Food prices and tax incidence: evidence from Brazilian data

Mauricio Canêdo-Pinheiro
Faculdade de Ciências Econômicas, UERJ, Rio de Janeiro, Brazil, and
Leonel Cesarino Pessôa, Kalil Said Jabour and William do Val Domingues Junior
FGV Direito SP, FGV, São Paulo, Brazil

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Abstract

Purpose – The paper estimates the ICMS (a kind of value-added tax at the state level) incidence on a basket of 79 food products from 1994 to 2021 in the Brazilian states of Bahia, Rio de Janeiro, Minas Gerais and São Paulo.
Design/methodology/approach – We use panel data estimators to evaluate the pass-through of the ICMS to consumer prices. Given that tax changes potentially influence prices of substitute and complementary products in the same geographic area, our empirical strategy relies on prices of similar products in other states to ensure causal identification.
Findings – The pass-through is neither complete nor immediate for many products, especially industrialized products, confirming the existing evidence for Brazil and other countries. On average, each percentage point of variation of the ICMS generates a cumulative variation of approximately 0.13% in prices. This variation takes 4 months after the change in the tax rate to be fully transmitted to final consumers.
Originality/value – Most of the literature focuses on developed countries. We innovate by using a novel database to estimate, with a solid causal identification strategy, the tax incidence for a broad basket of food products in a developing country. We also innovate by implementing a data-driven method for selecting lag length. The results can be helpful in the debate on tax reform underway in Brazil.

Keywords Taxation, ICMS, Tax incidence, Brazil

Paper type Research paper

1. Introduction

Theoretically, it is well-established that the consumer tax pass-through to prices is not necessarily complete. In a perfectly competitive environment, it depends on supply and demand elasticities, and it is only full if the supply is infinitely elastic. In a monopoly, the pass-through may even be more than proportional (Fullerton & Metcalf, 2002). Within these two extremes, both more or less than proportional pass-throughs are theoretically possible, depending on competition and other market characteristics (Katz & Rosen, 1985; Weyl & Fabinger, 2013; Adachi & Fabinger, 2022).

Therefore, as Poterba (1996) points out, the magnitude of the pass-through is eminently an empirical problem, which explains the substantial body of literature on this subject. It uses data

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for various products and services and considers distinct countries and regions [1]. The results indicate a great variety of patterns. There is evidence of partial pass-through to prices of home repair services and automobile sales (Carbonnier, 2007) and restaurants (Benzarti & Carloni, 2019) in France, of a broad basket of goods and services (Carare & Danninger, 2008) and supermarket products (Fuest, Neumeier, & Stöhlker, 2025) in Germany, of fuel in rural regions in the United States (Alm, Sennoga, & Skidmore, 2009) and in Germany and France (Montag, Sagimuldina, & Schnitzer, 2020), of automobiles (Viren, 2009) and beer (Ardalan & Kessing, 2021) in European countries, of haircut services in Finland (Kosonen, 2015) and of basic food products in Poland (Jaworski & Olipra, 2025).

By contrast, cases of full pass-through have been reported for clothing in the United States (Poterba, 1996), for fuels in North American urban regions (Alm *et al.*, 2009), for food products in Norway (Gaarder, 2019), for durable goods in European countries (Buettner & Madzharova, 2021) and for electricity in Belgium (Hindriks & Serse, 2022). Additionally, for an assorted basket of products in the United States (Besley & Rosen, 1999), for menstrual hygiene products (Frey & Haucap, 2024) and fuel (Schmerer & Hansen, 2023) in Germany, the pass-through is more than proportional.

There is also evidence of asymmetry: tax reductions have more impact on consumer prices than tax increases for a broad set of products in France (Carbonnier, 2005) and in a variety of European countries (Benzarti, Carloni, Harju, & Kosonen, 2020), for food products in Brazil (Politi & Mattos, 2011), for soft drinks in Holland (Bergman & Hansen, 2019) and haircuts in Finland (Kosonen, 2015). Furthermore, the pass-through isn't always immediate – see, for example, Politi and Mattos (2011) and Jaworski and Olipra (2025) – and may vary with the type of tax reform (Benedek, De Mooij, Keen, & Wingender, 2020). There is direct (Politi & Mattos, 2011; Montag *et al.*, 2020; Genakos & Pagliero, 2022; Shiraishi, 2022; Dimitrakopoulou, Genakos, Kampouris, & Papadokonstantaki, 2024; Chang, 2025; Fuest *et al.*, 2025) and indirect (Carbonnier, 2007; Alm *et al.*, 2009) evidence that the more competitive the market, the greater the tax pass-through [2].

Note that most of the literature on tax incidence focuses on developed countries (Europe and the United States, primarily). Some of the few exceptions are Politi and Mattos (2011), Campos-Vázquez and Medina-Cortina (2019), Brusco and Velayudhan (2024) and Arango, Flórez, Marín-Rodríguez, and Posada (2024). In this regard, expanding this literature on developing countries is quite pertinent, given that these economies display distinct characteristics, especially concerning informality, tax avoidance and size-based tax exemptions, compared to developed countries.

On this matter, one of the contributions of this paper is mapping, between 1994 and 2021, and for the Brazilian states of Bahia, Rio de Janeiro, Minas Gerais and São Paulo, all changes in the ICMS (a kind of value-added tax at the state level) on a set of 79 food products [3]. This contribution, on its own, is already quite relevant, given the complexity of the Brazilian tax system (Tanzi, 2013). Each state has its legislation, and different tax rates apply, state by state, without a general national standard.

We use this novel database to estimate the ICMS pass-through to consumer prices. Since tax changes also influence prices of substitute and complementary products in the same geographic area (Benedek *et al.*, 2020), our empirical strategy follows Buettner and Madzharova (2021). It relies on prices of similar products in other metropolitan areas to ensure causal identification. Moreover, the existing evidence points to a dynamic pass-through, but most of the literature – for example Benedek *et al.* (2020) and Buettner and Madzharova (2021) –arbitrarily chooses the number of periods over which the impact occurs. We innovate by implementing a data-driven method (Han, Phillips, & Sul, 2017) for selecting lag length.

Particularly concerning Brazil, Politi and Mattos (2011) consider a basket of ten food products from 1994 to 2008. In this respect, our contribution to the Brazilian case is twofold. First, we investigate a broader set of products compared to previous literature. Note that most studies, even for developed countries, estimated the effects of specific tax changes. Broadening the set of products is relevant to the overall literature, not just literature that considers the

Brazilian experience [4]. Second, since 2008, changes in ICMS have become more frequent. Thus, extending the analysis until 2021 gives a better picture of the magnitude of the pass-throughs in more recent periods. It is also helpful in shedding light on the debate about the details of an ambitious reform on consumption taxes that is currently in progress in Brazil [5].

In addition to this introduction, this article consists of four sections. Section 2 describes the database. Section 3 addresses the empirical strategy for estimating the tax pass-through to consumer prices. Section 4 describes the results that were obtained. Later, there are some brief final considerations.

2. The database

2.1 Prices

Price information is based on the Broad Consumer Prices Index (IPCA), which is calculated by the Brazilian Institute of Geography and Statistics (IBGE). The IPCA is calculated through the monthly collection of prices charged to the final consumer (including taxes) for a broad basket of products. The structure of the IPCA is based on four levels of disaggregation. From top to bottom, these are: group, subgroup, item and subitem (IBGE, 2020). In this study, only the subitems belonging to the subgroup Household Food Consumption are considered, which, for their part, belong to the group Food and Beverages. A total of 79 subitems (or products) are considered, belonging to 16 items (or categories) [6]. For more details on products and categories, see Table B1 in the Supplementary Material.

Additionally, the IPCA currently covers 16 geographical areas in Brazil (IBGE, 2020). Nevertheless, due to difficulties in collecting information on ICMS rates (see Section 2.2. for more details), only the metropolitan regions of Salvador (in the state of Bahia), Rio de Janeiro (in the state of Rio de Janeiro), Belo Horizonte (in the state of Minas Gerais) and São Paulo (in the state of São Paulo) are covered in this paper. Finally, to avoid the hyperinflation period in Brazil, we limited our analysis from July 1994 through July 2021.

2.2 Tax rates and changes in taxation

The classification of products used to define state taxation in Brazil is usually the NCM (Common Nomenclature of *Mercosul*). For this reason, it was necessary to make NCM and the classification of subitems (products) of the IPCA compatible (see Section 2.1).

Furthermore, identifying the applicable tax rate in Brazil is much more complex than in other countries. The following points delineate some aspects of the Brazilian tax system regarding the identification of tax incidence: (a) difficulty in obtaining tax rates in different states over time; (b) distinct forms for changing tax incidence; (c) the problem of pass-through in sales involving simplified regimes for small businesses.

2.2.1 Difficulty in obtaining tax rates. For other countries, information on tax rates is readily available. For example, in the European Union, tax legislation is harmonized, and annual reports are provided on the prevalent tax rates for all products (in all member countries) and their changes (Benzarti *et al.*, 2020). Studies limited to just one country also benefit from publications that systematically track tax rates on consumption, which are supplied by the official national agencies for statistics of each country (see, e.g., Ván & Oláh, 2018).

In Brazil, obtaining this information is much more complex. No national or other database provides current tax rates for all products (in all states). Each state has its legislation, and individual tax rates are established, state by state, without a general national rule. Even specialized businesses offering services related to tax data in Brazil have not compiled data on consumer tax rates, including all differentiated treatments, with the temporal and spatial coverage that this study aimed to assess. It is not simply a coincidence that empirical literature on this subject with Brazilian data is so scarce.

2.2.2 Different ways to change tax incidence. However, there are still more difficulties in identifying the tax rates. The existing literature referred to the variation in the tax burden

generically as a change in tax rates. This is one of the instruments that may be used in Brazil, even though it is the least used. An alternative mechanism is the change of the tax base. There is still another, more complex mechanism: presumed or granted credits. Such credits are not made explicit in the tax documents. Upon the calculation of the tax, there is compensation with an amount of credits greater than the normal credits related to the operations of that period, thus reducing the tax burden.

This way, there can be a difference between the instruments used by different states. Take the example of fish. Currently, Minas Gerais uses the instrument of granted tax credit, while São Paulo uses the instrument of reduction of the base. And this use of different instruments may also vary over time. Regarding the various approaches for fish, these products were exempted in São Paulo until 2001, when the instrument changed to reductions in the tax base. By contrast, in Minas Gerais, these products were subject to cuts in the tax base until 2006, when the differential approach was converted to presumed credits.

Both a change in the tax rate and a change in the base share the characteristic of requiring that these changes be explicitly described in their respective fiscal documents. This makes, for example, the work of supervision for controlling these benefits much easier. Conversely, in the case of presumed credit, the benefit does not appear on fiscal receipts when they are issued. The presumed credits will only be registered and used by the taxpayer after the taxes due are determined. At this time, the presumed credits will diminish the value of the tax to be paid. Thus, when the benefit is taken as presumed credit, an audit of the credit is required, making the supervision process much more complex and challenging.

Another point is that in some cases, more than one differential treatment may be granted for the same product. Situations in which goods benefit from both a reduction in the base and the granting of tax credits are not unusual. It happens, for example, with meat in São Paulo. Article 74 of Appendix II of the RICMS, in the wording established by Decree 62,401 of 2016, reduced the base of the ICMS to 12% if the product is destined for the final consumer, and to 7% for other internal destinations. Article 40 of Appendix III of the RICMS, for its part, establishes that the slaughterhouse company and the industrial cold storage company can take a credit of an amount equivalent to the application of a percentage of 6.7% of the internal delivery of meat.

Another difficulty is that, often, the benefit is not conceded throughout the entire chain, but only in a part of it. The case of presumed credits for meat, mentioned in the previous paragraph, is an example: they are conceded to industrial or cold storage establishments, but not to retailers.

There are situations, less common, in which the opposite occurs. That is, the benefit is granted only on sales to final consumers. An example is Decree 43,080 of 2002, which addresses ICMS Regulation for the State of Minas Gerais. Item 13 of Appendix I of the Decree rules the "delivery, in an internal operation, of type 'A', 'B' and 'C' pasteurized milk, including long life". Its wording has been changed over the years, but from 04/20/2005 until 01/31/2011, it established an exemption to sales of this product when it was "carried out by a retail establishment to the final consumer".

In addition to creating greater complexity for the system, this plurality of benefits makes tax incidence less transparent to the public. Nevertheless, it is possible for every reduction in the base to calculate its equivalent in terms of a decrease in the tax rate. For example, if a product has a nominal tax rate of 18% and the base for the tax is cut in half, this is the equivalent of a reduction of 18 to 9% in the nominal tax rate. Furthermore, in the case of presumed credit, while less transparent, it is also possible to calculate the equivalence in terms of the variation in the nominal tax rate. In this sense, to evaluate the tax pass-through to consumer prices, all the tax variations were expressed in terms of changes in the tax rate, meaning that they were incorporated as an increase or a reduction in the variable that measures the tax rate.

2.2.3 Simplified regimes for micro and small businesses. In 1996, all federal taxes for small businesses were unified, granting them differential treatment (*Simples Nacional*). In July 2007, this treatment was extended to the ICMS (state) and the ISS (municipal). This differential regime for small businesses assumed greater importance in Brazil. It implied a single substitutive tax regime: a company could pay, as a tax, a percentage of its total revenue in place

of some federal taxes, ICMS and ISS. We point out that, even though the *Simples Nacional* began to cover the ICMS in 2007, there were already state legislations in Bahia, Minas Gerais, Rio de Janeiro and São Paulo providing differential tax treatment to small businesses. The evolution of this legislation is described in section D of the Supplementary Material.

This problem can be especially complicated in Brazil because the annual threshold for eligibility for the differential regime is R$ 4.8 million (approximately the equivalent of US$ 950 thousand). A broad study regarding taxation of micro and small businesses shows how a single substitute tax regime exists in just a few countries other than Brazil: South Africa, Hungary, Italy, Mexico and Turkey (OECD, 2015). In other countries, there may be a threshold for total revenue under which paying the VAT would not be necessary. Still, they are far lower than those observed in Brazil, for example: US$ 22.5 thousand in Canada, US$ 48 thousand in South Korea, US$ 26.5 thousand in Israel, US$ 11 thousand in Portugal and US$ 104 thousand in the United Kingdom (Pessôa & Pessôa, 2020). This explains the fact that none of the articles that propose to investigate tax incidence, except for Politi and Mattos (2011) and Brusco and Velayudhan (2024), which focused on the Brazilian and Indian cases, paid attention to the special tax treatment for small firms.

Moreover, state legislations and even the Supplementary Law 123 – that created the *Simples Nacional* – block the entities that opt for the differential regime from benefiting from exemptions or reductions conceded for different products. If a business opts for the differential regime, the only differential treatment it can benefit from is the favorable tax rates established in the system. To take advantage of the occasional exemptions or reductions in tax rates, a small business would have to abandon this regime.

In this sense, as Politi and Mattos (2011) pointed out, tax rate reductions affect businesses that opted for the *Simples Nacional* differently. Changes in ICMS rates in principle would not change the taxation of the companies that opt for the simplified regime. As a result, the scope of the results may be limited because there is no information on the size of the establishment from which the price was collected, nor whether the business had opted for the simplified regime.

In this respect, Politi and Mattos (2011) point out that the results determined for the products sold mainly in supermarkets – in our sample, subitems in categories 1101, 1102, 1104, 1109, 1113, 1114, 1115 and 1116 – would be more reliable than those found for products commercialized primarily on small establishments, such as butcher shops and bakeries [7].

2.3 Some descriptive statistics

Table A1 – see section A of the Supplementary Material – presents a summary of the tax changes that occurred in Bahia (BA), Rio de Janeiro (RJ), Minas Gerais (MG) and São Paulo (SP) between 1994 and 2021. There were changes on 10 occasions in Bahia: 33 increases and 35 reductions in tax rates. In Rio de Janeiro, there were changes on seven separate occasions: 26 increases and 16 reductions in tax rates. For its part, in Minas Gerais, there were changes on seven separate occasions: no increases and 42 reductions in tax rates. Finally, in São Paulo, there were changes on 12 separate occasions: 29 increases and 29 reductions in tax rates. Furthermore, the incidence of tax increases (98) and reductions (122) in the sample is reasonably balanced. Figure A1 – see section A of the Supplementary Material – presents a histogram of tax rate variations: even though some of the changes are of little relevance, some variations can reach 10 or 20% points.

3. Empirical strategy

3.1 Econometric model

Different versions of the model shown below were estimated:

$$\Delta ln\, P_{i,r,m,t} = \alpha_{i,m,t} + \alpha_m + \alpha_r + \alpha_{r,m} + \sum_{k=0}^{K} \beta_k L^{-k}(\Delta\tau_{i,r,m,t}) + \gamma \Delta ln\, C_{i,r,m,t} + \nu_{i,r,m,t}, \qquad (1)$$

In which the subscripts $i = 1, \ldots, I$, $r = 1, \ldots, R$, $m = 1, \ldots, M$, e $t = 1, \ldots, T$, indicate product, metropolitan region, month and year, respectively. In addition, $L^{-k}(\cdot)$ indicates a lag of k months, Δ indicates the variation between consecutive months, P denotes the consumer price (including taxes), τ is the nominal tax rate, C is a vector for variables that measure local production costs, K determines the order of the lag terms and ν is a random error. The other variables are parameters to be estimated.

The contemporaneous effect of a change in the nominal tax rate on prices is captured by β_0: a variation of 1% point in the tax rate increases the product price by β_0% within the same month. In turn, the accumulated effect over time is captured by $\beta = \beta_0 + \ldots + \beta_K$. A variation of 1% point in the tax rate cumulatively increases the price of the product by β% over K months. If $\beta = 1$, there is a complete pass-through of the tax to prices.

3.1.1 Identification strategy. One aspect that is sometimes overlooked is that, theoretically, tax changes on a product also impact the prices of substitute and complementary products in the same region (Benedek *et al.*, 2020). In this respect, including in the sample only prices of similar products not directly affected by the changes in taxation, but surveyed in the same geographic area, as in Carare and Danninger (2008) and Crossley, Low, and Sleeman (2014), violates the stable unit treatment value assumption – SUTVA (Rubin, 1980). Particularly, it infringes the no-interference requirement (NIR), which states that the treatment received by one unit does not affect the outcomes of other units. In other words, the causal identification of the pass-through should ideally include prices of similar products in different geographic areas as controls, mainly when evaluating the pass-through for a large basket of products [8]. More formally, suppose a tax change in region r on month m and year t, for a given product i, also sold in regions $\bar{r} = \{1, \ldots, R\}$, such as $r \notin \bar{r}$. Then, $\Delta ln\, P_{i,r,m,t}$ is compared to the prices in all other regions in which the product i is also available, $\Delta ln\, P_{i,\bar{r},m,t}$. Therefore, to reinforce this identification strategy, we follow in Buettner and Madzharova (2021) and include in the sample only products whose prices were collected simultaneously in at least two metropolitan regions [9].

Compliance with the NIR relies on the absence of cross-state effects from tax rate changes. That is, it depends on tax changes on a product in one state not affecting the prices of products in neighboring states. This condition may fail, for example, if the volume of interstate purchases made by final consumers is relevant. Since the sample consists only of food products, and given the distance between the metropolitan regions in our sample, the relevance of such purchases is unlikely. A robustness test was carried out in this regard (see Section 4.2), without substantial changes in the results.

3.1.2 The importance of costs (C) and fixed effects for identification. The proposed counterfactual also lies in the common-trend assumption to hold. That is, conditional on all controls, in the absence of tax changes in region r, the prices of the product i must follow the same trend in region r and the other regions ($\bar{r}$). Including a sufficiently rich set of control variables gives us more confidence that treatment is nearly randomly assigned conditional on the covariates, because conditional random assignment can fail so long as the remaining unobservable variables have a time-invariant additive effect on the outcome (Roth, Sant'Anna, Bilinski, & Poe, 2023).

Therefore, from an identification point of view, it is essential to include in (1) some measure of the local production costs (ideally product-specific). As in Poterba (1996), we assume that changes in the taxation of a product in a metropolitan region do not significantly affect the aggregate inflation rate in that region. Therefore, it is possible to use the percentage of the variation of the aggregate IPCA for each metropolitan area as an approximate measure of the percentage of variation of local costs. Moreover, as in Politi and Mattos (2011), percentage variations for two indicators of costs were used – material and labor, which were obtained from the National System for Research of Costs and Indices in Civil Construction (SINAPI). These indicators are calculated for each Brazilian state (IBGE, 2017) and may be considered a proxy of local costs in metropolitan regions.

Note that α_{imt} denotes fixed effects that capture price trends common across regions but specific for each product. Meanwhile, α_r denotes fixed effects that capture region-specific movements shared among all products and periods. Since the cost measures used are not specific to each product-region pair, these fixed effects help control price variations unrelated to tax changes. Finally, we build on Buettner and Madzharova (2021) and include in (1) binary indicators for months (α_m) and their interactions with metropolitan regions dummies (α_{rm}) to capture seasonal effects on prices.

We hope that fixed effects and measurements of local costs capture a substantial share of the cost variation across products and regions, thereby supporting the validity of the common-trend assumption. In this regard, similarly to Besley and Rosen (1999), whenever they were statistically significant, the local costs measurement only failed to present a positive signal in one opportunity, reinforcing confidence in their use as controls. Nevertheless, some specifications concerning the inclusion of local costs were tested (see Section 4.2), and they didn't significantly affect the results.

3.1.3 The choice of K. In several articles – for example Poterba (1996), Besley and Rosen (1999), Carbonnier (2007), Benedek *et al.* (2020), Buettner and Madzharova (2021) – the maximum lag length (K) is chosen arbitrarily and kept as a fixed value. In this article, we used the sequential procedure described, for example, in Han *et al.* (2017). We began with $K = K_{MAX}$. Then we tested the null hypothesis that $\beta_{MAX} = 0$. In the event of rejection, we chose K_{MAX} as the maximum lag length. If the opposite was true, the model is estimated as $K = K_{MAX} - 1$. This procedure is repeated until there is the acceptance of the null hypothesis. If there is no rejection, we select the model with no lag, or $K = 0$. We defined $K_{MAX} = \sqrt[3]{int(MT)}$, resulting in models with 6 lags at most [10].

3.1.4 Errors. It is reasonable to expect that prices would be correlated not only within the same metropolitan region or over time, but also that there would be a correlation between prices in different metropolitan regions. In this respect, Politi and Mattos (2011) followed the approach of Beck and Katz (1995), which is robust to spatial dependence if the ratio between MT and IR is large. Unfortunately, given the large quantity of products, this condition is not met for some model specifications estimated in this article. Some authors opt for errors clustered in the spatial and product dimensions (Benedek *et al.*, 2020; Buettner & Madzharova, 2021, among others). In these cases, the consistency of estimated errors depends on the hypothesis that there is only correlation between distinct products within the same region and for the same product in different regions. Nevertheless, estimated errors are not consistent if there is dependence between different products in different regions. We use the covariance matrix proposed in Driscoll and Kraay (1998) to allow this last possibility. For large values of MT (which is the case in this paper), it is robust for heteroscedasticity, serial autocorrelation and very general forms of spatial dependence.

4. Results

4.1 Main results

Table 1 presents the results for the estimations of different versions of Equation (1). The model for products across all categories is presented in the first column. The effect of tax changes is minimal in the initial months and only becomes statistically significant in the third or fourth month after the change. This result reinforces the importance of correctly specifying the number of lags. While the cumulative effect is statistically significant, it is also small: a variation of one percentage point in the nominal tax rate leads, on average, to a 0.130% price change. This indicates that the pass-through is not immediate and is far from complete.

The results of Equation (1) estimation for each product category are shown in the remaining columns. For products in categories 1105 and 1115, the pass-through is complete or more than full: a variation of one percentage point in the nominal tax rate causes an average variation in prices of 1.819% and 1.109%, respectively.

Table 1. Results from estimates using Equation (1)

					Categories												
	All	1101	1102	1103	1104	1105	1106	1107	1108	1109	1110	1111	1112	1113	1114	1115	1116
$L^{0}(\Delta\tau)$	0.001	−0.104	−0.088		−0.907	0.315***	0.129	−0.083	0.046	0.152	−0.064	0.012	0.200	−0.039	0.183	0.497**	0.048
	(0.053)	(0.206)	(0.087)		(0.709)	(0.042)	(0.144)	(0.066)	(0.146)	(0.113)	(0.069)	(0.028)	(0.155)	(0.058)	(0.158)	(0.196)	(0.137)
$L^{-1}(\Delta\tau)$	0.011		−0.079		0.665***	0.395***	0.111	0.011	−0.131		0.042	0.043	−0.112		0.115	0.103	0.002
	(0.024)		(0.071)		(0.172)	(0.043)	(0.106)	(0.012)	(0.095)		(0.053)	(0.042)	(0.071)		(0.210)	(0.079)	(0.116)
$L^{-2}(\Delta\tau)$	0.026		−0.076*		0.131	0.311***	0.139**	−0.002	0.160		0.055*	−0.029	0.101**		0.289	−0.163***	−0.078
	(0.019)		(0.046)		(0.202)	(0.047)	(0.063)	(0.059)	(0.107)		(0.030)	(0.042)	(0.043)		(0.330)	(0.048)	(0.052)
$L^{-3}(\Delta\tau)$	0.030*				0.341***	0.230***		0.026	0.179**		0.056	0.026	−0.039		−0.153	−0.012	0.163***
	(0.018)				(0.077)	(0.037)		(0.029)	(0.069)		(0.072)	(0.040)	(0.069)		(0.098)	(0.099)	(0.042)
$L^{-4}(\Delta\tau)$	0.062**				0.125	0.323***		0.015			0.059	−0.008	−0.073		−0.083	0.347**	0.338*
	(0.027)				(0.148)	(0.039)		(0.019)			(0.069)	(0.031)	(0.140)		(0.093)	(0.145)	(0.200)
$L^{-5}(\Delta\tau)$					0.267**	0.245***		0.040*			0.042	0.052**	0.042		0.092***	0.032	
					(0.133)	(0.040)		(0.023)			(0.042)	(0.022)	(0.058)		(0.024)	(0.053)	
$L^{-6}(\Delta\tau)$					0.266***						0.062**		−0.047*		0.234**	0.304***	
					(0.058)						(0.028)		(0.026)		(0.110)	(0.107)	
Accumulated	0.130*	−0.104	−0.243**		0.889	1.819***	0.379***	0.007	0.254	0.152	0.251*	0.096	0.072	−0.039	0.677	1.109***	0.473
effect	(0.078)	(0.206)	(0.116)		(0.623)	(0.109)	(0.106)	(0.121)	(0.310)	(0.113)	(0.130)	(0.105)	(0.176)	(0.058)	(0.451)	(0.292)	(0.301)
Number of observations	70,909	2,563	4,379	9,303	949	4,890	12,504	12,429	2,802	4,935	2,457	5,159	2,020	2,471	1,216	1,228	1,879
Number of products	79	3	4	11	1	6	14	14	4	6	2	6	2	2	1	1	2

Note(s): This table presents the results from the estimation of the model described in Equation (1) for products whose prices were collected in at least two metropolitan regions during the period. The values for the constants, the fixed effects (for product-month-year, month, metropolitan region and month-region), and the parameters associated with the cost variables were omitted for convenience. $L^{-k}(\Delta\tau)$ refers to the parameters associated with the k-th lag of the variation of the ICMS nominal rate. The cumulative effect is the sum of the parameters related to all lags included in the models. The maximum number for lags (K) chosen using the sequential procedure described in Han *et al.* (2017), with $K_{MAX} = 6$. No product in category 1103 experienced alterations in tax rate, preventing the estimation of a pass-through rate of ICMS to prices. The standard deviations, robust for heteroscedasticity, serial autocorrelation and spatial dependence (Driscoll and Kraay, 1998), are in parentheses. The symbols *, ** and *** indicate parameters statistically different from zero at 10, 5 and 1% significance level, respectively

Source(s): Authors' elaboration

The cumulative pass-through is statistically not null for the products in categories 1106 and 1110. Still, it is not full: a variation of one percentage point in the nominal tax rate causes an average variation in prices of just 0.379% and 0.251%, respectively.

For the categories 1101, 1104, 1107, 1108, 1109, 1111, 1112, 1113, 1114 and 1116, the cumulative impact is not statistically different from zero [11]. Most of these categories include industrialized products, whose markets are usually more concentrated and which, according to existing empirical evidence, are more prone to smaller tax pass-throughs. Unfortunately, a lack of information on market concentration makes it impossible to confirm this conjecture. Nevertheless, supporting evidence has been found for similar products in other countries (Fuest *et al.*, 2025) and for Brazil by Politi and Mattos (2011), although based on a smaller product sample.

Our results contribute to the ongoing debate on tax reform in Brazil (Orair & Gobetti, 2021), particularly the controversy around the adoption of differentiated VAT rates. Brazil is one of the most unequal countries in the world, and, regarding VAT, it is often argued that exemptions or reduced rates on some fundamental consumer goods are justified for distributional reasons. However, this point fundamentally relies on the premise – widespread in public opinion and even among policy makers (Bird & Gendron, 2007) – that reductions in tax rates are fully passed through to consumers. Our empirical evidence suggests that relying on such an argument for distributional purposes may be misguided.

In addition, most of the categories for which the pass-through was estimated to be null – 1101, 1104, 1109, 1113, 1114 and 1116 – mainly comprise products primarily sold in supermarkets, consistent with Politi and Mattos (2011). This suggests that they are less affected by issues arising from small businesses opting for differentiated tax regimes (see Section 2.2). This way, we have greater confidence in asserting that, for many products in our sample, the pass-through is very small or null, in line with the evidence of partial pass-through found for similar products in other countries (Jaworski & Olipra, 2025; Fuest *et al.*, 2025).

4.2 Robustness tests and alternative specifications

In this section, we present and discuss alternative specifications for the model described by Equation (1), whose results are presented in Table 1. To facilitate a comparison between the models in Table 2, we show only the cumulative effect for each specification. The cumulative effect for the specification presented in Table 1, model (1), is reproduced in the first line. Complete results can be found in section B of the Supplementary Material.

4.2.1 Different specifications regarding cost measurements. As a robustness test, we also estimated models with costs built only using SINAPI, column (1A), and models using only the aggregate local IPCA as the cost variable, column (1B). Moreover, as in Besley and Rosen (1999), we also estimated the model without local cost controls (column 1C). The results did not change substantially [12].

4.2.2 Real variations in prices. For a better comparison with Politi and Mattos (2011), who also used Brazilian data, we chose to re-estimate the model (1) using real (instead of nominal) variations in prices, column (1D). The effect of inflation was removed by using a national-level aggregate inflation measure (IPCA) as a deflator. The results resemble those described in Table 1, [13].

4.2.3 Restricting the sample to only products present in all regions. The causal identification strategy relies on using comparable products across the states. This strategy may weaken if a product is sold only in a few states. To ascertain whether this consideration is relevant, as in Buettner and Madzharova (2021), we re-estimated model (1) using only products whose prices were collected in all four metropolitan regions. The results, column (1E), are very similar to those in Table 1. The only difference worth noting is that the pass-through for the products in category 1111, while partial, is statistically not null [14].

5. Final considerations

Using a novel database of tax changes and a basket of 79 food products from 1994 to 2021, we have estimated the pass-through rate for this tax to consumer prices in the Brazilian states of

Table 2. Comparison of cumulative effect for different specifications

									Categories								
	All	1101	1102	1103	1104	1105	1106	1107	1108	1109	1110	1111	1112	1113	1114	1115	1116
(1)	0.130*	−0.104	−0.243**		0.889	1.819***	0.379***	0.007	0.254	0.152	0.251*	0.096	0.072	−0.039	0.677	1.109***	0.473
	(0.078)	(0.206)	(0.116)		(0.623)	(0.109)	(0.106)	(0.121)	(0.310)	(0.113)	(0.130)	(0.105)	(0.176)	(0.058)	(0.451)	(0.292)	(0.301)
(1A)	0.130*	−0.107	−0.095		0.883	1.842***	0.387***	0.006	0.243	0.153	0.251*	0.089	0.176	−0.044	0.726	1.101***	0.470
	(0.077)	(0.206)	(0.085)		(0.622)	(0.110)	(0.110)	(0.118)	(0.308)	(0.114)	(0.130)	(0.106)	(0.142)	(0.058)	(0.466)	(0.292)	(0.299)
(1B)	0.131*	−0.103	−0.089		0.879	1.819***	0.376***	0.012	0.246	0.154	0.250*	0.096	0.182	−0.040	0.658	1.118***	0.473
	(0.078)	(0.211)	(0.082)		(0.613)	(0.109)	(0.105)	(0.123)	(0.320)	(0.114)	(0.129)	(0.105)	(0.151)	(0.058)	(0.444)	(0.286)	(0.299)
(1C)	0.132*	−0.106	−0.093		0.874	1.843***	0.384***	0.011	0.234	0.155	0.251*	0.089	0.172	−0.045	0.707	1.111***	0.470
	(0.077)	(0.211)	(0.083)		(0.612)	(0.109)	(0.108)	(0.120)	(0.318)	(0.115)	(0.129)	(0.106)	(0.146)	(0.058)	(0.459)	(0.287)	(0.297)
(1D)	0.130*	−0.104	−0.243**		0.889	1.819***	0.379***	0.007	0.254	0.152	0.251*	0.096	0.072	−0.039	0.677	1.109***	0.473
	(0.078)	(0.206)	(0.116)		(0.623)	(0.109)	(0.106)	(0.121)	(0.310)	(0.113)	(0.130)	(0.105)	(0.176)	(0.058)	(0.451)	(0.292)	(0.301)
(1E)	0.118	0.362	−0.243**		0.889	1.798***	0.421***	−0.101	0.254	0.081	0.251*	0.201*	0.059	−0.039	0.677	1.109***	0.473
	(0.076)	(0.227)	(0.116)		(0.623)	(0.111)	(0.118)	(0.070)	(0.483)	(0.176)	(0.130)	(0.107)	(0.205)	(0.058)	(0.451)	(0.292)	(0.301)

Note(s): This table presents the estimated accumulated effect of taxes on prices for different versions of the model described in Equation (1) and for products whose prices are collected in at least two metropolitan regions in the period. The specification (1) refers to the version of the model presented in Table 1. The specifications (1A), (1B) and (1C) refer to the model presented in Table 1, but estimated only using the costs from SINAPI (see Table C1 in the Supplementary Material for details), and only with costs built using the local aggregate IPCA (see Table C2 in the Supplementary Material for more information) and with no cost variables (see Table C3 in the Supplementary Material for details), respectively. The specification (1D) refers to the model presented in Table 1, but estimated with prices deflated by the aggregate national IPCA (see Table C4 in the Supplementary Material for details). The specification (1E) refers to the model presented in Table 1, but is restricted to the sample of products found in all four regions (see Table C5 in the Supplementary Material for details). The standard deviations, robust for heteroscedasticity, serial autocorrelation and spatial dependence (Driscoll and Kraay, 1998), are in parentheses. No product in category 1103 experienced changes in tax rate, preventing the estimation of a pass-through rate of ICMS to prices. The symbols *, ** and *** indicate parameters statistically different from zero at 10, 5 and 1% significance level, respectively

Source(s): Authors' elaboration

Bahia, Rio de Janeiro, Minas Gerais and São Paulo. Most existing studies – even for developed countries – focus on the effects of specific tax changes. Thus, broadening the scope of the products represents a meaningful contribution to the overall literature.

Developing economies display distinct characteristics compared to developed countries, especially concerning informality, tax avoidance and size-based tax exemptions. Therefore, the behavioral responses to tax incidence are likely to differ between the two groups of countries. In this regard, expanding the still scarce literature on VAT incidence in developing countries is quite relevant.

Our empirical strategy relies on prices for similar products in neighboring states to ensure causal identification. Unlike most existing literature, we innovate by implementing a data-driven method for selecting lag length. Most of our results are consistent with empirical evidence from other countries: the pass-through is neither complete nor immediate for many products, especially industrialized products. On average, each percentage point of variation in the tax rate leads to a variation of approximately 0.13% in prices, with the pass-through occurring over four months following the change in the tax rate.

In practice, public policy debates take for granted that taxes, particularly value-added taxes, are fully passed through to the final consumer prices. Public opinion and even policymakers tend to believe that tax rate reductions necessarily result in lower prices, as if the pass-through were complete. In this context, our findings contribute to the ongoing debate on tax reform in Brazil, especially the controversy surrounding the adoption of differentiated VAT rates. The main argument in favor of differentiated rates is grounded in distributional concerns. However, this reasoning relies on the assumption that tax reductions are fully transmitted to final consumers, an assumption that is unsupported for most of the food product categories analyzed in this article.

Finally, this article represents a first step toward estimating tax pass-through to food prices in Brazil. In this respect, we plan to expand our research in several directions. First, we intend to explore the possibility of asymmetric pass-throughs. Second, since consumption tax changes in Brazil have taken at least three distinct forms, we aim to investigate whether the nature of these changes affects the magnitude and timing of the pass-through. Third, we plan to expand the number of products and, most importantly, the number of states included in the sample. This is not a simple task, given the difficulty in mapping tax rate changes over time. However, such an expansion would improve the model's causal identification and, given that we currently cover only four out of Brazil's 27 states, would also increase confidence in the external validity of the results [15].

Notes

1. Recently, Fedoseeva and Van Droogenbroeck (2024) extended the investigation of tax pass-through to digital markets. See Ván and Oláh (2018) and Benzarti (2024) for a more comprehensive literature review.
2. Additionally, regarding the vertical market structure, Bajo-Buenestado and Borrella-Mas (2022) document that the tax pass-through is higher in vertically integrated gas stations than in independent ones in Spain.
3. The ICMS is the Portuguese abbreviation for the Tax on Operations related to the Circulation of Goods and the Provision of Interstate and Intermunicipal Transport and Communication Services. In Brazil, consumption is taxed at the Federal, State and Municipal levels. At the State level, consumption of goods (and the two services mentioned above) used to be taxed by the ICMS, a tax modeled after the European value-added tax, but which has a series of particularities, including the fact that it does not ensure the complete avoidance of cumulative incidences of taxation. The Brazilian consumption tax system was recently remodeled (and simplified), and the country is transitioning to the new system.
4. Much of the recent literature investigates the pass-through of transitory tax changes (e.g. Montag *et al.*, 2020; Schmerer & Hansen, 2023; Arango *et al.*, 2024; Fedoseeva & Van Droogenbroeck, 2024; Fuest *et al.*, 2025), many of which were driven by the COVID-19 pandemic. Our paper differs from this literature by capturing the effects of (potentially) permanent tax changes.

5. See Orair and Gobetti (2021) for a description and analysis of the changes under discussion.
6. From this point on, the terms product and subitem, category and item, will be used interchangeably.
7. To address this question adequately, it would be ideal to have access to prices at the company level, as in Kosonen (2015), Benzarti *et al.* (2020), Piga, Onnis, Conti, and Bottasso (2022) and Frey and Haucap (2024).
8. For examples of this approach, see Poterba (1996), Besley and Rosen (1999), Politi and Mattos (2011), Benedek *et al.* (2020) and Buettner and Madzharova (2021).
9. Due to these criteria, 3,580 observations were left out. See Table B2 in the Supplementary Material for excluded products.
10. As $K_{MAX} = 6$, all pairs of products and metropolitan areas with less than seven observations were dropped from the sample. This procedure eliminated 86 observations.
11. The cumulative effect is negative and statistically different from zero for category 1102. No product in category 1103 experienced tax changes during the period, preventing the estimation of the pass-through to consumer prices.
12. For more details, see Table C1, Table C2, and Table C3 in the Supplementary Material.
13. See Table C4 in the Supplementary Material for more details.
14. See Table C5 in the Supplementary Material for more information.
15. Regarding external validity, although Bahia, Minas Gerais, Rio de Janeiro and São Paulo represent less than 15% of Brazilian states, according to official statistics, they made up 54.1% of GDP and 47.2% of the Brazilian population in 2020.

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Supplementary material
The supplementary material for this article can be found online.

Corresponding author
Mauricio Canêdo-Pinheiro can be contacted at: mauricio.canedo.pinheiro@gmail.com