



# Reducing the regressivity of indirect taxation in Brazil through a personalized value-added tax<sup>☆</sup>

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## Abstract

ICMS is a value-added tax and the most important tax in Brazil in terms of revenue. This paper investigates the technical feasibility and impact of a reform to ICMS. The aim of the reform is twofold, on the one hand, to modernize the tax and redress some current flaws in terms of neutrality, simplicity and transparency and, on the other, to reduce its regressivity, increase redistribution, reduce poverty and impact positively on social welfare (without a loss in the tax revenue). A static behavioral microsimulation model was purpose-constructed to study the proposed reform. The new tax simplifies the current system by introducing a single general tax rate and an increased rate for alcoholic beverages and tobacco, without exemptions, combining this with a total or partial refund for the poorest families. The empirical results show that the new tax is superior to the current one, both in terms of efficiency and equity.

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## 1. Introduction

The Brazilian VAT, the *Imposto sobre Operações Relativas à Circulação de Mercadorias e sobre Prestações de Serviços de Transporte Interestadual e Intermunicipal e de Comunicação* (ICMS hereafter) is the most important tax in Brazil in terms of tax revenue (Higgins & Pereira, 2013). Its greatest shortcomings are mostly due to the classic mitigation mechanism aimed at reducing regressivity, as it relies on multiple tax rates and an abundance of exemptions, trying, with little success, to increase tax progressivity (Silveira et al., 2013). The regressivity of indirect taxation is a well-known issue (see, for instance, Decoster et al., 2010). This is source of concerns in Brazil where labor income is very unequally distributed (Higgins & Pereira, 2013), and personal income tax revenues is not as relevant as in other developed countries, providing thus a limited redistributive capacity.

There is a consensus among policy-makers that the current model of ICMS needs to be reformed because, in addition to serious economic inefficiencies, it leads to federal conflicts and worsens social inequalities. However, any reform to it is complicated because: i) three levels of government can regulate the tax, ii) it can have important effects on industrial activity,<sup>3</sup> and iii) the federated states' tax revenues might be strongly affected.

Given previous failures to reform the tax from a broad national perspective, other alternatives must be explored. One plausible way is to take advantage of the legal opportunities that Brazil's states have to change certain elements of the tax. Each Brazilian state holds the necessary legislative power to: i) define tax rates, ii) grant and revoke exemptions, iii) establish set-off mechanisms, and iv) establish tax refunds for companies whose input tax is higher than their output tax. This high scope of authority justifies possible reforms at this level.

Our proposal focuses on two paradigms: modernization and personalization. Modernization, as defined by Ebrill et al. (2001), consists of adapting taxation to consumption in line with current best practices, based on the following premises: a simple tax (with a reduced number of tax rates), and a broad base (all goods and services should be taxed). This generally implies positive economic effects in terms of efficiency (minimizing the distortionary effect of taxation caused by the low tax rates or exemptions typically applied to basic goods in order to reduce regressivity) and a high revenue-collection capacity. Personalization, on the other hand, has redistributive goals, aiming at reducing poverty and inequality and boosting social welfare. Our proposed personalization is inspired by the work of Barreix et al. (2010, 2011).<sup>4</sup>

In this study, three scenarios are simulated: the model of ICMS in force in 2015, which serves as a baseline, and two hypothetical reforms. The first reform, called the Intensified Universal Solution (IUS), explores whether the economic and social effects of a simple increase in tax differentiation would be an interesting way of helping to improve redistribution. The second reform, the Personalized ICMS (P-ICMS), eliminates the existing exemptions and

<sup>3</sup> As discussed later, unlike most VAT systems, ICMS is applied at source. The tax's collection by a state is not based on the place where the good is consumed but on the location of the company where it is produced.

<sup>4</sup> Note that anti-poverty policies could be implemented using taxation, as in our case, or through expenditure policies, as in Nugroho et al. (2021).

multiplicity of tax rates to achieve greater efficiency. Only two tax rates are considered: the general tax rate and an increased tax rate for alcoholic drinks and tobacco. This is combined with a total or partial refund of ICMS paid by the poorest households.

The proposed reforms are feasible from several perspectives. First, the tax revenue is held constant. Second, the proposed changes come under the federated states' exclusive authority, avoiding comprehensive reforms that need consensus between the states and the national administration. Third, the proposed changes are perfectly feasible with the technology and information currently held by the Brazilian tax authorities.

The data is taken from the Family Budget Survey for 2008–2009 collected by the Brazilian Institute of Statistics and Geography. It is important to note that the proposed reforms are applicable to any of the 27 federated states in Brazil but, given that ICMS changes from one state to another, the study focuses on one of them: Rio Grande do Sul. To obtain the simulation results, a specific static behavioral microsimulation model of ICMS for the state of Rio Grande do Sul has been constructed. It is called the MECI/RS.<sup>5</sup> The results show that P-ICMS is superior to the current model of ICMS and to IUS in all areas of interest: it substantially reduces regressivity, it lowers poverty and it has a positive impact on social welfare, without any reduction in revenue for the administrations.

We believe that the analysis is useful beyond the specific state of Brazil. First, the study examines two ways of counteracting the typical regressivity of indirect taxation, an exercise that is of general interest. It compares the conventional way, where equity and redistributive objectives are incorporated into the tax design, with a more innovative way, in which a tax refund mechanism is used for equity purposes and the design of the tax is strictly focused on efficiency, operational simplicity and its collection capacity<sup>6</sup>. Second, similar results could be obtained in other Brazilian states. The impact of the reform could be even better in terms of poverty and regressivity reduction in poorer states with more unequal income distributions.

The study contributes to the relevant literature in several ways. First, to our knowledge, it is the first time that an indirect tax reform involving a refund for poor households has been simulated using real data. Second, the simulated reform has been studied so that it can be implemented from a legal and technical point of view by Brazil's different federated states. Third, a purpose-built microsimulation model of Brazil's ICMS was used. This is the first specific simulator of this tax and it includes behavioral reactions in household consumption decisions. Fourth, the simulations account for household income elasticities in order to explore the effects of tax refunds, while other VAT reform simulations only consider price elasticities, since they regard income to be exogenously determined.

## 2. Description of the scenarios: the modernization and personalization of ICMS

### 2.1. The modernization of ICMS

By “modernizing” ICMS, the aim is to boost its efficiency and to bring it in line with current best practices. This implies reducing the number of tax rates, modifying the tax setoff system, and drafting a refund policy. In this sense, [Majumder et al. \(2021\)](#) analyze the convenience of having uniform tax rates across regions.

<sup>5</sup> MECI/RS is an acronym for the Portuguese name *Microsimulador Estático con Comportamiento del ICMS del Estado de Rio Grande do Sul*.

<sup>6</sup> Other authors use VAT policies with other purposes. For example, [Funke and Terasa \(2022\)](#) analyze the countercyclical properties of a temporary reduction of the VAT in Germany.

First, number of tax rates would be simplified. There are currently 7 different tax rates in the state of Rio Grande do Sul. According to the [International Tax Dialogue \(2013\)](#), only 1 % of the world's present VAT systems has more than six positive rates. The tax benefits or exemptions that are currently available would be eliminated (except for those under national authority provided for in the Federal Constitution or in the act known as the *Ley Complementar*).

Second, the physical deduction criterion would be abandoned and the financial deduction criterion adopted. All inputs, including physical capital and services, would be subject to tax deductions, and there would be a quick refund if the input tax exceeded the output tax.

This modernization policy would imply first and second-order revenue gains. The first-order revenue gains directly derive from the tax uniformity policy. The second-order revenue gains, not included in our simulations, would be derived from the increase in economic activity.

## 2.2. *The personalization of ICMS*

The modernization process alone would make ICMS even more regressive. A plausible solution to this dilemma between efficiency and equity is the personalization of fiscal benefits, similar to the policy presented by [Barreix et al. \(2010\)](#). This is inspired by Japan and Canada, the first countries to introduce alternative solutions to standard practices.

The idea is to lower VAT for certain groups of individuals/households whom the system aspires to favor. For instance, a combination of “personalization” and what [Barreix et al. \(2010\)](#) term the “Universal Solution” has been introduced in Japan, where there are tax deductions on combinations of specific types of goods and consumers. The Japanese solution, however, is characterized by a complexity that tends to partly counteract the “simplicity” pursued through the uniformity of a modern VAT. Canada has opted for an easier solution by applying a proportional rate. Basic products, such as food and others related to healthcare products, are exempt. In addition, there is a partial tax refund mechanism on consumption for the most socially vulnerable sectors of the population (depending on the households' socio-economic characteristics).

Our proposed personalization of ICMS is aimed at reducing tax on consumption for the poorest sectors of the population. With this strategy, tax reductions would be introduced through refunds to poorer households, instead of the exemptions on products found in the reference baseline system. The personalization process does not interfere with transactions by companies or their behavior. When tax is levied on a purchase, the company is unaware whether the purchaser is entitled to a tax refund or not. The same rate is applied to everybody and the tax is recorded in the usual way.

## 2.3. *Simulated scenarios*

This section briefly describes the 2015 scenario, which is used as a reference, and the different simulated scenarios. See [Padilha \(2017\)](#) for further details of the 2015 scenario and the tax rate of each product in all the simulated scenarios. [Table 1](#) summarizes the features of each scenario.

### A. *Baseline scenario (ICMS 2015)*

The (pre-reform) reference scenario is the system in force in 2015. This, in general, consists of the application of a general tax rate of 17 %, in combination with increased tax rates and a policy of selective deductions and reduced tax rates used to counteract regressivity (the

**Table 1**  
Main characteristics of simulated scenarios.

Structural elements	Current ICMS	"IUS"	P-ICMS
General tax rate	17 %	17 %	18 %
Increased Tax Rates	18 % / 25 %	18 % / 30 %	25 %
Reduced tax rates	7 % / 12 %	4 % / 12 %	None
Exemptions	Many	= CURRENT ICMS	None
Personalization	None	None	Full refund in the first decile Partial refund between 1 <sup>st</sup> and 3 <sup>rd</sup> decile
Compensation scheme	"Physical" criterion	"Physical" criterion	"Financial" Criterion

"universal solution"). As mentioned earlier, there are 7 different tax rates in Rio Grande do Sul and a multitude of deductions and exemptions for specific products.<sup>7</sup>

**B. Intensified Universal Solution (IUS)**

This paper considers a second scenario, based on further differentiation of tax rates: the IUS. This involves a cut in the tax rate on basic products from 7 % to 4 %. The tax rate on medicines would also be lowered from 17 % to 9 %. On the other hand, the effective tax rates on alcoholic beverages, tobacco, electricity, communication, fuel (except diesel), perfume, vehicles, hair products and firearms would be raised from 25 % to 30 %. The objective is to increase the difference between the tax burden on basic consumption and on other expenses, holding the tax revenue constant.

**C. Personalized ICMS (P-ICMS)**

The proposed P-ICMS contemplates both the modernization and personalization of ICMS. The simulated P-ICMS only uses two tax rates: a general 18 % rate and an increased rate of 25 % on alcoholic beverages and tobacco. All tax exemptions and reductions dependent on certain types of products would be eliminated.

Personalization would favor approximately one million poor households (about 30 % of the total). It would consist of a full or partial refund of the ICMS paid by the poorest families. A full refund would be given to households with incomes below the first decile or when their per capita income was below 20 % of the first decile. The partial refunds would be in inverse proportion to the household's net income, as per Eq. (1) below. This would affect families with a net income between the 10<sup>th</sup> and the 30<sup>th</sup> percentiles. In relative terms, households in the 30<sup>th</sup> percentile would benefit the least, with a 50 % refund of the general ICMS tax rate. Households in the first decile would benefit the most, with a 100 % refund.

$$E_F^f \% = 50\% \times \left( \frac{Y_{p30} - Y_f}{Y_{p30} - Y_{p10}} + 1 \right) \tag{1}$$

Where  $Y_{p30}$  is the net income corresponding to the maximum limit for the receipt of a partial refund (the third decile) and  $Y_{p10}$  is the net income corresponding to the bottom limit for the receipt of a partial refund (the first decile).<sup>8</sup>  $E_F^f$  % is the percentage of ICMS to be refunded to a

<sup>7</sup> It should be clarified that all the simulations were conducted using values updated monetarily to the year 2016, based on variations in the revenue from ICMS collected by the state of Rio Grande do Sul, in order to offer a more representative picture of the current reality and to facilitate its interpretation.

<sup>8</sup> In 2015, the household income in the first decile was R\$ 1780.16 ( $Y_{p10}$ ), while for the third decile ( $Y_{p30}$ ), it was R\$

family with monthly net income  $Y_f$ . In addition, to discourage fraud a per-household maximum refund limit is computed multiplying  $E_F^f$  % by 60 % of its gross income.

The refund is calculated on the families' estimated expenditure following the modernization of ICMS and not on any expenditure made with refunded income, which avoids having to iterate the model. Hence, when computing the benefits of personalization, figures do not account for some of the reform's benefits for poor families or for economic activity.<sup>9</sup>

### 3. The microsimulation model

#### 3.1. Rio Grande do Sul

Rio Grande do Sul (RS) is a state with a population of almost 12 million. The revenue from ICMS in 2016 was R\$31,000 million, equivalent to US\$7,560 million. This amount is equivalent to 7.5 % of the state's GDP and it implies a per-capita income of approximately US\$ 1,000. There are about 1.3 million ICMS taxpayers, 340 thousand are companies (69 thousand subject to the general tax system, 270 thousand to the *Simple National* system) and 920 thousand rural producers.

#### 3.2. The data

MECI/RS uses microdata from the 2008-2009 edition of the *Pesquisa de Orçamentos Familiares* (POF).<sup>10</sup> This is an expenditure survey of Brazilian households, conducted periodically by the Brazilian Institute of Statistics and Geography (IBGE), which obtains general information on households, families and individuals, in addition to the consumption habits, expenditures and incomes of the surveyed families.

Out of the 134,240 households interviewed, 2,210 were based in Rio Grande do Sul. The sample weights are representative at a state level, so it is possible to compute consumption, income and tax figures for the population of Rio Grande do Sul.

#### 3.3. The model

Although simulation models have become a widely used technique in the field of public economics, there are very few microsimulation models that simulate the effects of fiscal reforms in Brazil. To our knowledge, there are two microsimulation models that aim to simulate the main figures in the Brazilian tax system: i) the Brazilian Household Microsimulation System

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(footnote continued)

3141.84.

<sup>9</sup> To differentiate between the consequences of the modernization of ICMS and its personalization, a reform called M-ICMS was simulated. This reform only includes modernization and not personalization. Obviously, it leads to a significant increase in tax revenue.

<sup>10</sup> We are aware that data from 2008-2009 are not the latest, but a new wave (for years 2017-18) was released only in 2019. The construction of the microsimulation model and the simulations were completed well before 2019. More information about the POF data are availability at <https://www.ibge.gov.br/estatisticas/sociais/educacao/24786-pesquisa-de-orcamentos-familiares-2.html?edicao=25578&t=publicacoes>. However, in the online appendix we offer a comparison of income distribution in the two datasets, POF 2008-2008 and POF 2017-2018, reaching to the conclusion that distribution hardly changed. Therefore, redistribution impact of the reforms should be similar using the new dataset.

(BRAHMS) developed by Immervoll et al. (2006),<sup>11</sup> and ii) the Brazilian tax-benefit micro-simulation model developed by Bezerra Nogueira et al. (2011). Both are general models that simulate a larger number of fiscal instruments than MECI/RS, but they are not appropriate for this study. While they both simulate ICMS, the data that they are built on does not include household expenditure, hence it would not be possible to evaluate the redistributive effects of ICMS reforms and possible behavioral reactions.

Thus, to analyze the modernization and personalization of ICMS, the MECI/RS micro-simulation model was developed.<sup>12</sup> The model is static, and so it is useful for simulating short-term effects of the reform. All of the sample's heterogeneity has been exploited in order to simulate the *ex-ante* effects of a hypothetical reform. MECI/RS incorporates consumer behavior reactions, specifically changes in household spending behavior brought about by changes in prices and, where appropriate, by changes in income. This required the development of an econometric model to estimate a demand system for these households in response to variations in their income and in the relative prices of consumed products. More specifically, the income and price elasticities were the relevant parameters drawn from the demand system. Elasticities were estimated for each household, enabling to assess the reform's impact on expenditure on each good for each household and thus its overall redistributive implications. More details about the ICMS, the data, the microsimulation model and the econometric specification to introduce the behavioral reactions are available in the online appendix.

MECI/RS uses the regulations in force in 2015 (the year of the model's construction) under Act 8820 of January 27<sup>th</sup> 1989, which regulates ICMS. The expenditures in the survey were updated from 2008 and 2009 to 2015 by proportionally increasing ICMS tax revenues during the same period.<sup>13</sup>

MECI/RS was run in two steps to simulate the effects of the P-ICMS scenario. First, estimated price elasticities, the expenditures declared by families in the baseline scenario and the tax changes in the simulated scenario were used to calculate the new household expenditures after modernization, the new tax and the (full or partial) refunds owing to households. As a precautionary assumption, the tax changes were assumed to be fully transferred to prices. Second, income elasticities were used to find out the final expenditures on each product after personalization. In the IUS simulation, this second step was not necessary.

The model was validated to ensure that the calculations were adequate and that they fit in with current legislation. The model was calibrated to ensure that the results were representative of the aggregate data for Rio Grande do Sul. To achieve as realistic estimates as possible, a certain degree of tax evasion was accounted for, implying the existence of a black market. Available information on tax evasion suggests that 11.25 % of sales are not taxed. This value is maintained in all the simulated scenarios, although both modernization (which simplifies taxation) and personalization (which allows for refunds of paid taxes) should reduce the incentive to evade taxes.

In this regard, it is worth noting that household income is underreported in the database: the declared income is often lower than the sum of the expenditures. Although this is actually a possibility, it is unlikely to be widespread, especially among low-income households, who are

<sup>11</sup> Neri et al. (2018) provide an interesting analysis of redistribution in Brazil from 1995 to 2015 using this model.

<sup>12</sup> See Padilha (2017) for more details of how it works, as well as the manipulation of the data, the assumptions that were made and other technical details.

<sup>13</sup> This allowed us to obtain tax revenue figures closer to national accounts than if, for example, we adjusted expenses based on nominal GDP growth.

more likely to be liquidity constrained (they cannot borrow money easily) and who usually lack the necessary savings to fund such expenditures. Consequently, incomes of some of the families needed to be imputed, as described in Padhila (2017). This does not affect the simulated expenditures or the collected ICMS in each scenario, but it does affect the redistributive analysis whenever household income information is used.

The tax revenue that was calculated by the model for 2015 is a good approximation of the official figures, with a small difference of just about 1 %. In conclusion, after validating and calibrating the model, we can confirm that it works correctly and that it is a true reflection of ICMS in the state of Rio Grande do Sul.

#### 4. Results

This section presents the results of simulations, including the tax burden, the redistributive effects (the effects on inequality, poverty, progressivity and redistribution), the efficiency and welfare impact of each simulated scenario. The household incomes and expenditures were transformed into equivalent incomes, using the modified OECD equivalence scale, to deal with households of differing sizes.

##### 4.1. Tax burden

The tax burden is the ratio between the families’ input ICMS and their consumption expenditure (on products subject to ICMS). The results are presented in Fig. 1.

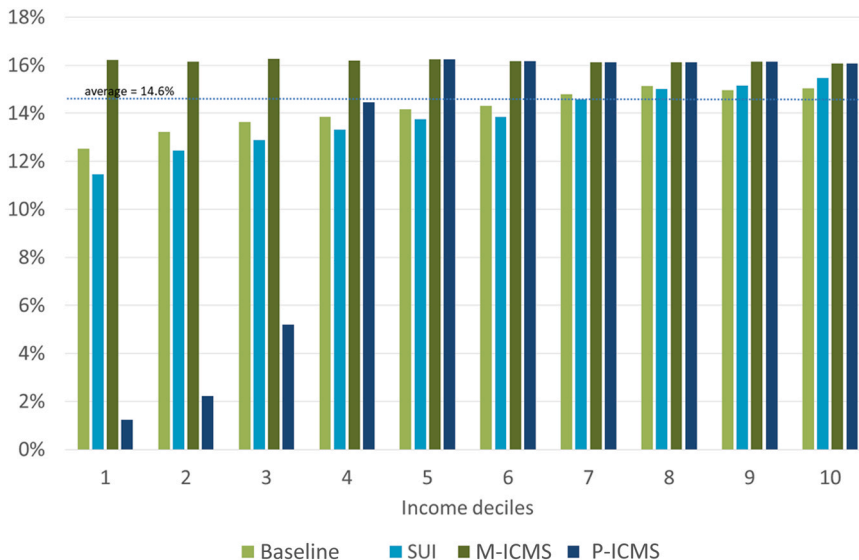


Fig. 1. Tax burden by ICMS (in deciles). Source: own calculations, based on MECI/RS.



The first salient aspect is that in the universal-solution scenarios (the baseline and IUS scenarios), the ICMS tax burden grows as the income deciles rise. This indicates that, in global terms, the definition of the tax rates and exemptions serves to ensure that the higher tax burden is on the richest. When this is compared with a uniform tax scenario (the dotted line in Fig. 1), the ICMS in force in 2015 (our baseline) has a significant effect on the tax burden. The population with a gross income below the first decile benefits the most, with a relative 14 % reduction in their tax burden. At the other end of the spectrum, the wealthiest members of the population are only slightly affected, with a rise in their tax burden from 14.6 % to 15 %, i.e. less than 3 % in relative terms. The impact is slightly larger for the IUS scenario. In this case, the population in the first decile sees a 22 % drop in their tax burden in relative terms, while it rises by 6 % for the richest.

Lastly, the P-ICMS is much more effective at reducing the tax burden on lower-income households. The simulations show that the tax modernization process (M-ICMS) leads to an average tax burden of about 16.1 %, similarly distributed among all the deciles. However, following tax refunds, the tax burden on low-income households drops substantially. The average tax rate paid by households below the first, second and third deciles is 1.2 %, 2.2 % and 5.2 % respectively. Above the third decile, the tax burden is larger than in the reference scenario.

## 4.2. Redistribution

Analyses of the redistributive effects of taxation are generally based on the ratio between the taxes paid by households and their gross income. From this perspective, indirect taxation of consumption is essentially regressive, because families with relatively low income levels devote a larger proportion of their income to the consumption of goods and services. However, some authors (see Creedy, 1998 or Barreix et al., 2006) argue that it is more appropriate to measure redistribution in terms of household expenditure. We report both approaches, although they lead to the same conclusions.

To measure inequality, we used the Gini coefficient before and after taxes. The Gini index ranges between 0 and 1, with 0 indicating perfect equality. The Reynolds-Smolensky (RS) and Kakwani indexes were also calculated to analyze redistribution and progressivity, respectively. The RS index estimates redistribution as the difference in the Gini index before and after tax. Positive (negative) values imply that taxation reduces (increases) the existing inequality. The Kakwani index focuses on the progressivity of taxation. The more unequal the tax burden, the higher the burden for richer households and so the greater the progressivity. Negative values of the Kakwani index indicate that the tax is regressive, while positive values indicate a progressive tax.

### 4.2.1. Income inequality

Our simulations confirm a high degree of inequality in the initial distribution of income in *Rio Grande do Sul*, indicated by the high value of the Gini coefficient for pre-tax equivalent income (0.426). ICMS fails to reduce the existing inequality, as shown by the RS index, which takes negative values. This also happens with the "universal solution" (the baseline and IUS scenarios) and with the modernization of ICMS (M-ICMS). The RS only takes a positive value in the case of P-ICMS, implying a reduction in inequality after tax, although the extent of the change is very small (RS = 0.0011). Since the pre-tax income is identical in all the scenarios, the

**Table 2**  
Inequality, redistribution and progressivity.

	Equivalent income				Equivalent consumption			
	<i>Gini</i> $G_X$	<i>Gini</i> $G_{X-T}$	RS	Kakwani	<i>Gini</i> $C_X$	<i>Gini</i> $C_{X-T}$	RS	Kakwani
Reference	0.426	0.4317	-0.0057	-0.0271	0.3851	0.3887	-0.0036	0.0138
IUS	0.426	0.4306	-0.0046	-0.013	0.3851	0.3874	-0.0023	0.0279
M-ICMS	0.426	0.4338	-0.0078	-0.0468	0.3851	0.3918	-0.0067	-0.0059
P-ICMS	0.426	0.4249	0.0011	0.0488	0.3851	0.3712	0.0139	0.0897

Source: own calculations extracted from MECI/RS.

Kakwani index shows the same signs, indicating that only the P-ICMS scenario is a progressive system (Kakwani = 0.0488). These results are presented in Table 2.

#### 4.2.2. Inequality in consumption

For the baseline scenario, the IUS and the M-ICMS, the concentration of consumption after tax ( $C_{X-T}$ ) is higher than the pre-tax concentration of this variable ( $C_X$ ), which leads to a negative RS index. That is, as in the case of income, the tax only serves to aggravate the initial poor distribution of consumption. In contrast, P-ICMS has a positive redistributive effect (RS = 0.0139), reducing the level of inequality by more than one point. However, progressivity measured in terms of consumption shows that the three scenarios are progressive. The Kakwani index takes a value of 0.0138 and 0.0279 for the baseline and IUS scenarios respectively. However, the P-ICMS achieves far higher degree of redistribution (Kakwani = 0.0897).

It might seem illogical for there to be no improvement in redistribution in scenarios with progressive taxes. This is because although the tax burden is not low, the relationship between taxed expenditure and gross income is weak. Many services are not taxed because they are excluded from the tax base.

#### 4.2.3. Poverty

Two indexes were used to study the impact of the reforms on poverty: first, the head count ratio (H), which calculates the percentage of households living below the poverty line; and second, the income gap (I), which measures the intensity of poverty. For more details on how to calculate these and other poverty rates, see Lambert (2001).

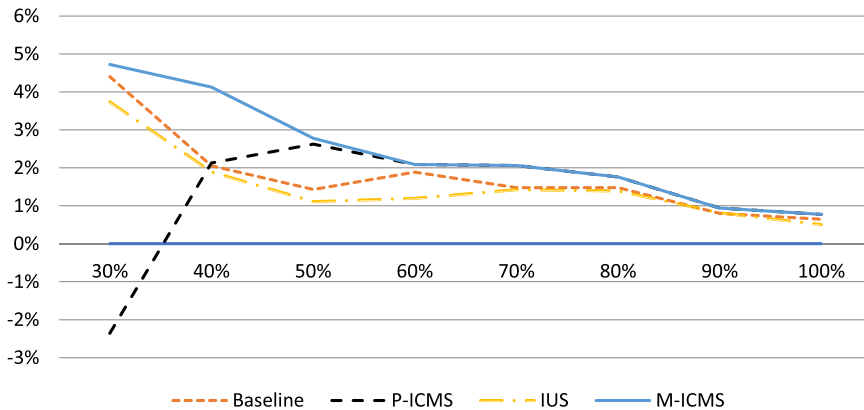
Table 3 shows the percentage of poor households and the intensity of poverty for each of the assessed scenarios according to the corresponding poverty lines. To reduce the dependence on a specific poverty line, they were allowed to vary from 30 % to 100 % of the average equivalent income.<sup>14</sup> The results of Table 3 and Fig. 2 show that all the scenarios considered in this study increase relative poverty. Only in the case of P-ICMS poverty drops (very slightly) in comparison with pre-tax income when the poverty threshold is 30 % of the average income. This is expected as the reform focuses on the first three deciles of the income distribution.

<sup>14</sup> The average gross equivalent household income is R\$ 3830 (figure for 2016 in Brazilian reals). The amounts for the three simulated scenarios, the “baseline”, “IUS” and “P-ICMS” scenarios, are R\$ 3608, R\$ 3609 and R\$ 3606 respectively.

**Table 3**  
Poverty rate and poverty intensity.

Poverty line	Gross income	Baseline	IUS	M-ICMS	P-ICMS
<b>Poverty rate</b>					
30 %	0.177	0.185	0.184	0.185	0.173
40 %	0.293	0.299	0.298	0.305	0.299
50 %	0.403	0.409	0.407	0.414	0.414
60 %	0.496	0.506	0.502	0.507	0.507
70 %	0.572	0.58	0.58	0.583	0.583
80 %	0.64	0.649	0.649	0.651	0.651
90 %	0.679	0.684	0.684	0.685	0.685
100 %	0.714	0.719	0.718	0.718	0.719
Average equivalent monthly income (*)	3830	3608	3609	3568	3606
<b>Poverty intensity</b>					
30 %	0.277	0.273	0.273	0.282	0.261
40 %	0.327	0.329	0.328	0.330	0.312
50 %	0.361	0.365	0.365	0.368	0.352
60 %	0.395	0.397	0.398	0.401	0.391
70 %	0.428	0.431	0.430	0.434	0.425
80 %	0.454	0.455	0.455	0.459	0.452
90 %	0.489	0.493	0.492	0.496	0.490
100 %	0.516	0.520	0.520	0.522	0.518

Source: own calculations based on MECI/RS. (\*) Year 2016

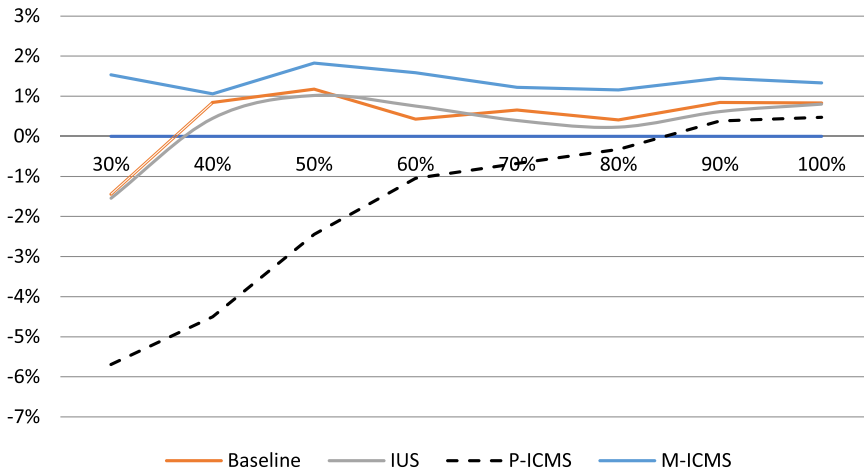


**Fig. 2.** Relative effect on the poverty rate. Note: the abscissa axis reflects the percentage of the equivalent average income used to calculate the poverty threshold.

4.2.4. Intensity of poverty

Table 3 also shows the estimated values of the intensity of poverty, *I*, which measures the relative distance between the average equivalent income of poor families and the poverty line. This means that as the value of the index rises, there is an increase in the intensity of aggregate poverty.

The results reveal a lower intensity of poverty for the P-ICMS scenario, independent on how the poverty line is defined. This is interesting because although the personalization policy mainly favors families with equivalent incomes below 30 % of the overall average, the



**Fig. 3.** Relative effect on poverty intensity. Note: the abscissa axis reflects the percentage of the equivalent average income used to calculate the poverty threshold.

reduction in the intensity of poverty is large even for poverty lines closer to the average. Taking as a reference the poverty gap index for the original baseline equivalent incomes, all the simulated scenarios have a positive impact on poverty when the poverty line is defined as 30 % of the mean income. However, when the poverty line is closer to the average income (40 % or more), the scenarios corresponding to the universal solution are not able to reduce poverty. Meanwhile, P-ICMS has a positive effect on the gap for all the lower poverty lines, up to 80 % of the average equivalent income, as shown in Fig. 3.

### 4.3. Welfare

To evaluate the welfare gains, we use three measures: the compensating variation (CV), the excess burden of taxation and the social welfare function introduced by Sen (1973).

#### 4.3.1. Compensating variation

The compensating variation measures the monetary units that we would have to give an individual for them to achieve the same level of wellbeing without the reform that they would after it. It takes positive values when a welfare gain is achieved and negative values otherwise. Because it is an individual measure, it allows the “winners” and “losers” to be identified in each case. We take the 2015 ICMS as a reference.

Table 4 shows the results by income distribution deciles for the P-ICMS, M-ICMS and IUS scenarios. The “YEARLY EQ CV” and “CV%” columns show the absolute and relative compensating variation respectively, while the “YEARLY CV/HH” column captures the yearly average compensating variation value for each income stratum.

In line with the theoretical predictions, the modernization of the tax implies welfare losses for all the deciles, because the households’ tax burden increases. In addition, the lower the household’s income, the bigger the relative drop in welfare due to the disappearance of exemptions and reduced rates. The IUS manages to boost the average welfare up to the seventh decile, from which point losses can be seen. However, in relative terms, these welfare gains or

**Table 4**  
Equivalent Compensating variation: IUS, M-ICMS and P-ICMS.

Decile	EQ NET CONSUMPTION	IUS			M-ICMS			P-ICMS		
		YEARLY EQ CV*	CV%	YEARLY CV/HH	YEARLY EQ CV*	CV%	YEARLY CV/HH	CV ANNUAL EQ.(*)	CV%	YEARLY CV/HH
1	3189	38	1.18 %	105	-54	-1.70 %	-150	419	13.15 %	1165
2	4665	38	0.82 %	106	-49	-1.06 %	-137	599	12.85 %	1665
3	5880	44	0.75 %	122	-56	-0.95 %	-155	592	10.06 %	1643
4	6994	28	0.40 %	77	-61	-0.87 %	-169	-113	-1.62 %	-315
5	8846	11	0.13 %	32	-64	-0.72 %	-178	-249	-2.82 %	-693
6	10,125	17	0.17 %	47	-56	-0.56 %	-157	-230	-2.27 %	-639
7	12,596	-11	-0.09 %	-30	-46	-0.37 %	-128	-203	-1.61 %	-563
8	15,007	-42	-0.28 %	-117	-25	-0.17 %	-70	-155	-1.03 %	-431
9	22,214	-146	-0.66 %	-406	-62	-0.28 %	-173	-288	-1.30 %	-801
10	45,474	-348	-0.77 %	-967	-103	-0.23 %	-286	-440	-0.97 %	-1223
Total	134,991	-371	-0.28 %	-103	-577	-0.43 %	-160	-68	-0.05 %	-19

Source: Own calculations. EQ, CV and HH stands for Equivalent, compensating variation and household respectively. (\*) millions of R\$ in year 2016

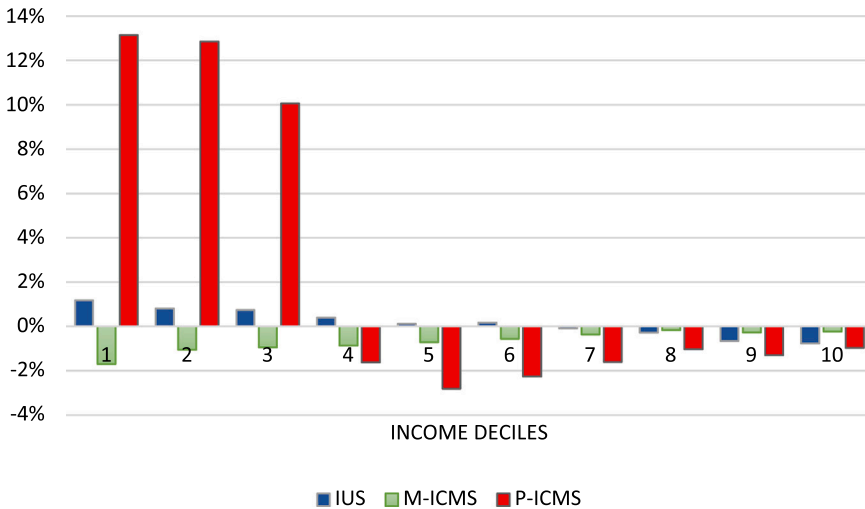


Fig. 4. Relative Compensating variation: IUS, M-ICMS and P-ICMS. Source: Own calculations.

losses are low, less than 1.2 %. Under the P-ICMS scenario, gains can also be observed in the first deciles and losses in the last. If we compare this scenario with the IUS, it should be noted that with P-ICMS the gains mainly benefit the poorest 30 % of the population. Secondly, in relative terms, the gains are much larger. The first three deciles experience a significant increase in wellbeing (by more than 10 %). At the same time, although the average losses from the fourth decile to the last decile are higher when compared with the IUS scenario, in no case do they exceed 3 %. These results can also be seen in graphic form in Fig. 4.

#### 4.3.2. Excess burden of taxation

According to economic theory, any increase in tax leads to a loss of efficiency if the drop in consumer welfare exceeds the payment of the tax. This loss of efficiency is called the excess burden of taxation. This excess burden is calculated as the difference between the variation in aggregate welfare measured in monetary units (calculated through the compensating variation) and the variation in tax revenue after the reform. The excess burden of taxation is positive (negative) when the tax revenue exceeds (does not exceed) the increase in welfare produced by the tax. The results are shown in Table 5.

The tax revenue associated with the different scenarios is not identical, although the simulations sought to hold the revenue constant. These differences are justified because to increase the applicability of the reform, we rounded tax rates to the closest natural number rather than using decimal points. This generated small differences in the tax revenue collected in each scenario. The IUS leads to a slight reduction in revenue, while P-ICMS achieves a higher amount.

The positive excess burden of taxation associated with the IUS is of R\$ 522 million per year, equivalent to R\$ 145 per household, indicating that the intensification of tax differentiation (IUS) leads to a loss of efficiency. In contrast, P-ICMS boosts the economy’s efficiency, thanks to a policy of modernization. The excess burden of taxation is significantly negative, at R\$ 441 million per year, which corresponds to an annual social welfare gain of R\$ 122 per household.

**Table 5**

Excess burden.

	IUS	M-ICMS	P-ICMS
BASELINE TAX REVENUE (*)	26,516	26,516	26,516
TAX REVENUE AFTER THE REFORM (*)	26,365	28,837	27,025
VARIATION OF TAX REVENUE ( $\Delta T$ ) (*)	-151	2301	509
% CHANGE OF TAX REVENUE	-0.57 %	8.75 %	1.92 %
COMPENSATING VARIATION ( $\Sigma VC$ ) (*)	- 371	-577	-68
EXCESS OF TAX BURDEN = $\Delta T - \Sigma VC$ (*)	522	- 1743	-441
EXCESS OF TAX BURDEN PER HH/YEAR (R\$)	145	-484	-122

Source: Own calculations. Based on MECI/RS (\*) R\$ / 1,000,000 of the year 2016

**Table 6**

Average equivalent income inequality and social welfare.

	Baseline		IUS		M-ICMS		P-ICMS	
	Consumption	Income	Consumption	Income	Consumption	Income	Consumption	Income
Mean	46.761	37.490	46.777	37.474	46.491	37.109	46.818	37.746
Gini	0,4317	0,3887	0,4306	0,3874	0,4338	0,3918	0,4249	0,3712
$W^S$	26.575	22.918	26.633	22.957	26.323	22.569	26.924	23.734
Change (%)			0,22 %	0,17 %	-0,95 %	-1,52 %	1,31 %	3,56 %

### 4.3.3. Sen’s social welfare function

An alternative social welfare approach is to use a fairly simple function introduced by Sen (1973). This function,  $W^S$ , lies in individual wellbeing taking average equivalent net income ( $\bar{Y}$ ) or average equivalent net consumption ( $\bar{C}$ ) as a measure with inequality, measured, for example, by the Gini index. Hence, in a very simple way, the social welfare function takes into account the trade-off between efficiency and equity. Formally,  $W_Y^S = \bar{Y} \times (1 - G_Y)$  in the case of equivalent net income and  $W_C^S = \bar{C} \times (1 - G_C)$  in the case of equivalent net consumption, where  $G_Y$  and  $G_C$  represent the Gini coefficient for household equivalent disposable incomes and household equivalent disposable expenditures respectively.

Table 6 shows that both policies, IUS and P-ICMS, lead to social welfare gains when compared with current legislation. However, the size of the gains is noticeably different. P-ICMS achieves welfare gains of 3.5 %, while IUS welfare improvements are negligible (around 0.2 %). As the table shows, the gain in wellbeing is solely due to personalization, since modernization (M-ICMS) implies a welfare loss.

## 5. Conclusions

This study analyses a reform that modernizes and personalizes the current system of ICMS in force in the federated state of Rio Grande do Sul in Brazil. Through modernization, the aim is to improve efficiency by, first, reducing the multitude of tax rates to just two (one general rate and another higher on drinks and tobacco) and second, by eliminating all existing deductions on goods. Through personalization, the aim is to pursue equity by introducing a total or partial tax refund for lower-income families. Families below the first income decile would be entitled to a total tax refund, while families between the first and the third deciles would get a partial refund that would decrease in value as family income rise.

The simulation results show that the "modernization" of ICMS has important positive impacts on efficiency, as it would reduce the current ICMS system's excess burden of taxation and, at the same time, simplify management of the taxation process.

As regards equity objectives, personalization of ICMS has important redistributive effects. It is actually able to transform a regressive tax into a progressive one, a very significant advance for an indirect tax on consumption. The personalization of ICMS also reduces the intensity of poverty, and, to a lower extent, also its prevalence. That is, poor households would be substantially closer to the poverty line after personalization.

According to our simulations, there is a clear superiority of the proposed P-ICMS in improving equity, efficiency and operational effectiveness compared with the baseline scenario (the pre-reform ICMS) and a fictional ICMS corresponding to an increase in tax differentiation (IUS). Combining modernization and personalization is therefore a very interesting, promising way of reforming taxes on consumption, especially in countries where there is a high level of inequality and direct taxation plays only a minor role.

Although the results are consistent with economic theory and point in the expected direction, they should be interpreted with caution. For the construction of a microsimulation model, a multitude of assumptions must be made that could condition the results, and the sources of data do not always offer all the relevant information for an analysis of the impacts of a reform.

The present study opens the door to future research. First, it is a study based on one of Brazil's federated states. It would be interesting to explore the effects of a similar reform on other states and countries. Everything seems to indicate that the effects would be similar or stronger: we expect to find a greater impact on the reduction of inequality in less developed and more unequal states. Secondly, if indirect taxation is genuinely to be modernized, the effect of reforms at a national level should be explored even though we are aware that the introduction of such reforms is very complicated for political and regulatory reasons. Finally, in the event of reforms of such a magnitude, where the effective rates on some products vary considerably, there might be effects on the supply side. In this study, we have assumed that companies hold net prices constant, so changes in the taxes are transferred directly to end prices. This is a reasonable supposition if we assume the existence of competitive markets, but we already know that this is not the case in some industries. A computable general equilibrium model would allow us to explore the impact of these reforms on the prices set by companies. Our intuition is that the modernization of the tax would encourage economic activity, amplifying the benefits of the reform in terms of efficiency and equity.

A reform similar to the proposed "P-ICMS" took shape in the State of Rio Grande do Sul through a program called "DEVOLVE ICMS" that started in December 2021. It has already benefited approximately 430,000 families and will benefit, in the second stage (by July 2022), more than 1 million low-income families. In the first stage, the refund consists of fixed amounts corresponding to approximately 100 % of the ICMS paid and reached almost 80 % of the beneficiary population. In the second stage, the solutions suggested in the study presented here will be introduced, maintaining a hybrid system of refunds, that is: a fixed part, as in the first stage, and a part associated with the actual consumption of beneficiary families, which will be calculated based on purchases of goods and services and will be formalized through electronic tax documents (NFC-e).

In addition, the success of the "DEVOLVE ICMS" program in the State of Rio Grande do Sul has had an impact throughout Brazil. The results observed in the study, as well as the characteristics and virtues of the system of individualization of the fiscal benefits, were presented in various discussion forums with specialists from the finance area and political agents in



Brazil. This resulted in the inclusion of a VAT “personalization” in the main proposals to change the Brazilian tax system, which are about to be approved by the National Parliament.

## Appendix A. Supporting information

Supplementary data associated with this article can be found in the online version at [doi:10.1016/j.jpolmod.2022.09.002](https://doi.org/10.1016/j.jpolmod.2022.09.002).

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