasconcelos (2018) analyze the tax impact policy on inequality of income distribution in Brazil. The authors sought to identify which categories of public spending contributed to the reduction of inequality from 2004 to 2014. The results indicate that higher spending on social assistance and welfare promote lower inequality indices.

Cubero and Hollar (2010) state that the impacts of tax policy on income distribution in developed and developing countries tend to be similar. Goñi, López and Servén (2008), however, note that tax collection in Latin American countries is lower than in European countries. The authors also note that despite the low personal and corporate collaboration, the income tax of the upper classes fell from 49.5% in 1985 to 30% in 2004. For the case of Brazil, the work of Varsano et al. (1998) addresses basically the same characteristics pointed out by Goñi, López and Servén (2008), but the first states that given the fiscal crisis of the Brazilian state, at the time of the study, any policy that diminishes the receipt of the state would be discarded. Given the consumption tax as the safest amount received by the state and accompanied by the uncertainties through a higher income tax, this change was left in a second plan.

An increase in the taxation of higher income people is worrying in terms of their changing behavior in the face of a reduction in their effective income. A possible adverse behavior is the non-transition of the economic agent to higher income class, either by varying the source of income that is declared, changing the number of children (there is an income tax deduction for each child) and others. Saez (2001) indicates that more efficient taxations should occur incrementally, but with a certain limit.

In contrast Silveira, Fernandes and Passos (2019) affirm that there is still room for a higher taxation of the higher income classes. The higher the level of income of the agents, the higher is the portion of income exempted from taxation. Thus, the progressive character of the tax would not be affected. In relation to profits and dividends, the mentioned work calculates a loss of up to R$ 40, if they were taxed progressively.

Income between Brazilian affirm is also diversified. There is higher income in the South and Southeast and lower in the North and Northeast although all states are subject to the same federal laws (Piancastelli, Perobelli and Mello, 1996). By raising the direct tax, it is possible that there is also a redistribution of income between the states. As Medeiros, Souza and Castro (2015) states, despite the growth in income, its appropriation is primarily by the richest part of the population.

II. METHODOLOGY

To achieve the proposal a computable General Equilibrium Model was used, the Brazilian

Economy General Equilibrium Analysis Project (PAEG), an analytical set of static, multiregional and multi-sectoral general equilibrium, based on GTAPinGAMS.

The model uses the Modeling Programming System for General Equilibrium (MPSGE) algorithm syntax, developed by Rutherford (1999), which represents a general equilibrium model by means of equations blocks of production functions, demand and specific constraints. MPSGE transforms this information into algebraic equations, which are processed in GAMS software. The generated equations characterize zero profit conditions for production, balance between supply and demand in the markets and definition of income for the consumers of the model.

In PAEG, the database for the Brazilian economy is disaggregated into five regions, keeping the GTAP data for other regions and data on trade flows between Brazil and other regions of the world intact. Two versions of the model were chosen, one with the possibility of dividing the government in two (NAZARETH, 2017) and the version that allows families to be divided into ten income classes (WOLF, 2016). Table 1 presents the aggregation of the PAEG, which would be highlighted for the regions and sectors analyzed in this study.

TABLE I
AGGREGATION OF SECTORS, REGIONS AND INCOME CLASSES CONSIDERED IN PAEG MODEL

SECTORS	REGIONS
Rice (pdr)	**Brazil – North**
Maize and other cereals (gro)	**Brazil – Northeast**
Soybeans and other oilseeds (osd)	**Brazil – Midwest**
Sugar industry (c_b)	**Brazil – Southeast**
Meat and alive animals (oap)	**Brazil – South**
Milk and dairy products (rmk)	Rest of Mercosur
Other agricultural products (agr)	United States of America
Food (foo)	Rest of NAFTA
Textile industry	Rest of Americas
Clothing and shoes	China
Wood and furniture	Rest of the World
Indústria do papel	
Chemicals, rubber and plastics	
Manufacturing	
Electricity, gas and distribution	
Trade	
Transport	
Public administration	

Source: Teixeira, Gurgel e Wemerson (2013).

Each region is represented by a final demand structure, composed of public and private expenditures on goods and services. The productive sectors combine intermediate inputs and primary production factors - capital, labor, land and natural resources - to minimize costs, given the technology. The database includes bilateral trade flows between countries and regions, as well as transportation costs, import tariffs and export taxes (or subsidies)[5].

In the Gurgel, Pereira and Teixeira (2011) work, the variables representing the levels of activities in equilibrium and the relative prices of goods and factors are presented in detail. All variables have a value determined by the model, where each price in equilibrium is associated with the market equilibrium condition. The optimization processes are described by different mathematical relationships that occur in the general equilibrium model. In addition to these relationships, the model considers the equilibrium conditions between supply and demand in the markets, zero profit and

5 More details on the PAEG model structure in: Gurgel, Pereira and Teixeira (2011) and Wolf *et al.* (2018).

income and expenses equilibrium of agents to complete the computational equilibrium process.

Public sector consumption combines domestic ($vdgm_{ir}$) and imported ($vigm_{ir}$) commodities, through a constant elasticity substitution function (CES), and taxes (R^{G}_{ir}), to form the aggregate government demand (G_r), as follows:

$$G_r: \sum_i (vdgm_{ir} + vigm_{ir}) + R^G_{ir} \tag{1}$$

Government revenue considers indirect tax revenues on production and exports (R^{Y}_{ir}), imports (R^{M}_{ir}), consumption (R^{C}_{r}), government demand (R^{G}_{r}), on factors of production (R^{HH}_{r}) transfers from abroad (vb_r), and net transfers between government and households ($vtax_r$). The government's restriction is therefore:

$$vgm_r = \sum_i R^Y_{ir} + \sum_i R^M_{ir} + R^C_r + R^G_r + R^{HH}_r + vb_r - vtax_r \tag{2}$$

Total government income, given by international transfers, household transfers and tax revenue, should be equal to government expenditures, i.e. $vgm_r = G_r$. At the highest level of the government consumption basket, goods are combined in a Leontief function (elasticity of substitution equals zero).

The private sector combines domestic ($vdpm_{ir}$) and imported ($vipm_{ir}$) commodities, considering a constant elasticity of substitution (CES), and taxes (R^{C}_{ir}), to form the aggregate consumption of households, as follows:

$$C_r: \sum_i (vdpm_{ir} + vipm_{ir}) + R^C_{ir} \tag{3}$$

The budget constraint of the representative agent equals income from factors of production ($evom_{fr}$), discounting taxes on factor income (R^{HH}_{ir}), transfers between government and households ($vtax_r$), with consumption expenditure (vpm_r) and private investment (vim_r), as follows:

$$\sum_f evom_{fr} - R^{HH}_r + vtax_r = vpm_r + vim_r \tag{4}$$

The total income of the representative agent, given by the income from the factors of production, discounting the taxes on the factors, plus the net transfers between government and households, should be equal to private expenditure ($vpm_r = C_r$). In the consumption basket of the representative agent goods are combined in a Cobb-Douglas function (elasticity of substitution equals one). A priori, the model considers $vtax_r$ and vim_r as exogenous.

Private agent consumption can be represented by a problem of minimizing the cost of a given level of aggregate consumption, as follows[6]:

$$\min_{ddpm,dipm} \sum_s py_{is}\left(1 + rt^{pd}_{ir}\right) ddpm_{ir} + pm_{ir}\left(1 + rt^{pi}_{ir}\right) dipm_{ir}$$
$$subject\ to: H_r(ddpm, dipm) = C_{ir} \tag{5}$$

Where: py_{is} is the domestic supply price, gross of taxes/indirect subsidies on production; pm_{ir} is the import price, gross of indirect taxes on imports; rt^{pd}_{ir} are the taxes on private consumption within the region itself; and, rt^{pi}_{ir} are the taxes on private consumption originating outside the region. The commodities priced by py_{ir} and pm_{ir} form an aggregate index of private consumption: pc_r.

The model stores in its database the specific taxes of the Brazilian regions (icms, ipi and iss). Therefore, to represent a reduction of these taxes on household consumption in the Brazilian regions, it is enough to remove them from the taxes on private consumption inside and outside the region (see Annex A).

The model' closure considers that the total supply of each production factor does not change, but such factors are mobile between sectors within a region. There is no unemployment in the model, so factor prices are flexible. On the demand side, investments and capital flows are kept fixed, as well as the balance in the balance of payments, so changes in the real exchange rate should occur to accommodate changes in exports and imports flows after the applied shocks. The representative agent aggregate

6 In these equations, the decision variables correspond to the initial (or benchmark) data, with the initial letter "d" in place of the letter "v".

consumption may change with changes in goods prices, as well as the revenue from taxes will be subject to changes in the activity level and consumption.

The analysis will be made in three scenarios:

a) The first scenario does not consider the households disaggregation, in order to be able to activate the mobility of the primary factors (capital and labor) between the regions, thus it will be possible to verify the behavior of factor evasion between the regions;

- The impact on welfare in Brazilian regions, and on the main GDP aggregates, including the consumption of federal and regional governments, is analyzed.

b) The second scenario considers the income classes disaggregated in the Brazilian regions, making it possible to analyze the impact of the policy of eliminating taxes on the welfare of families in each region, as well as the impact on GDP;

c) The third scenario will be to consider the transfer mechanism of the wealthiest households in the model (classes 8, 9 and 10) to analyze the effects on household welfare and GDP.

When we chooses to allow for factor mobility between the regions of the model, in the first scenario, it is not possible to consider income class disaggregation, since the activation of these two properties at the same time generates greater complication in the mathematical formulation of the model and requires greater data for its adequate representation. Furthermore, when we consider the disaggregation into ten income classes it is possible to analyze only the behavior of capital and labor factors.

In the federal version of the PAEG, taxes in the economy are divided between the federal and regional governments, the net transfer between the two (TF^{RF}) is considered, and the government restriction is distinguished in vgm_{rF} and vmg_{rR}, as follows[7]:

$$\begin{aligned} vgm_{rF} &= \sum_i R^Y_{irF} + R^C_{rF} + \sum_i R^M_{irF} + R^{GF}_{rF} + R^{GR}_{rF} + R^{HH}_{rF} + TR^{RF} + vb_{rF} - vtax_{rF} \\ vgm_{rR} &= \sum_i R^Y_{irR} + R^C_{rR} + \sum_i R^M_{irR} + R^{GF}_{rR} + R^{GR}_{rR} + R^{HH}_{rR} + TR^{RF} - vtax_{rR} \end{aligned} \tag{6}$$

Thus:

$$\begin{aligned} GF_r &: \sum_i (vdgm_{irF} + vigm_{irF}) + R^{GF}_{rR} + R^{GF}_{rF} \\ GR_r &: \sum_i (vdgm_{irR} + vigm_{irR}) + R^{GR}_{rF} + R^{GR}_{rR} \\ C_r &: \sum_i (vdpm_{ir} + vipm_{ir}) + R^C_{rF} + R^C_{rR} \end{aligned} \tag{7}$$

In the second scenario, the government becomes one again, and the activation of the different income classes divides the consumption of the private agent ($vdpm_{ir}$ and $vipm_{ir}$) into ten classes in the Brazilian regions ($vdpm\_f_{ir}$ and $vdpm\_f_{ir}$), as well as the income from primary factors ($evom\_f_{fr}$) and direct taxes ($vtax\_f_r$), where f = 1, ... ,10. In addition, domestic (py_{ir}) and imported (pm_{ir}) commodities are combined to form an aggregate index of consumption (pc_r) for each household in the Brazilian regions ($pcbra\_f_r$). This allows the model to change its formation from a single agent to the representation of ten household classes in each region, separated by income level and representing the specific consumption preferences of the different classes.

The disaggregation by income class allows a more refined analysis of the impacts of government policies on different social strata in the five Brazilian regions. The income classes considered in the model are:

Class 1 – up to R$ 400,00;
Class 2 – from R$400,00 to R600,00;
Class 3 – from R$ 600,00 to R$ 1000,00;
Class 4 – from R$ 1000,00 to R$ 1200,00;
Class 5 – from R$ 1200,00 to R$ 1600,00;
Class 6 – from R$ 2000,00 to R$ 3000,00;

7 see Nazareth (2017). The federal government receives international transfers, vb_{rF}

Class 7 – from R$ 3000,00 to R$ 4000,00;
Class 8 – from R$ 4000,00 to R$ 5000,00;
Class 9 – from R$ 5000,00 to R$ 6000,00;
Class 10 – mora than de R$ 6000,00.

In the third scenario, the option to distinguish between federal and regional government is deactivated, and a variable is added to the model that allows endogenous net income transfers between the wealthiest households in the model (8, 9 and 10) and the government, in order to keep public sector activity constant after a shock, of, for example, reduction of indirect taxes on consumption of private consumption, this variable is defined as tau_r. Thus, when f = 8, 9 and 10, we have:

$$vgm_r = \sum_i R_{ir}^Y + \sum_i R_{ir}^M + R_r^C + R_r^G + R_r^{HH} + vb_r - vtax_r + tau_r$$
$$\sum_f evom_{fr} - R_r^{HH} + vtax_r - tau_r = vpm_r + vim_r \quad (8)$$

The tau_r variable should assume a value in the model solution that balances government expenditures and revenues after any shock applied in the model, i.e., the income of the richest households is reduced to the same intensity that the government needs to maintain the level of consumption in the public sector.

The parameter that calculates the change in economic welfare is the equivalent variation (EV) in percentage terms. Varian (1992) indicates that EV expresses the necessary change in income to maintain the level of utility, at initial equilibrium prices, when the consumer faces a new set of prices:

$$\mathrm{EV} = \frac{(U^f - U^0)}{U^0}\mathrm{RA}^0 \quad (9)$$

U^f represents the final utility level, U^0 represents the initial utility level and RA^0 represents the private agent's income in the initial balance.

III. Results and Discussion

In a first moment, is analyzed a scenario where families are not divided into different classes. After this initial analysis, the mobility of primary factors (capital and labor) is allowed, allowing the assessment of the impact of their transfer between regions. In order to reach such result, two types of government are considered in the analysis: one is the regional government, corresponding to the Brazilian regions; and the other is the federal government. The impacts of the taxes' withdrawal on the consumption of food and agricultural products in the Brazilian regions, without considering the mobility of factors between the regions, on the welfare of the regions are presented in Table 2.

Table II
Impact of the taxes withdrawal on the food and agricultural products consumption on the Brazilian regions welfare (without factors mobility between regions)

Region	Welfare	GDP	Government_R	Government _F
North	0.204%	0.142%	-0.641%	-0.207%
Northeast	0.165%	0.111%	-0.547%	-0.207%
Midwest	0.194%	0.167%	-0.735%	-0.207%
Southeast	0.060%	0.085%	-0.357%	-0.207%
South	0.273%	0.215%	-0.831%	-0.207%

Where: Government_R is the Regional Government welfare; Government_F is the Federal Government welfare

Source: The authors

Since the scenario reduces taxes on final consumption for all households, the immediate impact is a reduction in government revenue (federal and regional), thus a reduction in their consumption capacity, which represents a drop in their welfare. The greatest impacts are in regions where there is

greater agricultural and food activity. The South (-0.831%) and Midwest (-0.735%) regions are those where the regional government shows a greater loss of welfare.

In contrast, the removal of consumption taxes means an increase in household welfare. The households that would benefit most from the policy would be those in the South and North, with welfare gains of 0.273% and 0.204%, respectively. The warming in terms of domestic consumption in the agricultural and food sectors raises welfare in all regions, raising GDP, especially in regions where these sectors take a larger share in economic activities, even with the participation of both governments in the economy.

Table 3 presents the volume of capital and work transferred between regions, since factor mobility is allowed. Positive values indicate that the region receives a certain type of factor while the region loses resources if the value is negative. Therefore, the higher the value reported in Table 3, the higher the value received from the factor in question. It is expected that regions with a comparative advantage in the sectors favored by the policy in relation to the others will receive a larger volume of resources (capital/labor).

TABLE III
IMPACT OF FOOD AND AGRICULTURE TAX WITHDRAWAL ON THE MOBILITY OF THE FACTORS BETWEEN BRAZILIAN REGIONS

FACTOR*	NORTH	NORTHEAST	MIDWEST	SOUTHEAST	SOUTH
Labor	0.12	-0.13	1.25	-0.54	0.92
Capital	0.10	-0.11	1.22	-0.62	0.93

* percentual variation

Source: The authors

The results show that the exemption from taxes on the final consumption of food and agricultural products enhances the comparative advantage of the Central West region as the main food producer in the country, which ends up attracting capital and labor from other regions. The South and North regions also receive resources from other regions. In this scenario, the Southeast and Northeast lose factors to other regions, since the food and agricultural sectors are less expressive in these regions compared to the others.

The impacts of the withdrawal of taxes on food and agricultural products, considering the mobility of factors between regions, on the welfare of the regions are presented in Table 4.

TABLE IV
IMPACT OF THE TAXES WITHDRAWAL ON THE FOOD AND AGRICULTURAL PRODUCTS CONSUMPTION ON THE BRAZILIAN REGIONS WELFARE (WITH FACTORS MOBILITY BETWEEN REGIONS)

REGION	WELFARE	GDP	GOVERNMENT _R	GOVERNMENT _F
North	0.331%	0.206%	-0.570%	-0.178%
Northeast	0.064%	0.005%	-0.607%	-0.178%
Midwest	1.334%	1.365%	0.133%	-0.178%
Southeast	-0.443%	- 0.458%	- 0.750%	-0.178%
South	1.232%	1.146%	- 0.214%	-0.178%

Where: Government_R is the Regional Government welfare; Government_F is the Federal Government welfare

Source: The authors

The regional government of the Midwest benefits in terms of welfare, which is easily explained by the strong increase in GDP, of US$1.88bi and in consumption in this region. In other words, with perfect mobility, the exemption from taxes on the final consumption of food intensifies the comparative advantage of the region, which ends up attracting capital and labor from other regions and growing to the point of reversing the loss of regional tax revenue. The South region has an even stronger GDP growth than the Midwest region, representing US$3.9bi, but not enough to reverse the loss in revenue.

This can occur both because the taxes on food and agricultural products have a more relevant weight in the tax collection of the South in relation to the Midwest, so that the elimination of tax revenue

from food from the South is not replaced by tax revenue from other sectors even though the economy is heated, and because the South is a more relevant region for consumption in these sectors, i.e., the South is more populous and spends more resources on the consumption of food and agricultural products, while the Midwest is a major exporter of food to the rest of the country.

The warming of the economy of the South means a greater increase in food consumption than in other regions. The Southeast region presents a drop in economic welfare, since the sectors heated by the reduction of taxes are smaller compared to other sectors of the economy. The negative impact is felt in the GDP and welfare of the regional government, the region loses resources to others where the food and agricultural sectors are more productive.

The impacts of the taxes withdrawal on the food and agricultural products consumption in Brazilian regions on welfare in each income class in the regions are presented in Table 5. Since taxes on the analyzed sectors tend to reduce the price of these in relation to other sectors, the results suggest greater gains in economic welfare the higher the consumption of each class of sectors with reduced taxes, with welfare gains for households and a reduction in consumption of goods other than those in the tax cut, due to the relative price of food and agricultural products becoming lower.

TABLE V
IMPACT OF THE TAXES WITHDRAWAL ON THE FOOD AND AGRICULTURAL PRODUCTS CONSUMPTION ON THE FAMILIES WELFARE ON BRAZILIAN REGIONS

INCOME CLASS	NORTH	NORTHEAST	MIDWEST	SOUTHEAST	SOUTH
1st	0.574%	0.615%	0.931%	0.251%	1.161%
2nd	0.721%	0.506%	0.854%	0.362%	0.963%
3rd	0.688%	0.494%	0.847%	0.402%	0.793%
4th	0.637%	0.425%	0.678%	0.347%	0.623%
5th	0.469%	0.740%	0.601%	0.325%	0.734%
6th	0.385%	0.337%	0.597%	0.281%	0.629%
7th	0.350%	0.267%	0.604%	0.212%	0.450%
8th	0.327%	0.189%	0.598%	0.216%	0.431%
9th	0.262%	0.231%	0.353%	0.169%	0.423%
10th	0.169%	0.148%	0.234%	0.126%	0.253%

Source: The authors

It is shown that, in general, the first income classes families are the ones who present the greatest welfare gain, mainly in regions where the agricultural and food sectors are more expressive in relation to the other sectors of the economy. The poorest families have a greater share of consumption of food and agricultural products. The result shows that taxes on the consumption of basic goods punish poor households more than rich ones. Poorer households spend a larger share of their income on food and agricultural products than richer households in all regions, even if the price of these sectors is lower compared to other sectors of the economy. This is corroborated by Griffith and O'Connell (2010), who concluded that poorer families commit a larger share of their income to taxes.

It is important to note that lower welfare gains do not necessarily mean lower consumption in comparison, since the gain in terms of percentage of welfare refers to a comparison of initial consumption and after the shock analyzed in the income class itself. For example, the 0.251% welfare gains in the Southeast region represent a gain of 0.016 US$bi, while the Midwest region, the 0.931% gain represents 0.015 US$bi. A 1.161% variation in the welfare of the first income class in the South region corresponds to US$ 0.027 US$bi, while a 0.615% variation in the Northeast corresponds to US$ 0.044 US$ bi.

The results show the importance of analyzing Brazilian regions in isolation. More populated regions may present a lower increase in welfare in terms of percentage variation, but in real terms the gains are high, as is the case of the Southeast. The same is true for a region where few families are part of the lower extracts, so the results may be more expressive, as is the case in the Southern region. What we see is that, in all regions, the poorest families increase their welfare in relation to the richest ones, the

weight of the sectors that suffer tax reductions is greater for the poorest in all regions.

In order to maintain the government activity level at the beginning of the equilibrium, which loses welfare after the adopted policy (since it loses tax collection and reduces its consumption) the compensation mechanism for the richest families of the model is activated. That is, families in the income classes 8,9,10 will make transfers to the government in order to reestablish their activity in the economy. The impact of this policy in the Brazilian regions is presented in Table 6.

TABLE VI
COMPENSATION GENERATED BY HIGH INCOME CLASSES TRANSFERS

REGION	FAMILIES CONSUMPTION	GOVERNMENT CONSUMPTION	GDP
North	0.004%	0.342%	0.124%
Northeast	-0.007%	0.313%	0.088%
Midwest	-0.004%	0.452%	0.154%
Southeast	-0.016%	0.214%	0.067%
South	0.019%	0.433%	0.161%

Source: The authors

Table 6 shows that private welfare in the regions, in aggregate, is positive in the North and South and negative in the other regions. However, variations are minimal and the impact on GDP is positive for all regions. The impact is more significant in the regions with comparative advantages in the sectors that suffer tax cuts. It can be observed that government activity is re-established in the economy, with a return in terms of welfare for the government, therefore the objective outlined in the scenario was achieved. The added (aggregate) welfare is not very expressive (or even negative) because these same households are responsible for a considerable portion of consumption (since they concentrate most of the regions' income). Table 7 presents the impacts of the income classes of each Brazilian region.

TABLE VII
IMPACT OF THE TAXES WITHDRAWAL ON THE FOOD AND AGRICULTURAL PRODUCTS CONSUMPTION ON THE FAMILIES WELFARE ON BRAZILIAN REGIONS, KEEPING THE GOVERNMENT CONSUMPTION LEVEL

INCOME CLASS	NORTH	NORTHEAST	MIDWEST	SOUTHEAST	SOUTH
1st	0.574%	0.615%	0.931%	0.251%	1.161%
2nd	0.721%	0.506%	0.854%	0.362%	0.963%
3rd	0.688%	0.494%	0.847%	0.402%	0.793%
4th	0.637%	0.425%	0.678%	0.347%	0.623%
5th	0.469%	0.740%	0.601%	0.325%	0.734%
6th	0.385%	0.337%	0.597%	0.281%	0.629%
7th	0.350%	0.267%	0.604%	0.212%	0.450%
8th	- 0.637%	- 1.222%	- 0.742%	- 0.236%	- 0.671%
9th	- 0.437%	- 0.703%	- 1.075%	- 0.202%	- 0.328%
10th	- 0.583%	- 0.201%	- 0.168%	- 0.154%	- 0.264%
Agg_1	(0.260)	(0.528)	(0.412)	(0.964)	(0.628)
Agg_2	(-0.256)	(-0.546)	(-0.418)	(-1.122)	(-0.577)
Welfare	(0.004)	(-0.018)	(-0.006)	(-0.158)	(0.051)

Source: The authors

The results presented in Table 7 indicate that the disaggregated household's welfare shows gains for all income classes, except income classes 8 to 10, which are responsible for maintaining government activity. The income transfers of the richest households for the government to balance their accounts

represent an increase in income tax. The impacts on the first seven income classes are the same as presented in the previous scenario, since nothing, other than the reduction of taxes on food and agricultural products, affects these families.

The Agg_1 indicator represents the aggregate welfare of income classes 1 to 7 in US$bi, while the Agg_2 indicator represents the aggregate welfare of households in income classes 8 to 10. We note that the (negative) aggregate impact suffered by the richest households in the model, and responsible for the transfers to the government, is practically the same as the welfare gains of the poorest households. Thus, the scenario shows an optimal income redistribution, with positive effects on GDP, but with the aggregate welfare of the regions as whole suffering almost no change (poor households do not fully appropriate the consumption that the rich gave up).

In general, when comparing the effect of tax withdrawal with other papers such as Ball *et al* (2013), Davoodi, Gupta and Chu (2000), Woo et al (2013) and Smed, Jensen and Denver (2007), we see similar conclusions that reinforce the use of this mechanism to improve income distribution in the economy, but we perceive a contrary result of Azevedo et al (2014). The results of the income tax changes, in the higher income classes, contradict in part the results addressed by Varsano et al (1998), since the present study shows that compensating the loss of government revenues through higher taxation of wealthy households turns out to be a good alternative of income redistribution policy.

This study shows that the loss of government revenue in the first scenario is converted into welfare gains for all family classes. It is also observed that due to the mobility of the factors the regions with more prominent agricultural activities are benefited both by the tax reduction, which increases the welfare gain of families, and by the economic heating due to the fact that food products are cheaper and there is then migration of capital and labor for them. In the second scenario, although some regions show a loss of welfare, the exercise shows that families are benefited by the policy of tax reduction, only the government suffering a loss of welfare, except for the Midwest.

With the direct tax increase in the upper classes a possible adverse behavior of the economic agent would be an attempt at tax evasion, but labor does not consider this possibility. Font, Spanakos and Bordin (2004) point out that Brazil has some cascading taxes and a possible withdrawal of these would imply uncertainty in relation to the government budget, which justifies, therefore, a source of collection via direct taxes.

Moreover, a more stable political scenario with a primary surplus that allows the reduction of public spending is necessary before a change in fiscal policy. Since government consumption is maintained through the transfer of the richest families (8, 9 and 10), in the third scenario, the transfer of their welfare to other families is evident. The aggregate welfare balance is nonetheless positive, or with a low negative impact, which reveals an efficient transfer policy, with positive impacts on income inequality.

IV Concluding Remarks

The main interest of the study was to investigate changes in household welfare by eliminating excise taxes on food and agricultural products. Preliminary studies indicate that the welfare of lower-income families would increase, since a large part of their salary is spent on these items. In the first simulation, without factor mobility between regions, there was an increase in well-being in all income classes, with lower income classes benefiting the most. Furthermore, the value of the variable representing GDP increased, while public spending necessarily had to decrease, as tax revenues decreased.

Regarding income inequality, it can be said that it has decreased, since the income classes with lower wages had a greater gain in welfare than the income classes with higher wages. However, when looking at capital mobility between regions, the simulation results were of a movement of capital and labor to regions that were already rich, indicating an increase in regional income inequality, thus contrasting with the result of decreasing income inequality in general.

To restore public spending, the transfer of income from the upper classes was simulated along with the reduction of taxes. In this simulation, there was an even more marked reduction in income inequality between classes at the aggregate level. At the regional level, there was little change compared to the baseline scenario used in the comparison, that is, the aggregate well-being of the regions has changed relatively little. This result indicates the great importance of income taxation, reflecting its positive impact on reducing income inequality.

Increasing household consumption is equivalent to a cash transfer and reducing government revenue only implies equivalent expenditure for this purpose. This result is very positive if one considers the speed of transfer and the low administrative cost for the government, thus using the collected resource in an economically efficient way.

Although the issue of stabilization is not present in the analysis, considering a transfer from the higher income classes to the government has two merits: distributional objectives and income. Despite the gain in aggregate welfare, there are almost no changes and an income generation transfers income to the poorest families.

In this way, it is concluded that the progressive tax issue in fact reduces income inequality and improves aggregate welfare. Therefore, eliminating taxes on agricultural and food products and, at the same time, inducing a mechanism similar to a progressive tax improves income distribution, there is a very subtle impact on aggregate welfare and an improvement in government revenues.

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ANNEX A

The parameter of the model representing the rates on household consumption in the region itself is rtpd(i,r) which represents the household consumption tax on good "i" within region "r". The parameters representing the taxes (icms, ipi and iss) to be taken from the final consumption of households are icms(i,j,r), which represents the portion of the ICMS tax on goods "i" by sector "j" originating within region "r" and ipi_iss(i,j,r), which represents part of IPI+ISS of good "i" by sector "j" originating within region "r". Thus, the shocks applied in the PAEG model were:

rtpd(“*pdr*”, *bra*) = *rtpd*0(“*pdr*”, *bra*) - *ipi_iss*(“*pdr*”, “*cf*”, *bra*) - *icms*(“*pdr*”, “*cf*”, *bra*);
rtpd(“*gro*”, *bra*) = *rtpd*0(“*gro*”, *bra*) - *ipi_iss*(“*gro*”, ”*cf*”, *bra*) - *icms*(“*gro*”, “*cf*”, *bra*);
rtpd(“*osd*”, *bra*) = *rtpd*0(“*osd*”, *bra*) - *ipi_iss*(“*osd*”, ”*cf*”, *bra*) - *icms*(“*osd*”, “*cf*”, *bra*);
rtpd(“*c_b*”, *bra*) = *rtpd*0(“*c_b*”, *bra*) - *ipi_iss*(“*c_b*”, “*cf*”, *bra*) - *icms*(“*c_b*”, “*cf*”, *bra*);
rtpd(“*oap*”, *bra*) = *rtpd*0(“*oap*”, *bra*) - *ipi_iss*(“*oap*”, “*cf*”, *bra*) - *icms*(“*oap*”, “*cf*”, *bra*);
rtpd(“*rmk*”, *bra*) = *rtpd*0(“*rmk*”, *bra*) - *ipi_iss*(“*rmk*”, “*cf*”, *bra*) - *icms*(“*rmk*”, “*cf*”, *bra*);
rtpd(“*agr*”, *bra*) = *rtpd*0(“*agr*”, *bra*) - *ipi_iss*(“*agr*”, “*cf*”, *bra*) - *icms*(“*agr*”, “*cf*”, *bra*);
rtpd(“*foo*”, *bra*) = *rtpd*0(“*foo*”, *bra*) - *ipi_iss*(“*foo*”, “*cf*”, *bra*) - *icms*(“*foo*”, “*cf*”, *bra*);

The parameter of the model representing the rates on consumption of households outside the region is the rtpi(i,r), which represents the household consumption tax on good "i" in region "r". Then, to remove the taxes on all products, including those consumed by households in the region, originating in another region, the following lines are added to the shock code:

rtpi(“*pdr*”, *bra*) = *rtpi*0(“*pdr*”, *bra*) - *ipi_iss*(“*pdr*”, “*cf*”, *bra*) - *icms*(“*pdr*”, “*cf*”, *bra*);
rtpi(“*gro*”, *bra*) = *rtpi*0(“*gro*”, *bra*) - *ipi_iss*(“*gro*”, ”*cf*”, *bra*) - *icms*(“*gro*”, “*cf*”, *bra*);
rtpi(“*osd*”, *bra*) = *rtpi*0(“*osd*”, *bra*) - *ipi_iss*(“*osd*”, ”*cf*”, *bra*) - *icms*(“*osd*”, “*cf*”, *bra*);
rtpi(“*c_b*”, *bra*) = *rtpi*0(“*c_b*”, *bra*) - *ipi_iss*(“*c_b*”, “*cf*”, *bra*) - *icms*(“*c_b*”, “*cf*”, *bra*);
rtpi(“*oap*”, *bra*) = *rtpi*0(“*oap*”, *bra*) - *ipi_iss*(“*oap*”, “*cf*”, *bra*) - *icms*(“*oap*”, “*cf*”, *bra*);
rtpi(“*rmk*”, *bra*) = *rtpi*0(“*rmk*”, *bra*) - *ipi_iss*(“*rmk*”, “*cf*”, *bra*) - *icms*(“*rmk*”, “*cf*”, *bra*);
rtpi(“*agr*”, *bra*) = *rtpi*0(“*agr*”, *bra*) - *ipi_iss*(“*agr*”, “*cf*”, *bra*) - *icms*(“*agr*”, “*cf*”, *bra*);
rtpi(“*foo*”, *bra*) = *rtpi*0(“*foo*”, *bra*) - *ipi_iss*(“*foo*”, “*cf*”, *bra*) - *icms*(“*foo*”, “*cf*”, *bra*);

The shocks represent that the new rate on final consumption of imported products "cf" in each Brazilian region ("bra") will be equal to the initial rate (rtpdi0) minus taxes (icms, ipi and iss) in the food and agricultural sectors.