



Universidade Católica de Brasília

ASSESSING TOBACCO TAX REFORM AND EFFECTS OF THE ILLICIT MARKET IN BRAZIL



Assessing Tobacco Tax Reform and Effects of the Illicit Market in Brazil*

José Angelo Divino♦ Philipp Ehrl♦ Osvaldo Candido♦ Marcos Valadão♦

Key messages

- A tobacco tax reform, along the lines of the proposed Constitutional Amendment Bill 45/2019, has the potential to increase total tax collection and reduce fiscal imbalance.
- If the proposed reform is implemented, the cigarette tax burden would be the same across all Brazilian states.
- In order to avoid decreasing tobacco tax revenues in any state, the proposed reform must increase the cigarette tax burden to 83 percent.
- After the proposed tobacco tax reform, the average consumer price would increase to 9.8 BRL per low-cost cigarette pack and 16.4 BRL per premium-brand pack, while smoking would decrease by 25.3 percent and 39.9 percent, respectively. That would result in additional tax revenues of 5.4 billion BRL per year.
- Efforts to reduce illicit trade would increase revenues. A 10 percent reduction in the size of the illicit cigarette market would lead to an increase of 8.5 percent in total tobacco tax revenue, which corresponds to about 1.6 billion BRL of extra revenue per year.
- A tobacco tax reform coupled with a reduction in the illicit cigarette market has the potential to bring multiple benefits to the Brazilian society, including additional tax revenue for healthcare costs during the COVID-19 pandemic and to reduce chronic fiscal imbalance.

* We are grateful to Frank Chaloupka, German Rodriguez Iglesias and Erika Siu for their comments and suggestions. This research (grant number 17409-01) is funded by the University of Illinois at Chicago's (UIC) Institute for Health Research and Policy to conduct economic research on tobacco taxation in Brazil. UIC is a partner of the Bloomberg Initiative to Reduce Tobacco Use. The views expressed in this document cannot be attributed to, nor do they represent, the views of UIC, the Institute for Health Research and Policy, the Bloomberg Philanthropies, or the Catholic University of Brasília.

♦ Catholic University of Brasília.

Executive summary

Since 2019 the Brazilian National Congress is analyzing Constitutional Amendment Bills for tax reform. At least two Bills (Constitutional Amendments 45/2019 and 110/2019) intend to simplify the tax scheme by unifying different taxes at the federal level.

These proposals aim to replace the subnational ICMS, the local ISS, the federal taxes PIS/COFINS and IPI by an unique and harmonized federal VAT-type tax, the so-called Goods and Services Tax (GST). They also replace the current the IPI, which also works as a federal selective tax, by a federal excise tax, that when levied on tobacco is named Tobacco Excise Tax (TET) in this research report. Furthermore, the Executive Power is working on separate tax reform proposal, through a Bill of Law, which is more restricted.

The proposal of the Bill of Law n. 3,887/2020 is to replace the current PIS/COFINS by a general tax on consumption, named CBS (Social Contribution on Operations with Goods and Services). No other tax will be changed under this proposal. However, this Bill of Law is not addressed in this research that deals only with the Amendment 45/2019, which is the amendment the Congress is more likely to pass. This research simulates how a tax reform that unifies and harmonizes tax rates across Brazilian States might affect cigarette prices, consumption, and tax revenue. Alternative tax reform scenarios are simulated, considering both pure *ad valorem* and mix *ad valorem* and specific value tax schemes.

The research follows Odair and Gobetti (2019) and considers a nationwide GST of 27 percent over all goods and services. Then, three scenarios are simulated for the TET: (i) No-tax-revenue-loss scenario, where TET is adjusted to obtain no reduction of revenues in any state; (ii) Maximum-excise-tax scenario, where TET is adjusted to obtain the highest revenue collection for the country as a whole; and (iii) Specific tax with no-revenue-loss scenario, which is equivalent to Scenario I but using a specific value (*ad rem*) TET instead of an *ad valorem* rate. Finally, for each one of these scenarios, the impacts of a reduction in the illicit cigarette market is simulated.

If the government chooses TET, such that no state will lose tax revenues, as in **Scenario I**:

- The **TET rate** would be set to 50.85 percent and the overall tax burden would be 77.85 percent (GST 27.0 percent plus TET 50.85 percent).
- The **average price** would be 7.57 BRL for cheaper brands and 12.65 BRL for premium brands. These new prices corresponded to increases of 18.3 and 45.9 percent in relation to the 2018 baseline prices, respectively.
- **Cigarette consumption** would decrease by 9.9 and 20.9 percent for each price category, respectively.
- **Overall cigarette revenue collection** would increase by about 27.3 percent relative to the baseline.

If the government's goal is to align the TET rate, such that the aggregate tobacco tax revenue is maximized under the condition that no state will lose tax revenue, as in **Scenario II**:

- The **TET rate** would be set to 55.95 percent and the overall tax burden on cigarettes would be 82.95 percent (GST 27.0 percent plus TET 55.95 percent).
- The **average price** would be 9.83 BRL for cheaper brands and 16.43 BRL for premium brands. These new prices corresponded to increases of 53.6 and 89.5 percent in relation to the 2018 baseline prices, respectively.
- **Cigarette consumption** would decrease by 25.3 and 39.9 percent for each price category, respectively.
- **Overall cigarette revenue collection** would increase by about 8.5 percent compared to baseline.

In case the government aims to keep the *ad valorem*–specific tax structure on cigarettes, the research also simulates the effects of introducing a specific (*ad rem*) TET in **Scenario III**:

- The **TET value** would be set to 3.89 BRL per pack and the overall tax burden would be 78.2 percent for cheaper brands and 69.6 percent for premium brands.
- The **average price** for these brands would be 7.63 BRL and 9.17 BRL, respectively. These new prices corresponded to increases of 19.2 and 5.8 percent relative to the 2018 baseline prices, respectively. The price gap is smaller than in Scenarios I and II.
- **Cigarette consumption**, however, would decrease by just 6.7 and 1.0 percent across these two price categories, respectively.
- **Overall cigarette revenue collection** would increase by about 8.3 percent compared to baseline.

Finally, for all three previous scenarios, the impact of a 10 percent reduction in the illicit cigarette market is simulated. The results indicate that a 10 percent reduction in the size of the illicit cigarette market would lead to an average increase of 8.5 percent in the total tobacco tax revenue in all scenarios, including the baseline. This corresponds to about 1.6 billion BRL of extra tax collection per year.

The simulation results indicate that, independent of the scenario, the tax reform is a great opportunity to increase cigarette prices, reduce cigarette consumption, and, above all, raise cigarette tax collection. This extra revenue can be used to support the most vulnerable during the COVID-19 pandemic and reduce the country's chronic fiscal imbalance.

1. Introduction

Over the past years, Brazil has significantly reduced the prevalence of smoking, from 34.8 percent in 1989 to approximately 10.5 percent in Brazilian capitals in 2019 (São José et al., 2017, Vigitel Brasil, 2019). This dramatic decrease can be attributed to the implementation of strong tobacco control policies. This includes smoking restrictions, advertising regulations, cutting economic incentives to tobacco farming, and, of course, tobacco taxation. In the last twenty years, more than one thousand legislative acts and Bills of Law related to these issues have been presented before the National Congress (see Appendix C).

In the recent period, two bills have proposed increases on tobacco taxes. Bill of Law 3421/2020 (which is still pending of Speaker's approval for proceedings) increases the PIS/COFINS social contributions levied on cigarettes. Another important proposal is the Bill of Law 3199/2019, which increases the PIS/COFINS rate on cigarettes and, additionally, earmarks the additional revenue from COFINS to expenses related to cancer.¹

During 2019 and 2020, there have been important discussions about constitutional tax reform in Brazil. This subject has been on the table for the last twenty years, especially in regard to the complex system of taxation of consumption in the country. In addition to the proposals under consideration by the Congress, several organizations, such as labor unions and associations, including from specific states, such as the National Committee of State Finance Secretaries and the Federal District - Comsefaz, have developed proposals for tax reform and are debating this topic. There are also two Constitutional Amendment Bills (also called constitutional amendment proposal - PEC) for tax reform whose processing is relatively more advanced in the National Congress. More recently, in July 21, 2020, the Executive Power sent a Bill of Law to the Congress, dealing specifically with the PIS/COFINS, intended to simplify these contributions. The proposal of the Bill of Law n. 3,887/2020 is to replace the current PIS/COFINS by a general tax on consumption, named CBS (Social Contribution on Operations with Goods and Services), without changing any other taxes, namely IPI and ICMS.

Constitutional Amendment Bills 45/2019 and 110/2019 intend to simplify the tax scheme by unifying different federal, state and local taxes at the federal level. The plan includes a proposal to replace the subnational ICMS, the local ISS, the IPI², and the PIS/COFINS

¹ The Bill of Law 3199/2019 was attached to the Bill of Law 5429/2016, which also raises the PIS/COFINS (in a different amount), and brings the same proposal, with exactly the same wording, earmarking the COFINS additional revenue to health. This Bill of Law 5429/2016, by its turn, was attached to Bill of Law 513/1999 (which is not a tax Bill of Law on cigarette taxes, but demands compensation from tobacco industry to public health system). Information available at <https://www.camara.leg.br>

² The IPI is a sort of VAT on manufactured products and works as a federal selective (excise) tax, being levied under special tax regimes on cigarettes and alcoholic beverages.

with a unique and harmonized federal VAT-type tax, the Goods and Services Tax (GST).³ In addition, there will be a selective tax (excise tax) on selected goods such as tobacco, alcoholic beverages, etc. (when levied on tobacco this tax is named Tobacco Excise Tax (TET) in this Research Report). These proposals are the ones that may effectively result in a change in the tax system at both national and subnational levels and thus have repercussions on cigarette taxation and tobacco tax revenue as well. As it will be further explained Constitutional Amendment 45/2019 is the more likely to be approved, thus it will be subject to a more detailed analysis regarding its effects on cigarette taxation.

This Research Report analyzes the effects of tax reform at the national and subnational level in Brazil. The analysis focuses on a tax reform that unifies and harmonizes tax rates across Brazilian States, and estimates the impact on cigarette prices, consumption, and tax revenue.

A baseline model that replicates the cigarette total tax revenue in 2018 is used to calibrate the simulations and calculate the effects of the adoption of alternative cigarette tax reforms in substitution to the current federal and state tax schemes. The simulations of cigarette consumption, prices, and tax collection at national and subnational levels under different tax regimes use alternative data sets. Cigarette consumption patterns per year from 2008 to 2018 and by federal state were obtained from Vigitel. Current and past cigarette tax structure came from the tax legislation, while Receita Federal⁴ provided the aggregate tax revenue at the national level. The price elasticities by geographical regions and cigarette price categories, as well as the size of the illicit cigarette market, are estimated using the same approach used by Divino et al. (2019).

The simulation results indicate that the tobacco tax reform should be carefully designed in order to prevent any Brazilian state from losing tax revenue, given that the tax burden per cigarette pack will be the same across all states after the reform. Thus, any tax reform that yields a tax burden below the one currently observed in a given state would generate a loss in tobacco tax revenue related to that state. In addition, a reduction in the illicit cigarette market may have significant impacts on the cigarette tax revenue across Brazilian states.

Considering that the GST will be applied to all goods and services in the economy, the research follows Odair and Gobetti (2019) and considers a nationwide GST of 27 percent and simulates three alternative tobacco tax reform scenarios for the TET. In Scenario I, TET is chosen to yield the highest cigarette tax burden such that no state will lose tax

³ There are other aspects that are not relevant for this research towards cigarette taxation.

⁴ Receita Federal (or Receita Federal do Brasil - RFB) is equivalent to the Internal Revenue Service in the Brazilian economy.

revenue.⁵ In Scenario II, TET is set to produce the maximum aggregate tobacco tax revenue under the condition that no state will lose tax revenue. Scenario III considers a mixed tax structure of *ad valorem* GST and specific value TET per cigarette pack. The results indicate that, in all tax reform scenarios, the cigarette tax burden would increase across the Brazilian states. As a result, the aggregate tax revenue and the average price for low price brands and for premium brands would also increase. Cigarette consumption would substantially decrease in all scenarios when compared to the baseline, for both low price and premium brands. Thus, the simulation results indicate that the tax reform is a great opportunity for the country to increase cigarette prices, reduce cigarette consumption, and raise cigarette tax collection. These revenues can be directed toward health and social expenses to support the most vulnerable families during the COVID-19 pandemic and reduce the country's chronic fiscal imbalance.

2. Proposed tax reforms

This section summarizes the Constitutional Amendments Bills 45/2019 and 110/2019, with emphasis on aspects that might affect the taxation of cigarettes, and without considering issues related to transition period, revenue sharing, or other aspects that might affect other taxes, including taxes on equity and income.

2.1 Constitutional Amendment Bill 45/2019

Amendment Bill 45/2019 was presented at the Chamber of Deputies by the Representative Baleia Rossi, based on studies prepared by the economist Bernard Appy. This Bill was approved by the Constitution and Justice and Citizenship Commission (CCJ/CD) on May 22, 2019, and by August 2020 pending on Special Commissions decision.

The major effects of Amendment Bill 45/2019 on the current tax system, considering the existing taxes on consumption, are:

- 1) Cessation of the following federal taxes on consumption:
 - 1.1. Tax on industrialized products (IPI);
 - 1.2. Contribution to the Social Integration Program (PIS);
 - 1.3. Contribution to the financing of social security (COFINS).

⁵ Throughout the text, the expression referring to tobacco tax revenue as "state tax revenue" does not mean that this specific revenue is available to the state. The expression refers to the total cigarette tax revenue accrued in that specific state or states (that is, the sum of federal, state and local cigarette taxes collected in each state).

2) Cessation of the Tax on the circulation of goods and transportation and communication services (ICMS), which is a state tax on consumption.

3) Cessation of the Tax on services of any kind (ISS), which is a municipal tax on services.

These five taxes on consumption would be replaced by the Tax on Goods and Services (GST), which is a federal level value-added tax (VAT), but levied by federal, state and local governments. The tax basis calculation would be uniform throughout the country, but the federal entities would have the autonomy to set their own tax rates, which would be applied to all goods and services in general. The Bill also provides space for the creation of a federal selective tax, an excise tax on specific goods and services whose consumption is to be discouraged, such as cigarettes and alcoholic beverages.

Although the federative entities' prerogatives to set the tax rate is preserved, the tax rate cannot vary between any goods, services or rights. For example, if the GST state reference rate is 10 percent, the State of São Paulo may reduce it to 9 percent or increase it to 11 percent, but the fixed rate will apply to all commercial operations, and it is not possible to adopt a higher or lower rate only for televisions or mobile phones, for instance. As each federative entity would have its rate, the final GST tax rate would be formed by the sum of the federal, state and municipal rates. If, for instance, the federal rate of GST is 7 percent, the rate of the state of São Paulo is 11 percent, and the rate of one of its municipalities, say Campinas, is 2 percent, the sales made in Campinas would be taxed under the GST at the rate of 20 percent.

Therefore, according to Amendment Bill 45/2019, cigarettes would be taxed by GST at the same rates as other products, although the rate may vary among states and municipalities. Thus, under these tax schemes and limitations for taxation under the GST, an increase in cigarette taxation through GST would not be feasible because it is not possible to apply a higher tax rate only to cigarettes. In this way, any tobacco tax policy would be restricted to the new selective tax under the federal government. In addition, just after the Amendment comes into effect, all states would be applying the same tax burden throughout the country.

2.2 Constitutional Amendment Bill 110/2019

The Senate is discussing a proposal for a constitutional amendment that re-produces a previous Amendment Bill, whose base text had already been approved by a House Committee in 2018 (proposal by former representative Luiz Carlos Hauly), but which was never considered by the Senate plenary. At the beginning of the second half of 2019, some senators took advantage of the text of the Chamber's proposal and presented it in the Senate, as Amendment Bill 110/2019. The bill is currently in the Senate's Constitution, Justice and Citizenship Committee.

The major effects of Amendment Bill 110/2019 on the current tax system, considering the existing taxes on consumption goods, are:

1) Cessation of the following federal taxes on consumption:

1.1. Tax on industrialized products (IPI);

1.2. Contribution to the Social Integration Program (PIS);

1.3. Contribution to the financing of social security (COFINS);

1.4. Tax on Financial Operations (IOF);

1.5. Contribution to the Public Officers' Heritage Program (Pasep);

1.6. Social contribution to education (Salary-education);

1.7. Contribution of intervention in the economic domain related to the activities of import or commercialization of oil and its derivatives, natural gas and its derivatives, and fuel alcohol (Cide-Fuels).

2) Cessation of the Tax on the circulation of goods and transportation and communication services (ICMS), which is a state tax on consumption.

3) Cessation of the Tax on services of any kind (ISS), which is a municipal tax on services.

Under Amendment Bill 110/2019, the current taxes on consumption would be replaced by a value-added tax, but under this proposal, it would be controlled only by the states. It would be named Tax on Operations with Goods and Services (GST); the federal government would have the competence to levy a tax on specific goods and services (Selective Tax), which would apply to items such as oil and oil products, fuels and lubricants, cigarettes, electricity, and telecommunications services.

According to the Bill explanation, the GST would be created along the lines of what exists in industrialized countries (namely OECD countries, as related to value added taxes - VAT), and without taxing (or reduced rates for) medicines and food. GST tax rates would be uniform throughout the states, and states would not be allowed to differentiate rates for cigarettes or any other products. As it would be levied under state responsibility, but with single federal legislation, the collection must be managed by a state tax administration.

The Selective Tax, in turn, would be levied by the federal government and apply to specific products, such as oil and oil products, fuels and lubricants, cigarettes, electricity, and telecommunications services. Complementary law would define which products and services are included in the Selective Tax. Finally, any consumption tax policy related to tobacco would be restricted to the Selective Tax.

2.3 Comments on the Constitutional Amendments Bills up for discussion

There are a series of factors that result in Amendment Bill 110/2019 being too restrictive. If Amendment Bill 110/2019 is approved, this will result in no general consumption tax under the federal government. Currently, there are at least four types of consumption taxes under the federal government, and these taxes are responsible for a considerable amount of the federal revenue. Additionally, the Amendment Bill 110/2019 curtails state's autonomy by imposing unique tax legislation (including tax rate definition) to be followed by states, not allowing them any room for state-specific tax policy. For these two major reasons, this results in Amendment Bill 45/2019 being less restrictive and more likely to be approved by Congress compared to Amendment Bill 110/2019. Additionally, this research does not address the effects of the Bill of Law #3,887/2020 (replacing the PIS/COFINS by the CBS), which may be analyzed in further work. In either of the two amendment proposals there will be fewer tax types and fewer variations in tax rates. Thus, the tax burden of cigarettes is expected to vary less when compared to retail prices, which also vary by state. Another factor to consider is that under Amendment Bill 45/2019, there could be variation in the GST tax rate across municipal districts, which is not allowed nowadays.

3. Methodology and data

To implement the tax simulations, this research expands upon Divino et al. (2019) to include a new set of estimations at national and subnational levels. The micro data were inputs in the simulation in order to determine the smoking behavior and consumer responses to price as accurately as possible across the different Brazilian States. The aggregate macro data was used to calibrate the model, such that it replicated the tobacco tax incidence and revenue collection in 2018. Then, different scenarios for the federal tobacco tax were developed and their effects on cigarette prices, smoking behavior, and tax revenue were simulated. Finally, the research demonstrates that the size of the illicit cigarette market also plays a key role in the tax revenue simulations.

3.1 Data and sources

Two nationwide representative and extensive surveys about individual smoking behavior have been conducted in Brazil: the National Household Sample Survey (PNAD) of 2008 and the National Health Survey (PNS) of 2013. Besides their completeness and detailed questionnaires, the main limitation of these surveys is their sporadic occurrence and

temporal lag. Therefore, this micro data was complemented and updated with information from Vigitel, which uses a less detailed questionnaire, but is repeated annually.⁶

PNAD and PNS data reported the number of cigarettes an individual smoked per day and also how much he/she paid for the cigarettes at the time of his/her last purchase. Individual socio-economic information, such as gender, income, years of smoking, was also used to refine the price-elasticity estimation, as will be explained in the next section. Further information about the data sets and descriptive statistics can be found in Divino et al. (2019).

Based on the official minimum price, cigarettes purchased below this price were classified as illicit (or illegal), in line with Divino et al. (2019). This was the Price Category 1 (PC1). To increase the precision of the simulations, the legal market was also divided into low price and premium brands, according to the median in this market segment. These were Price Category 2 (PC2) and Price Category 3 (PC3), respectively. Table 1 shows a summary of these data.

In order to obtain good estimates for cigarette consumption and associated tax revenue in each state and price category, the daily cigarette consumption per price category (PC) and state from the PNAD and PNS is multiplied by the variation in daily cigarette consumption per Brazilian state between 2013 and 2018 according to the Vigitel data.

These updated consumption patterns and the current share of smokers is then multiplied by the exact number of inhabitants per state in 2018 from the IBGE (Brazilian Institute of Geography and Statistics) to derive the aggregate cigarette consumption. Finally, average cigarette prices are updated by the aggregate wide consumer price index tobacco sub-category (IPCA-Tobacco) in the same period and for each federal state. Because this information is not available for all states, regional averages are used as a substitute when needed. Table 2 summarizes these data.

Further information on the current tax system, officially registered cigarette prices data, and cigarette tax revenue was obtained from Receita Federal. Unfortunately, Receita Federal only provides tax revenue aggregated at the federal level. Table 3 reports a summary of the variables and respective sources used in the present research.

⁶ Vigitel is an annual national survey of the Ministry of Health conducted by phone call to individuals randomly chosen in the 26 state capitals and the Federal District. The purpose of Vigitel is surveillance of risk and protective factors for chronic diseases, see Vigitel Brasil (2019) for further details.

Table 1 - Smoking behavior: Brazilian regions, states, and price categories (PC)

Region	State	Distribution of smokers by price category (%)			Cigarette consumption by price category (units / day)		
		PC1	PC2	PC3	PC1	PC2	PC3
North	Rondônia	49.7	23.3	27.0	13.6	17.5	11.7
	Acre	68.1	9.6	22.3	12.7	11.5	13.0
	Amazonas	22.0	26.1	51.9	8.6	10.2	7.0
	Roraima	7.2	37.7	55.1	6.1	12.6	10.7
	Pará	26.2	36.1	37.7	8.4	10.2	8.4
	Amapá	14.9	35.1	50.0	5.3	7.9	9.5
	Tocantins	27.5	45.6	26.9	9.6	12.3	11.9
Northeast	Maranhão	48.9	31.1	20.0	11.0	10.5	7.9
	Piauí	41.9	34.3	23.7	10.1	10.8	11.5
	Ceará	42.2	37.8	20.0	13.1	11.9	12.4
	Rio Grande do Norte	34.0	45.2	20.8	12.9	14.0	11.1
	Paraíba	33.6	43.0	23.4	14.6	14.5	15.6
	Pernambuco	30.2	45.7	24.1	13.3	13.5	12.2
	Alagoas	29.0	52.7	18.3	14.2	10.3	13.9
	Sergipe	26.2	49.2	24.6	14.7	13.3	11.2
	Bahia	30.5	34.2	35.2	12.3	11.7	11.1
Southeast	Minas Gerais	33.0	41.1	25.9	14.0	13.1	12.4
	Espírito Santo	12.8	57.7	29.5	12.3	12.9	14.9
	Rio de Janeiro	10.6	61.7	27.8	18.7	15.0	14.7
	São Paulo	29.2	41.9	28.9	14.0	13.6	15.1
South	Paraná	47.2	27.6	25.2	15.2	13.5	14.1
	Santa Catarina	33.0	38.8	28.2	13.3	14.7	15.9
	Rio Grande do Sul	29.9	48.2	22.0	16.5	15.1	13.6
Midwest	Mato Grosso do Sul	65.9	16.7	17.4	14.3	14.6	14.9
	Mato Grosso	38.5	27.8	33.7	12.9	12.5	15.2
	Goiás	34.6	40.1	25.2	15.2	15.0	13.0
	Distrito Federal	13.1	43.7	43.3	11.3	13.4	13.4

Source: PNAD 2008 and PNS (2013)

Table 2 - Smoking behavior by Brazilian states and regions

Region	State	Share of smokers (% of population)		Cigarette consumption (units per day)		Population (millions of people)	
		2013	2018	2013	2018	2013	2018
North	Rondônia	11.7	8.7	12.3	12.7	1.73	1.78
	Acre	9.6	9.0	13.5	19.4	0.78	0.88
	Amazonas	7.0	6.4	10.9	9.6	3.81	4.14
	Roraima	9.2	7.2	12.3	10.5	0.49	0.61
	Pará	7.7	4.9	11.6	11.1	7.97	8.60
	Amapá	10.1	5.5	12.4	9.7	0.73	0.85
	Tocantins	5.7	6.5	14.9	11.1	1.48	1.57
Northeast	Maranhão	8.1	4.8	12.1	11.9	6.79	7.08
	Piauí	7.6	5.5	12.4	12.9	3.18	3.27
	Ceará	7.2	5.7	14.6	14.8	8.78	9.13
	Rio Grande do Norte	6.2	7.2	14.2	14.2	3.37	3.51
	Paraíba	7.3	7.1	16.3	10.9	3.91	4.02
	Pernambuco	10.7	7.2	16.1	12.9	9.21	9.56
	Alagoas	8.8	6.9	13.3	13.9	3.30	3.34
	Sergipe	7.9	5.6	15.0	13.5	2.20	2.30
	Bahia	5.2	4.8	11.1	12.5	15.04	14.87
Southeast	Minas Gerais	12.8	10.8	14.4	10.9	20.59	21.17
	Espírito Santo	8.2	7.6	23.2	11.3	3.84	4.02
	Rio de Janeiro	11.8	10.0	16.0	13.8	16.37	17.26
	São Paulo	14.9	12.5	14.1	13.6	43.66	45.92
South	Paraná	13.7	11.4	12.8	12.1	11.00	11.43
	Santa Catarina	12.4	11.2	16.2	13.2	6.63	7.16
	Rio Grande do Sul	16.5	14.4	15.8	14.0	11.16	11.38
Midwest	Mato Grosso do Sul	12.7	10.8	12.5	13.5	2.59	2.78
	Mato Grosso	10.8	7.5	11.7	12.2	3.18	3.48
	Goiás	10.4	8.8	13.2	15.7	6.43	7.02
	Distrito Federal	10.7	8.3	11.8	12.0	2.79	3.02

Source: Vigitel and IBGE

Table 3 – Variables and sources

Variable	Source
Current Cigarette Tax Rates	Federal and State Legislations
Proposed general tax rates for the new GST	Odair & Gobetti (2019)
New excise tax rate on cigarettes	Authors' choice
Share of smokers per federal state	Vigitel 2013, 2018
Cigarette consumption per smoker and state	Vigitel 2013, 2018
Cigarette tax revenue at national level	Receita Federal
Population per state	IBGE
Share of smokers per federal state and price category	PNAD 2008 and PNS 2013
Cigarette consumption per smoker and state and price category	PNAD 2008 and PNS 2013
Mean price of cigarettes in price categories 1, 2 and 3	PNAD 2008 and PNS 2013 updated with tobacco-specific consumer price index from IBGE

3.2 Tax reform simulations

The simulation scenarios in this study start from the current tax burden on cigarettes, which are then changed to a new tax scheme, after the implementation of the tax reform with only two taxes—the GST and the federal selective tax. Odair & Goibetti (2019) estimated the general tax rates for the new GST and the federal excise tax, for both Constitutional Amendment proposals, under the assumption of keeping the same overall tax burden (before and after the tax reform). This research uses their results in the simulation exercises, but properly adapted to the case of tobacco tax reform. Briefly, the simulations are derived according to the following steps:

1. **Baseline scenario:** Based on the smoking behavior of the Brazilian population, the size of the illegal market is calibrated such that, under the current tax legislation, the model replicates the actual tobacco tax collection in 2018.
2. **Reform scenarios:** The tobacco tax structure is adjusted according to the proposed Constitutional Amendment Bill 45/2019 and the specific values of the new tax components that define the overall tax burden of cigarettes are chosen according to specific political criteria.

The details and corresponding assumptions behind these steps are explained below.

3.2.1 Baseline scenario

The starting point of the simulations is the number of smokers, average consumption of cigarettes and average prices of cigarette across all Brazilian states, and within the three price categories defined previously. As explained in Section 3.1, these numbers refer to the baseline year of 2018. Recall that the share of cigarette sales in the first price category is equivalent to the extension of the illicit market of cigarettes, given that it is forbidden by law to sell cigarettes below the minimum price in Brazil. Price categories 2 and 3 represent cheaper cigarettes and premium brands, respectively.

Calibration of the model first adjusts the size of the illicit market, that is, the share of smokers that consume cigarettes of price category 1, such that the calculated aggregate tax revenue matches the observed cigarette tax collection in 2018. Based on the average cigarette prices and the number of smokers, the prevalent tax rules are used to calculate the monthly aggregate tobacco tax revenue per state for the IPI, PIS/CONFINS, and ICMS. Note that in absence of further information about the brand of cigarettes purchased, the Special Rule for IPI calculation is considered throughout the simulations, as explained in Divino et al. (2019). The ICMS tax rates on tobacco products for each Brazilian State are obtained from Ribeiro and Pinto (2019).

The rationale for choosing the size of the illegal market as the key parameter for the initial calibration is the following. Even with the most sophisticated techniques, a quantification of illegal cigarette consumption will always remain an imprecise estimate because the illicit market is unobserved in practice. In the present case, the classification of cigarette sales as legal or illegal is derived from the official minimum price and smokers' responses of cigarette expenditure from representative surveys in 2008 and 2013.⁷ The size of the illegal market changed over time so that the shares from 2013 need to be adjusted. Moreover, the estimates from 2013 and 2008 are likely to be lower than the true extent of the illegal market. First, some (illegal) cigarettes are sold individually "out of the pack". Because the unit price of those individually sold cigarettes is higher than its original price per pack, the imputed price for an entire pack may lie above the minimum price and thus the purchase would erroneously be classified as part of the legal market. Second, illegally sold premium brand cigarette prices are also likely to be above the minimum price. Consequently, the 2013 and 2008 microdata most likely lead to an underestimation of the size of the illegal market. The "misspecification" is considered equal for the two price categories and across Brazilian states. Therefore, the additional percentage points of the illegal market that are necessary to replicate the current tobacco tax revenue observed in 2018 are equally subtracted from the share of cigarettes price categories 2 and 3.

An explicit assumption in the reform scenario simulations is that, once the size of the illegal market is adjusted in the baseline scenario, it remains constant. This assumption

⁷ Alternative measures of the cigarette illicit market are discussed in Szklo et al. (2018).

is plausible because the official minimum price is not under discussion in the Constitutional Amendment Bills, and, therefore, it is likely to remain at its current level (anyway, it is a legal issue, not a constitutional matter). Nevertheless, in order to show how this assumption affects tax revenue collection under the new after-reform tax scheme, the research includes an additional exercise where the size of the illicit market is allowed to change exogenously in a sensitivity analysis.

3.2.2 Constitutional amendment 45/2019 – No-Tax-Revenue-Loss Scenario I

This scenario simulates the impacts of changing the Brazilian tax scheme according to the Constitutional Amendment Bill 45/2019. As explained in Section 2, the reform intends to simplify the tax scheme by unifying different tributes into a VAT-based tax scheme with two components: (i) general tax on operations with goods and services (GST); and (ii) a special tobacco excise tax (TET). In this simulation scenario, the value of the TET is chosen such that no state would experience a loss of tobacco tax revenue compared to the baseline tax scenario from the year 2018. Note that both types of taxes would not vary between federal states. That is, the state with the most unfavorable change of tobacco tax revenue after introduction of the new GST is taken and the TET is adjusted such that overall cigarette tax revenue change is equal to zero. This *ad valorem* TET rate is then applied in all other federal states. Given the current public deficit at all levels and the upcoming debates in the political landscape, the possibility of avoiding revenue lost from the tax reform is an important scenario to consider.

To make the simulations as realistic as possible, consumers' responses to the cigarette prices in the new after-reform scenario are taken into account. In states where tax revenue and thus cigarette prices would be higher, consumers tend to smoke less because most of them are price sensitive and respond to price variations according to the estimated state and price-category specific elasticities. Of course, the price adjustments depend on the market power of the tobacco companies. However, given that few companies dominate the market, it is very likely that cigarette producers would fully pass-through any tax increase to consumers (Euromonitor, 2019). For the sake of simplicity, full pass-through from the reform's tax variation to the final consumer prices is assumed. The assumption of full pass-through of tax changes to cigarette prices also implies that the factory price of cigarettes does not change due to the tax reform.

Consumers adjust their consumption behavior according to the estimated price-elasticity of demand. It is important to notice that, by assumption, the distribution of consumers by price category does not change. Consumers do not switch price categories, but instead adjust the intensity of their cigarette consumption.

3.2.3 Constitutional amendment 45/2019 – Maximum-Excise -Tax Scenario II

In this scenario, the TET rate is set so that total nationwide tobacco tax revenue is maximized under the condition that no Brazilian state would experience any reduction in tax revenue. The limit to maximize tax revenue depends on the price-elasticity of cigarette consumption and is given by the highest TET rate under which no state starts losing tax revenue. This latter condition seems a necessary factor in the political process because the Constitutional Amendment Bill's passage requires approval of state representatives in the Federal Senate. After the tax reform proposed by the Amendment Bill 45/2019, the implementation of this excise tax would be straightforward with the new TET.

3.3.4 Specific Excise Tax on Cigarettes (*ad rem* taxation) with No-Tax-Revenue-Loss – Scenario III

In this scenario, instead of having a federal excise tax as pure *ad valorem* tax assessed on the retail price as in the previous sections, a specific tax per pack (*ad rem* taxation) is considered.⁸ That is, the TET is a fixed absolute value (in BRL) charged per cigarette pack and the GST would be along the lines of the tax reform. In this case, there is a specific tax plus an *ad valorem* tax on cigarettes while the previous two scenarios consider only *ad valorem* taxes. Although this kind of tax scheme is currently not under consideration by the Brazilian Congress under the tax reform Constitutional Amendments, it is worthwhile to evaluate this hypothetical scenario as an alternative framework of comparison, because best practices on tobacco taxation rely on a mix structure of *ad valorem* and specific tax on cigarettes.

3.3.5 Reduction in the illicit cigarette market

For all previous scenarios, there is an additional simulation relaxing the assumption that illicit trade remains constant. This simulation allows the size of the illicit market to change exogenously in a sensitivity analysis. Despite the fact that the size of the illegal market is hard to determine and its estimate obviously affects the outcome of the tax revenue simulations, it is informative to show how the illegal market might affect tax collection in the reform scenarios. Moreover, the extent of the illegal cigarette market is a choice parameter because through tighter controls, monitoring, and many other public policies, cigarette smuggling could effectively be reduced. Specifically, the simulation considers the effects of a 10-percent reduction in the illegal market. To perform this simulation, the size of the illicit cigarette market in the initial calibration that was used to replicate the observed cigarette tax collection in 2018 is reduced. The reduction in the illicit market is

⁸ *Ad rem* tax is just a lump-sum tax. That is, it is a fixed amount imposed upon the taxpayer. In the scenario under analysis, the *ad rem* tax is a fixed value charged on each cigarette pack.

equally distributed as consumption increases of both cheaper cigarettes and premium brands.

4. Results

4.1 Price-elasticity of cigarette consumption

In this section, elasticity estimation by region and price category are presented. A price elasticity of consumption is a measure that indicates how many percentage points cigarette consumption would change if cigarette prices changed by one percent. Based on the procedure described in Divino et al. (2019), the price elasticity is obtained in two steps. First, the research estimates how smokers adjust the intensity of their current consumption for those individuals who continue smoking after a price change. Second, the research estimates how many individuals would quit or start smoking due to higher or lower cigarette prices. The combination of these conditional and unconditional elasticities yields to the aggregate price elasticity that is used in the simulation exercises. Note that the price elasticities are specific for each geographical region and price category and are obtained through a single estimation. In both estimations (aforementioned steps), the individually reported price is substituted by the state average price in order to avoid the endogeneity bias that occurs because consumers may adjust to price changes by switching to a cheaper brand.

Table 4 – Price-elasticities by region and price category

Region	Unconditional	Conditional			Total		
		PC1	PC2	PC3	PC1	PC2	PC3
Northeast	-0.26	-0.42	-0.41	-0.46	-0.57	-0.56	-0.60
North	-0.24	-0.42	-0.41	-0.46	-0.56	-0.55	-0.59
Southeast	-0.24	-0.29	-0.29	-0.33	-0.56	-0.55	-0.59
South	-0.21	-0.42	-0.41	-0.46	-0.54	-0.53	-0.57
Midwest	-0.23	-0.20	-0.30	-0.23	-0.41	-0.38	-0.46
BRAZIL	-0.24	-0.26	-0.29	-0.24	-0.42	-0.44	-0.46

Notes: PC1 = price category 1 or illicit market, PC2 = low price brands, and PC3 = premium brands.

Table 4 reports the resulting cigarette consumption price elasticity decomposed into its conditional and unconditional part by region and price category. The differences between these elasticities show that richer regions tend to be less sensitive to price increases and, as expected, individuals that buy brands that are more expensive seem to be less likely to respond to price changes. It is also interesting to note that the decrease in consumption

means a combination of both quitting and smoking less attributable to reductions in the intensity of smoking. In aggregate, a 10 percent price increase would lead to a decrease in consumption by 4 to 6 percent.

4.2 Baseline scenario

The total tax revenue collected from tobacco related products in 2018 was about 13.5 billion BRL. This value corresponds to about 0.19 percent of Brazil's GDP, with 0.11 percent going to the federal tax authorities and the remaining 0.08 percent to the 26 states and Federal District. Unfortunately, Receita Federal does not publish the tax revenue for each Brazilian state, so the model can only be calibrated in the baseline scenario to match the aggregate tobacco tax revenue. According to these numbers, the average tax burden of a cigarette pack was 72.8 percent in 2018, with a standard deviation of 4.17 percent.

As explained in Section 3.2.1, the sample is adjusted to account for the under-reported data in PNS and PNAD and the rising share of illegally purchased cigarettes since 2014 according to the Vigitel survey (2018). The original estimate of the illegal market in 2013 was about 32 percent on average across the states. Based on the estimated number of consumers and their average consumption, the size of the illegal market required to match the observed tax revenue in 2018, the base year, is 45 percent. It is important to mention that this value is also found by other authors, as recently reviewed by Ribeiro and Pinto (2019) and Szklo et al. (2018). Lacking further guidance from the available data, the first price category, which is a proxy for the illegal market, is increased by 13 percentage points (p.p.) and the share of the other two price categories is reduced by 6.5 p.p. each, across all states. The resulting distribution of smokers across price segments are reported in Table 5.

It is interesting to observe that states that are close to the border with Paraguay or Peru show a particularly high consumption of illegal cigarettes. Comparing Paraná and Rio Grande do Sul, for instance, is striking because both states are neighbors and have a similar degree of development and living standards, but the former borders Paraguay and the latter is next to Uruguay. While Rio Grande do Sul has only a 2 percent lower tax burden than Paraná, the differential in the size of the illegal market is almost 18 percent. This observation is in line with Ribeiro and Pinto (2019), who trace the routes of smuggled cigarettes that mainly enter Brazil across the Paraguayan border. Using a different and innovative methodology, Figueiredo et al. (2020) infer the size of the illicit cigarette market from litter collection. Due to the complex and costly data compilation, the survey is only implemented in selected capitals but the numbers, where available, are very much in line with the ones in Table 5.⁹

⁹Another possibility to account for regional differences in the extent of the illegal cigarette market is to assume a higher price-elasticity in states where tax evasion is easier, see National Research Council (2015).

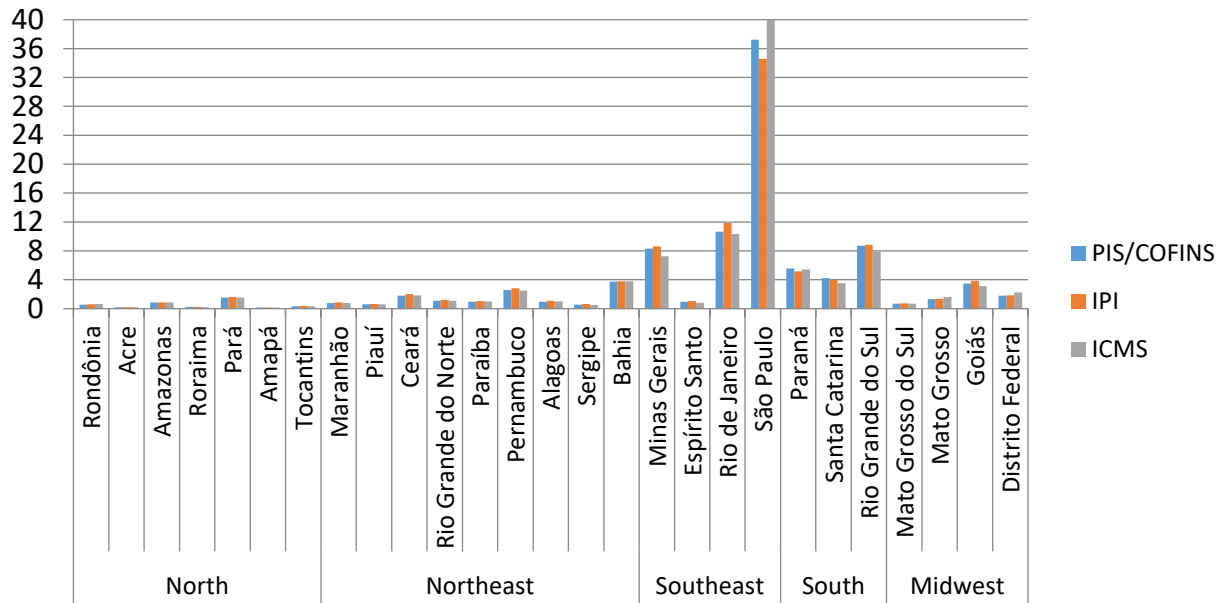
Table 5 - Smoking behavior across Brazilian States and price categories - Baseline Scenario

Region	State Name	Distribution of smokers by price category (%)			Cigarette consumption by price category (units per day)			Tax burden (%)	
		PC1	PC2	PC3	PC1	PC2	PC3	PC2	PC3
North	Rondônia	62.7	16.8	20.5	14.0	18.1	12.1	79.3	72.9
	Acre	81.1	3.1	15.8	18.2	16.4	18.6	75.3	68.9
	Amazonas	35.0	19.6	45.4	7.6	9.0	6.2	75.3	68.9
	Roraima	20.2	31.2	48.6	5.2	10.8	9.1	70.3	63.9
	Pará	39.2	29.6	31.2	8.1	9.8	8.0	75.3	68.9
	Amapá	27.9	28.6	43.5	4.2	6.1	7.4	70.3	63.9
	Tocantins	40.5	39.1	20.4	7.1	9.2	8.8	74.3	67.9
Northeast	Maranhão	61.9	24.6	13.5	10.8	10.3	7.8	74.1	67.8
	Piauí	54.9	27.8	17.2	10.5	11.2	11.9	74.1	67.8
	Ceará	55.2	31.3	13.5	13.3	12.1	12.6	75.5	69.1
	Rio Grande do Norte	47.0	38.7	14.3	12.9	14.0	11.1	74.1	67.8
	Paraíba	46.6	36.5	16.9	9.7	9.7	10.4	76.7	70.3
	Pernambuco	43.2	39.2	17.6	10.6	10.8	9.8	74.4	68.0
	Alagoas	42.0	46.2	11.8	14.8	10.7	14.5	76.1	69.8
	Sergipe	39.2	42.7	18.1	13.2	12.0	10.1	73.1	66.8
	Bahia	43.5	27.7	28.7	13.9	13.3	12.6	73.7	67.8
Southeast	Minas Gerais	46.0	34.6	19.4	10.6	9.9	9.4	69.6	63.7
	Espírito Santo	25.8	51.2	23.0	6.0	6.3	7.2	72.2	65.6
	Rio de Janeiro	23.6	55.2	21.3	16.2	13.0	12.7	74.6	68.2
	São Paulo	42.2	35.4	22.4	13.5	13.2	14.6	72.5	67.4
South	Paraná	60.2	21.1	18.7	14.4	12.7	13.3	69.9	64.7
	Santa Catarina	46.0	32.3	21.7	10.9	12.0	13.0	66.5	61.1
	Rio Grande do Sul	42.9	41.7	15.5	14.7	13.4	12.0	69.2	63.6
Midwest	Mato Grosso do Sul	78.9	10.2	10.9	15.4	15.8	16.0	74.8	68.5
	Mato Grosso	51.5	21.3	27.2	13.4	13.0	15.8	81.8	75.5
	Goiás	47.6	33.6	18.7	18.1	17.9	15.6	72.7	66.3
	Distrito Federal	26.1	37.2	36.8	11.6	13.7	13.7	80.9	74.9

Note: Updated values for 2018 using values from Tables 1 and 2.

The state that stands out the most by its monthly tax revenue is São Paulo. First of all, it is by far the most populous state, comprising almost 25 percent of the Brazilian population (46 million inhabitants). Second, the tobacco tax burden is the fourth highest in the country. If one takes into account the share of total tax revenue, São Paulo is responsible for collecting, on average, 40 percent. Indeed, the three biggest revenue collectors (São Paulo, Rio de Janeiro and Rio Grande do Sul) together represent almost 57 percent of total tobacco tax revenue of the country, considering the states' consumption. Figure 1 illustrates the source of the tax revenue share across Brazilian states.

Figure 1 - Tax revenue shares across Brazilian regions and states - Baseline scenario (in %)



4.3 Constitutional amendment 45/2019 – No-Tax-Revenue-Loss Scenario I

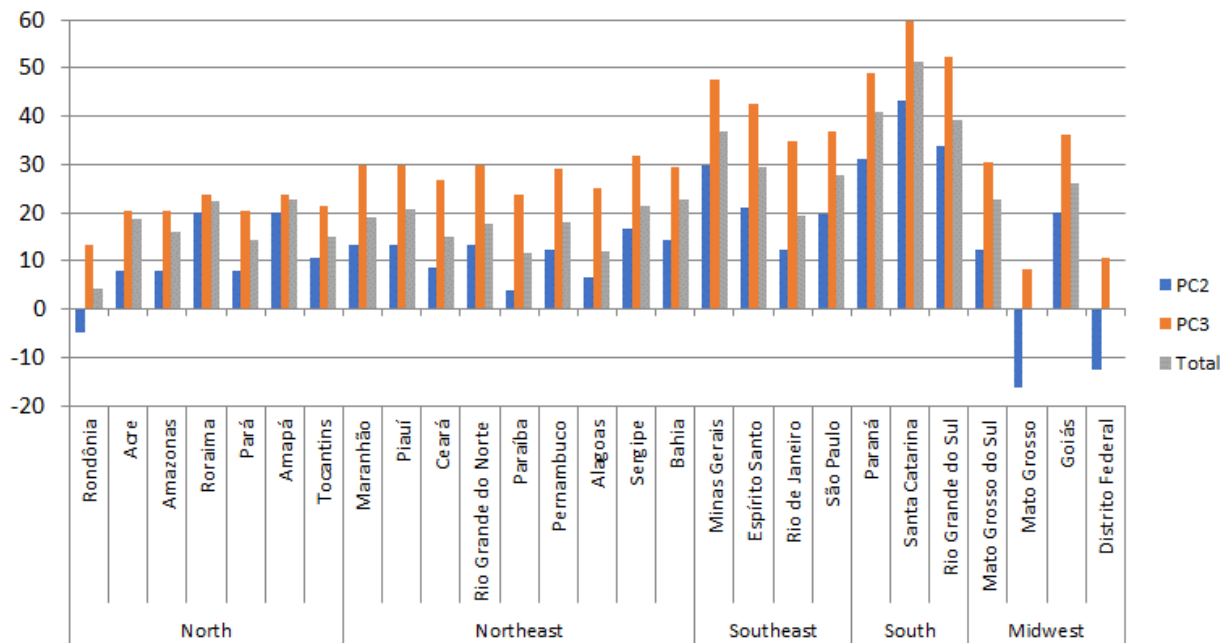
All tax-reform scenarios follow Odair and Gobetti (2019) and use the uniform rates for the new Tax on Goods and Services (GST) as follows: a GST-F (GST at federal level) of 10.3 percent, a GST_SC (GST at state and municipal level) of 16.7 percent. In this way, there is a unique, nationwide GST of 27 percent assessed on all goods and services traded in the country. A summary of the results for each state and region is displayed in Table A1 in the Appendix A.

The TET that defines the no-tax-revenue-loss scenario is equal to 50.85 percent and the total tax burden is 77.85 percent. Under the no-tax-revenue-loss scenario the average price increased by 34.2 percent, resulting in a decrease in consumption by 14 percent. This result is equivalent to an increase of BRL 3.7 billion in total revenue collection per year. The tax reform has a differential impact by price category. While low price brands increased by 18.3 percent, premium brands increased 45.9 percent. That can also be observed in consumption where smokers consuming PC2 reduce consumption by 9.8 percent, while premium brand smokers reduce consumption by 25.3 percent. Additionally, the price dispersion across Brazilian states increases substantially, more than 200%, increasing the standard deviation for both categories.

The state of Mato Grosso effectively defines the value of the TET because it experiences the most unfavorable alteration of its cigarette tax revenue structure. Figure 2 shows that in relation to the current cigarette tax revenue, Mato Grosso would see a 16.3 percent

revenue reduction from low-price cigarettes, but an 8.4 percent increase in revenue from high-price cigarettes. By definition of the TET in the no-tax-revenue-loss scenario, the change in the total tax revenue is exactly zero in the state of Mato Grosso, as the negative variation in tax collection for price category 2 exactly offsets the positive variation for price category 3.¹⁰ Thus, the TET rate, which is applied at the national level, is defined based on the effects in state of Mato Grosso.

Figure 2 - Percentage tax revenue change by price categories relative to the current tax structure - Tax reform Scenario I



Only two other federal units, namely Rondônia and the Federal District, would have falling cigarette tax revenues in one of the price categories, but this loss is more than compensated for by the increase in tax revenue in the other price category. As can be seen in Table 5, this result occurs because these two states along with Mato Grosso already have the highest tax burdens in the country. Thus, the reform would provoke

¹⁰Instead, the research could easily have simulated a “no-loss scenario,” where tax revenue within each price category would be at least zero. First, the differences between these two cases are minor and, further, the no-loss scenario is easier to explain and more transparent. Second, the price categories are arbitrarily defined and serve as approximations, so it is prudent not to put too much weight on them. Third, the price decreases do not violate the current minimum price of cigarettes or any other legislation. Finally, the result also serves to raise awareness for everyone involved in the discussion about the tax reform, that falling cigarette prices can be a punctual outcome. If falling cigarette prices were to be avoided, a sufficiently high TET or additional regulation should be introduced.

higher tax burdens in all other federal states. In Santa Catarina, the most extreme case, tax revenue would increase by 51.2 percent.

The observed differences across price categories even in the same state is due to the complicated tax calculation that currently combines a VAT component and a fixed absolute value (*ad rem*) for each cigarette pack, independent of its final price. Therefore, the prevailing tax burden is generally lower for high-price cigarettes. The equalization of the tax burden in both categories thus increases prices and tax revenue relatively more for high-value brands. This change in the tax structure explains why in the Federal District, for instance, the tax burden of cigarettes in price category 2 decrease by 13 percent while those in price category 3 increase by 13 percent. Finally, a lower tax burden implies lower prices and lower prices imply lower tax revenue. Despite the assumption that price category 1 does not change after the tax reform, the cigarette prices in the illegal market may potentially be lower in those three states than that in the baseline scenario. This is the case if one is willing to assume that the price of illegal cigarettes is somehow related to its closest competitor, that is price category 2 cigarettes that would increase after the tax reform.

The finding that cheaper cigarette would increase prices less than premium brands is of major political relevance. There is a debate between several public departments in Brazil about whether an alteration of the current cigarette price would affect the size of the illegal cigarette market. The final report of a task force on the evaluation of cigarette tax reduction comes to the conclusion that there is no substantial evidence that lower taxation would cause a relevant reduction of cigarette smuggling (Ministry of Justice and Public Security, 2019). At least, the present simulations indicate that the gap between low and high price cigarettes in the legal market widens. Another worry of the task force is that lower taxation could diminish revenue and increase consumption, which is clearly confirmed by the estimations of this research.

As a general result, one can observe in Table A1 (see Appendix A) that prices in the two categories of the formal market deviate further apart from each other. As explained above, this result is due to the transition from a mix of fixed and *ad valorem* structure to a pure *ad valorem* tax after the reform. This may lead to an increase in the price gap, which is not a recommended as tobacco tax policy (WHO, 2011). Note that the simulations could have included only a fixed component or a mixture as in the current case, but this would dissociate the present simulations from the Constitutional Amendment Bill proposal. In addition, it is and will remain mandatory that the final consumer price must be stamped on the cigarette packs.

This tax scheme, combined with the minimum price policy, makes the tax scheme fairly close to a fixed value. The advantages of this tax scheme are that it is neither regressive¹¹ nor there is a need to adjust the fixed value (specific tax) over time to avoid loss of value due to inflation, which would make tobacco taxation increasingly subject to political interference. In addition, once fixed by law, the tax burden is no longer affected by changes in producer price or inflation. Although the tax burden is uniform across federal states, the final cigarette prices could still vary among states for several reasons, including logistics costs, market characteristics, and price elasticities.

It is also important to note that there is a direct relation between the tax burden, tax revenue, and consumer prices. The initial change occurs via change of the tax burden, that is, the introduction of uniform GST and TET. Higher taxes will provoke higher prices and, although this change decreases the consumption of cigarettes in the population, the final change in tax revenue is still positive. The reason why the original tax burden adjustment dominates is the value of the price elasticities displayed in Table 4, whose magnitude in absolute terms is below one. In sum, the reform would by far result in higher cigarette prices and would benefit all states through a higher tax revenue, however, would result in an increase in the cigarette price gap.

4.4 Constitutional amendment 45/2019 – Maximum-Excise-Tax Scenario II

The mechanism used to obtain the results under the second reform scenario are the same as in the previous case, except that the TET rate is now set at a different value. The difference with respect to the first scenario is that the TET is sequentially increased up to the point where the first state would start to lose tax revenue. The TET is set to 55.95 percent in order to maximize tax revenue subject to the constraint that no state suffers any decrease in tobacco tax revenue. Thus, the total tax burden reaches 82.95 percent.

Under the maximum-excise-tax scenario, the average price increases by 74.2 percent, resulting in a decrease in consumption of 30.8 percent and an increase of BRL 5.4 billion in total revenue collection per year.

Prices of cheaper cigarettes increase by 53.6 percent and consumption declines by 25.3 percent while for premium brands cigarettes prices climb 89.5 percent and consumption decreases by 40 percent. Similar to the previous scenario, the price dispersion increases by 290 percent in relation to the baseline standard deviation for both categories.

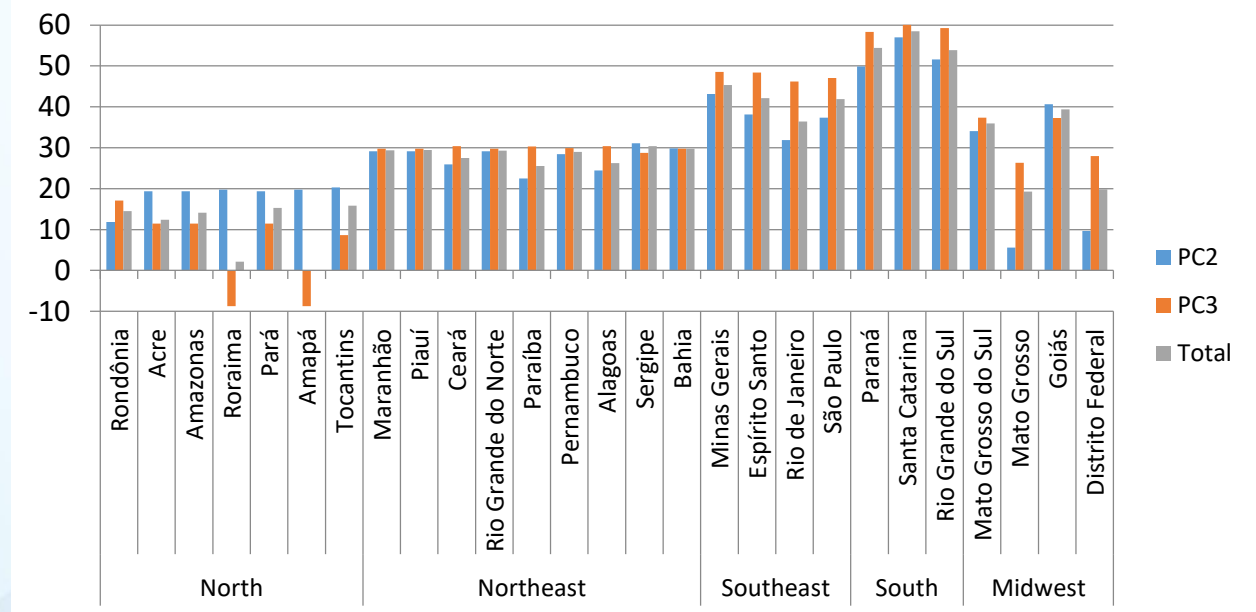
The intuition why tax revenue starts to decrease at some point is well known from the Laffer curve. Due to the negative price-elasticity of consumption and the proportional linkage between tax burden and consumer price, once prices are sufficiently high, falling

¹¹ Regressive means a tax scheme in which higher prices cigarettes would pay proportionally lower taxes than lower prices cigarettes.

consumption is relatively larger than the price increase. However, higher increases will result in additional revenues relative to the status quo situation. To reach the same revenue collection obtained in the current tax scheme and tax rates, the tax should increase to 82.95 percent. That means that any increase until that amount will result in increases on the overall revenue collection.

Figure 3 illustrates that the change in tax revenue becomes negative for the premium cigarette brands because the relative price increase is more pronounced. The state that defines the value of the TET in this second scenario is Amapá. At a TET of 55.95 percent, the revenue loss in premium brands is exactly equal to the tax revenue gain in cheaper cigarettes so that the overall change is equal to zero after the tax increase. Another state that has a similar pre-reform price and tax structure and thus experiences falling tax revenue for premium brands after the reform is Roraima.

Figure 3 - Percentage tax revenue changes by price categories relative to the current tax structure - Tax reform Scenario II



Appendix B contains the details and mathematical formula of this price adjustment mechanism. It shows why the adjustment of the tax burden is equivalent to adjustment increments (either specific or *ad valorem*) to a fixed factory price. Appendix B also illustrates graphically that the relative price increase is more than proportional to the tax burden, which implies that there is an upper bound to the TET beyond which, theoretically, consumption would drop to zero.

Given that the TET is higher than in the previous scenario, prices and tax revenues, in aggregate, are also higher. However, the configuration of percentage change in tax

collection is quite distinct across the two scenarios. In fact, the relative tobacco tax revenue decreases 8.7 percent for the cheaper cigarettes in Roraima and Amapá but increases by about 60 percent for premium brands in Santa Catarina and the other two states in the South region. In general, the maximum-excise-tax reform scenario does not widen the price gap between price categories as much as under the tax reform Scenario I. In the Northern states, where the consumption of premium cigarette brands is relatively high, the reform would even narrow the price discrepancy.

4.5 Specific federal excise tax on cigarettes (*ad rem*) with No-Tax-Revenue-Loss – Scenario III

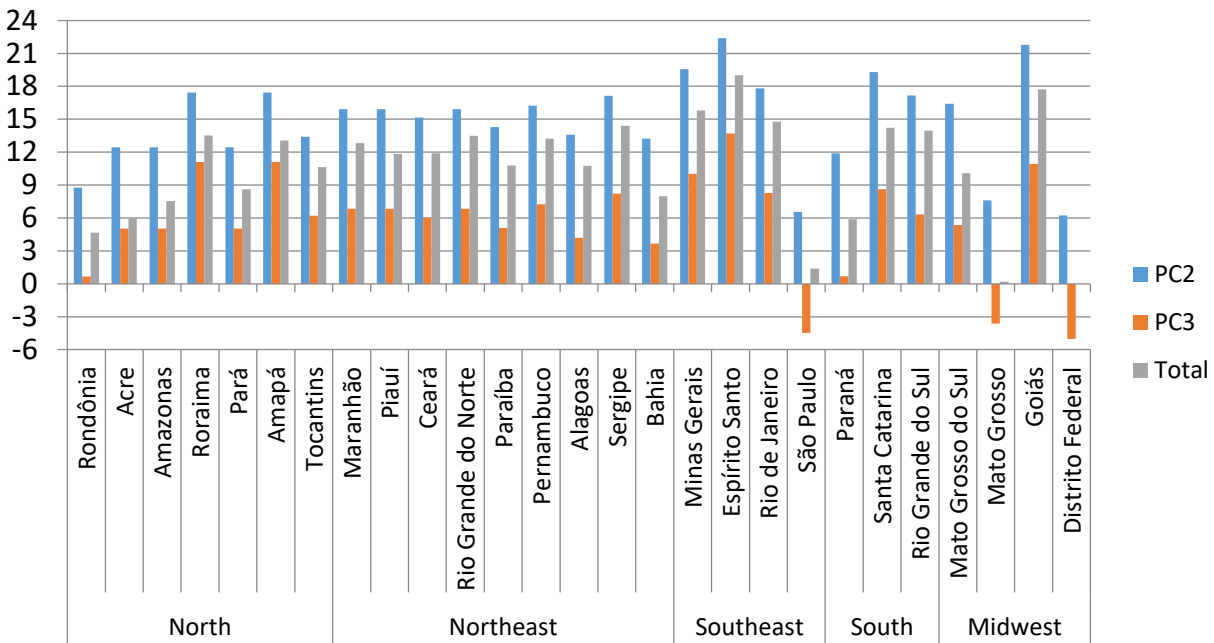
In this scenario, a specific tax value is chosen such that none of the Brazilian states experiences a tax collection loss. The value obtained for the TET under this constraint is BRL 3.89 per pack. In this scenario, the average price increases by 11.5 percent, resulting in a decrease in consumption of 4.6 percent. This results in an increase of BRL 1.1 billion in total revenue collection per year. The tax reform has a differential impact by price category. While the cheaper cigarette prices increase by 19.2 percent, premium cigarette prices rise by only 5.8 percent. This heterogeneous effect can also be observed in consumption where smokers consuming cheaper brands reduce smoking by 6.7 percent, while premium brand smokers reduce consumption by only 1.0 percent. Unlike the previous scenarios, the overall price dispersion decreases by 27.2 percent. These findings explain the observed reduction on the price gap and revenue gap by price category.

The Federal District is the only federal unit where the aggregate tobacco tax revenue remains the same as before the tax reform. Thus, all other 26 states increase their tax revenue with the specific TET of BRL 3.89. Figure 4 illustrates the relative tax revenue changes across states and regions under this scenario. It is worth noting that the tax revenue change in Scenario III is smaller than the other scenarios.

The specific tax component tends to equalize existing tax differences. In other words, after the introduction of reform Scenario III, states where the tax burden was highest (such as the federal District of São Paulo) experience zero or lower tax increases than states with an initial lower tax burden (such as Goiás, Santa Catarina, and others).

Since the specific tax is the same across states and price categories, the tax burden is different across states. This result differs from the previous scenarios with *ad valorem* taxes only, where the tax burden is the same across states as an assumption of the simulated tax reforms. Table A4 in the appendix illustrates the tax burden changes across Brazilian states in all three tax adjusted scenarios in relation to the baseline.

Figure 4 - Percentage tax revenue changes by price categories relative to the current tax structure - Tax Reform Scenario III



4.6 Alternative scenarios and effects of a reduction in the illicit market

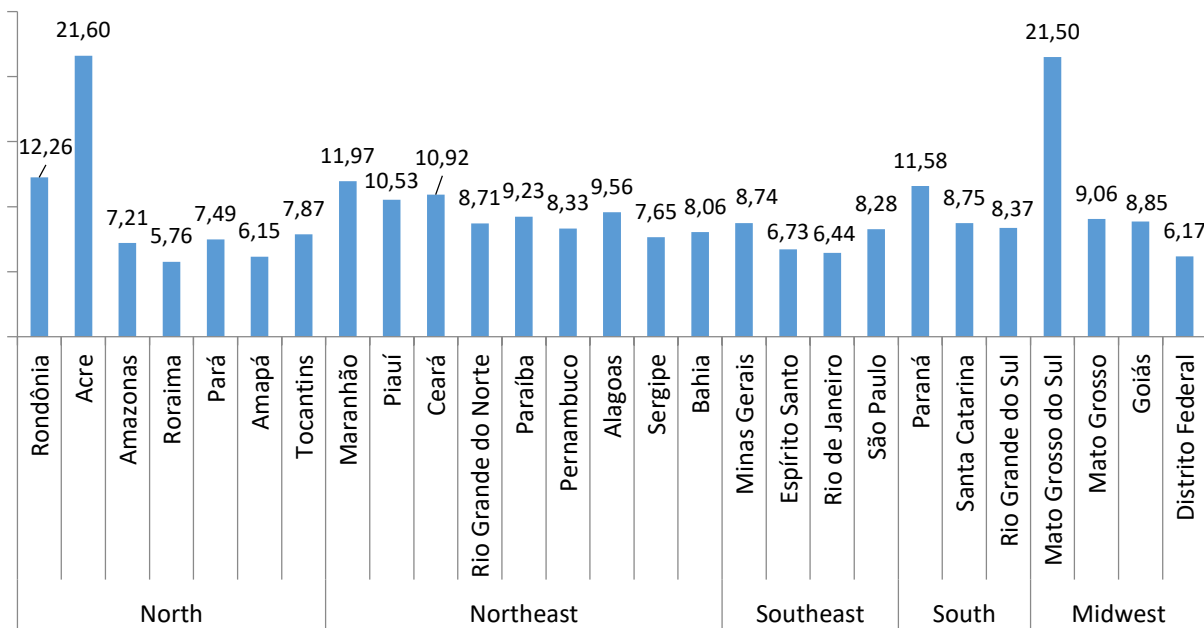
Two related alternative reform scenarios deserve discussion. If the no-loss condition is abandoned, and the only objective of the reform is to maximize total national tax revenue, the TET should be set at 56.94 percent. This value is slightly higher than in tax reform Scenario II but, as indicated above, it would imply revenue losses in Roraima and Amapá. As before, higher increases would result in additional revenues of 40 percent with respect to the status quo situation. To reach the same revenue collection obtained in the current tax scheme and tax rates, the TET should be set to 43.08 percent. This means that the overall revenue collection would not change with the tax reform. However, 18 out of 27 Brazilian states would experience a decrease in tax collection.

Another option is to increase the tobacco excise tax even further, up to the point where average consumption in both price categories and in each state is still greater than zero. The corresponding TET is 59.5 percent. This rate should be set if the government is not primarily interested in maximizing tax revenue, but is more concerned with tobacco control itself. In this scenario, all northern states would lose tax revenue when compared to the baseline scenario.

Regarding the influence of the illicit market, Figure 5 shows how a decrease of 10 percent in this market would affect tax revenues in each Brazilian state. As explained in Section 3.3.5, the idea is to shift cigarette consumption from the illegal to the legal market. Consequently, the government obtains tax gains from cigarette sales that would be lost

otherwise. At the same time, decreasing the illegal market means that the respective consumers have to pay higher prices and thus, overall consumption decreases due to consumers' price-sensitivity. The same elasticities for states and price categories are applied in this simulation. Note that the result is equal in both previous simulations because both the shifts in the share of the illegal market and the revenue change are expressed in percentage points. The absolute tax revenue gain obviously is not the same as it depends on the prevailing tax burden.

Figure 5 – Percentage change in tobacco tax revenue resulting from a 10 percent reduction in the illicit market



The changes in tobacco tax revenue after the 10 percent decrease in purchases of illegal cigarettes are quite different across the Brazilian states. In those regions where the illegal market is more extensive, such as Mato Grosso do Sul and Acre, tax revenue increases up to 21.6 percent. In other states like Roraima where the size of the illegal market is currently about 20 percent, the revenue change is still positive, but only about a fourth of that in Mato Grosso do Sul. Given the relative simplicity of the simulations, the regional differences represent a remarkable result: If the fight against cigarette smuggling is intensified on a national scale, those states with greater access to illegal products would reap the largest relative gains.

The data in Table 6 summarizes the results from the three tax reform scenarios relative to the pre-reform situation and the effects of the reduction in the illicit cigarette market. In aggregate, the major differences relative to the baseline scenario are as follows:

Table 6 – Tax reform simulation results across different scenarios

	Baseline	Scenario I	Scenario II	Scenario III
Tax revenue (BRL Mi. month)	1,125.49	1,433.16	1,576.32	1,217.29
Change (Baseline ref)	-	27.34%	40.06%	8.157%
Change (Illicit -10%)*	8.41%	8.59%	8.49%	8.31%
Cheaper cigarettes (PC2)	6.40	7.57	9.83	7.63
Tax burden	73.93%	77.85%	82.95%	78.17%
Share of tax revenue	56.89%	53.64%	55.78%	59.50%
Consumption (% Change)		-9.88%	-25.33%	-6.69%
Premium brands (PC3)	8.67	12.65	16.43	9.17
Tax burden	67.77%	77.85%	82.95%	69.60%
Share of tax revenue	43.11%	46.36%	44.22%	40.50%
Consumption (% Change)		-20.85%	-39.96%	-1.04%

Notes: * Additional overall tobacco tax revenue due to a decrease of 10 percent in the illicit market. Scenario I is the no-tax-revenue-loss case, where no federal state loses revenue. Scenario II defines the *ad valorem* tax that maximizes total nationwide tobacco tax revenue under the condition that no state experiences revenue losses. Scenario III includes a specific excise tax with no tax revenue loss for all federal states. The share in tax revenue refers to the percentage of revenue obtained by each price category relatively to the total cigarette tax collection.

1. The average tax burden is higher than the baseline in all scenarios, the prices for both cigarette categories are also higher and cigarette consumption decreases.

The cigarette tax burden per pack, that is, the total tax share of the final consumer price, increases from an average of 72.8 percent to 77.85 percent in Scenario I and to 82.95 percent in Scenario II. These increases correspond to an additional tax revenue of 3.7 and 5.4 billion BRL per year, respectively. For Scenario III, the average price increase is 11.5 percent, consumption decreases by 4.6 percent, and tax collection rises by about BRL 1.1 billion per year.

2. The final average price of a 20-cigarette pack of cheaper cigarettes would increase from 6.4 BRL to either 7.6 or 9.8 BRL in Scenarios I and II, respectively. For premium brands cigarettes, prices would rise from 8.7 BRL to either 12.6 or 16.4 BRL per pack, respectively. In Scenario III, cheaper cigarette prices increase to BRL 7.63 and BRL 9.17 for premium cigarettes. Unlike the previous scenarios, the overall price dispersion decreases by 27.2 percent in Scenario III.
3. In Scenarios I and II, since the tax burden becomes the same across all states after the tax reform, the distribution of gains across states is uneven, but no Brazilian state experiences tax revenue losses under either scenario. For Scenario III, the specific tax component tends to equalize existing tax differences, with the tax burden rising proportionately more in states with lower initial tax burden.
4. A reduction of 10 percent in the size of the illicit cigarette market in each one of the scenarios leads to an additional increase of about 8.5 percent in total tobacco

tax revenue, which corresponds to BRL 1.5, 1.6 and 1.2 billion per year in Scenarios I, II and III, respectively.

5. Even under the same condition that no federal state loses tax revenue, a tax structure with a specific component implies a lower average tax burden and lower aggregate revenue as compared to a pure *ad valorem* tax scheme.

5. Conclusions

The findings of this study suggest that the tobacco tax reform currently under discussion in the Brazilian National Congress (Constitutional Amendments 45/2019 and 110/2019) could result in reduction in revenue collection for some states. Given that the intent is to simplify the tax scheme by unifying different taxes at federal level by replacing the subnational ICMS into a unique and harmonized, federal VAT-type tax, the Goods and Services Tax (GST), if the tax structure presents a pure *ad valorem* form, the cigarette tax burden would be the same across all Brazilian states. Thus, any tax reform that yields a tax burden below the maximum tax burden currently observed across the states would result in a reduction of revenue for some states. As the tax reform will be discussed in the National Congress, its political viability requires a carefully designed proposal to avoid any Brazilian state from losing tax revenue derived from cigarette taxation.

In the case of tobacco taxes, the Amendment Proposals seek to replace the current alike excise tax (IPI) which is levied under a special regime for cigarettes, by a Tobacco Excise Tax (TET). This TET should be high enough so that no Brazilian state has a reduction in the cigarette tax burden, considering the states consumption, after the reform. Instead, the government could take advantage of this opportunity to increase tobacco tax revenue in a time of fiscal imbalance and reduce cigarette consumption to decrease the pressure of tobacco-related diseases on the health system.

Additionally, the tax reform could result in decreased cigarette prices. To keep the prices at least at the same level as those in the current tax scheme, TET should be no less than 77.85 percent. That goal is reached in all scenarios analyzed in this Policy Report. That means any politically viable tax reform should result in higher cigarette prices and a reduction in cigarette consumption.

In the first scenario, a TET combined with the GST yields a cigarette tax burden where none of Brazilian states lose tax revenue is considered. This corresponds to a tax burden of 77.85 percent currently under force in Mato Grosso. Roughly, the GST is 27.0 percent and the TET is 50.85 percent. As a result, the aggregate tax revenue increases by 27.34 percent. The average price in category 2 (low price brands) is 7.57 BRL and 12.65 BRL in price category 3 (premium brands). These new prices correspond to increases of 18.3 and 45.9 percent in relation to the 2018 baseline prices, respectively. Cigarette consumption also experiences a substantial decrease compared to the baseline in this

first scenario. Specifically, the decrease is 9.9 and 20.8 percent, for categories 2 and 3 respectively.

In Scenario II, the GST is still as in the previous scenario but the TET rate is set such that total nationwide tobacco tax revenue is maximized under the condition that no federal state experiences any reduction in tax revenue. This scenario yields a cigarette tax burden of 82.95 percent. The GST is 27.0 percent and the TET accounts for the remaining 55.95 percent. In this tax reform simulation, no Brazilian state loses tobacco tax revenue, but some of them would not increase tobacco tax revenue relative to the baseline scenario. The aggregate tax revenue increases by around 40 percent. The average price in category 2 (low price brands) is 9.83 BRL and 16.43 BRL in price category 3 (premium brands). These new prices correspond to increases of 53.6 and 89.5 percent in relation to the 2018 baseline prices, respectively. Cigarette consumption substantially decreases compared to the baseline. Specifically, the decrease is 25.33 and 39.94 percent for price categories 2 and 3, respectively.

While tiered tax systems are not recommended tobacco tax policies (Rodriguez-Iglesias & Blecher, 2018), mixed tax structures have an advantage over a pure *ad valorem* tax because it grants a high minimum tax on all cigarettes no matter the price, and decreases the overall price dispersion. Thus, a mixed tax structure appears more efficient under this approach. Additionally, if the base of the *ad valorem* tax is the retail price (not the ex-factory price), it is even more efficient when mixed with a specific tax, because it affects the ability of the manufacturer to manipulate the price (namely the before-tax price), which is easier when the tax is on the price ex-factory. Furthermore, it is affected less by price variation and inflation.

Specific taxes, if politically feasible, should be indexed for economic indexes (inflation, minimum wage, etc.) (Rodriguez-Iglesias & Blecher, 2018). However, it is difficult to achieve such structure because there is a strong distaste against indexation in the society, which is reflected in both policymakers and congressmen, as this was one of the major causes of the Brazilian hyperinflation during the 80s and 90s. On the other hand, a specific tax decreases the cigarette price gap, which is more effective at reducing tobacco consumption by decreasing incentives to trade down to cheaper brands (WHO, 2011, p. 59). Where there is a minimum price policy, a mixed system where the *ad valorem* tax base is based on the retail price can be an effective tax policy tool. The historical decrease in Brazilian smoking prevalence is a notable example.

A reduction in the illicit cigarette market has important effects on tobacco tax revenues in both simulated scenarios. The effects are different across the Brazilian states, depending on the size of the illicit market on each state. Specifically, in states where the illegal market is more extensive, such as Mato Grosso do Sul and Acre, tax revenue increases up to 21.6 percent after the reduction in the illicit market. Considering the nationwide effect, in all scenarios, the total increase in tobacco tax revenue is around 8.5 percent. This

corresponds to a tax revenue increase of around 1.5 billion BRL (or 1.6 billion for the second scenario) per year after the reduction in the illicit market. These numbers indicate that it is important to intensify the fight against cigarette smuggling nationwide as public policy to reduce cigarette consumption and raise fiscal revenues.

Thus, the simulation results from this research indicate that the tax reform is a great opportunity for the country to increase cigarette prices, reduce cigarette consumption, and, above all, raise cigarette tax revenue that can be used to reduce fiscal imbalance, and provide funds for health and other social expenditures needed to support the most vulnerable during the COVID-19 pandemic.

References

- Divino, J. A., Ehrl, P., Candido, O, Valadão, M. (2019) An extended cost-benefit-analysis of tobacco taxation in Brazil. Unpublished manuscript. Catholic University of Brasilia and University of Chicago at Illinois.
- Figueiredo, V., Szklo, A., Iglesias, R., Stoklosa, M., Welding, K. and Drope, J. (2020) Consumo de cigarros ilícitos em 5 cidades brasileiras - Resultados Preliminares. Universidade Johns Hopkins/Sociedade Americana de Câncer /Fiocruz/INCA. *Forthcoming*.
- Euromonitor International (2019) Cigarettes in Brazil: Country report. At <https://www.euromonitor.com/cigarettes-in-brazil/report>
- Ministry of Justice and Public Security (2019). RELATÓRIO FINAL N° 1/2019/CNCPDPI/SE, processo: 08007.003961/2019-36, published online
- National Research Council (2015). Understanding the U.S. Illicit Tobacco Market: Characteristics, Policy Context, and Lessons from International Experiences. Washington, DC: The National Academies Press
- Odair, R. O. and Gobetti, S. W. (2019) Reforma Tributária e Federalismo Fiscal: uma Análise das Propostas de Criação de um Novo Imposto sobre o Valor Adicionado para o Brasil. Texto para Discussão n° 2530, Instituto de Pesquisa Econômica Aplicada – IPEA.
- Ribeiro, L. and Pinto, V. (2019) Accelerating Effective Tobacco Taxes in Brazil: Trends and Perspectives. Red Sur Country Studies Series Tobacco Taxes in Latin America Country Study N° 3/2019.
- Rodriguez-Iglesias G and Blecher E. (2018). Tax Structures are Key in Raising Tobacco Taxes & Revenues. A Tobacconomics Policy Brief. Chicago, IL: Tobacconomics, Health Policy Center, Institute for Health Research and Policy, University of Illinois at Chicago.
- São José, B. P., Corrêa, R. D. A., Malta, D. C., Passos, V. M. D. A., França, E. B., Teixeira, R. A., Camargos, P. A. M. (2017). Mortality and disability from tobacco-related diseases in Brazil, 1990 to 2015. *Revista Brasileira de Epidemiologia*, 20, 75-89.
- Szklo, A., Iglesias, R., de Souza, M., Szklo, M., de Almeida, L. M. (2018). Trends in illicit cigarette use in Brazil estimated from legal sales, 2012–2016. *American Journal of Public Health*. Vol. 108 (2): 265-269.
- Vigitel Brasil. (2019). Vigilância de fatores de risco e proteção para doenças crônicas por inquérito telefônico : estimativas sobre frequência e distribuição sociodemográfica de fatores de risco e proteção para doenças crônicas nas capitais dos 26 estados brasileiros e no Distrito Federal em 2019. Brasília: Ministério da Saúde.
- WHO (World Health Organization). (2011). Technical Manual on Tobacco Tax Administration. Reprinted in 2011. Geneva: World Health Organization.

Appendix A – Additional tables and figures

Table A1 - Percentage tax revenue changes across scenarios by regions, states and price categories (PC) relative to the current tax structure

Region	State Name	Tax adjusted scenarios I			Tax adjusted scenarios II			Illicit share
		PC2	PC3	Total	PC2	PC3	Total	Change
North	Rondônia	-4.74	13.19	4.32	11.81	17.12	14.49	12.26
	Acre	7.95	20.31	18.79	19.38	11.43	12.41	21.60
	Amazonas	7.95	20.31	16.15	19.38	11.43	14.10	7.21
	Roraima	20.12	23.78	22.39	19.78	-8.70	2.15	5.76
	Pará	7.95	20.31	14.35	19.38	11.43	15.26	7.49
	Amapá	20.12	23.78	22.66	19.78	-8.70	0.00	6.15
	Tocantins	10.73	21.52	14.87	20.32	8.65	15.84	7.87
Northeast	Maranhão	13.37	29.68	18.91	29.17	29.76	29.37	11.97
	Piauí	13.37	29.68	20.69	29.17	29.76	29.43	10.53
	Ceará	8.58	26.66	15.04	25.94	30.38	27.53	10.92
	Rio Grande do Norte	13.37	29.68	17.71	29.17	29.76	29.33	8.71
	Paraíba	4.05	23.63	11.54	22.51	30.33	25.51	9.23
	Pernambuco	12.25	29.13	17.92	28.46	29.93	28.95	8.33
	Alagoas	6.52	24.94	12.06	24.42	30.42	26.23	9.56
	Sergipe	16.63	31.80	21.29	31.10	28.78	30.38	7.65
Bahia	14.44	29.63	22.79	29.83	29.77	29.80	8.06	
Southeast	Minas Gerais	29.74	47.77	36.88	43.17	48.55	45.30	8.74
	Espírito Santo	21.01	42.44	29.35	38.13	48.39	42.13	6.73
	Rio de Janeiro	12.41	34.70	19.52	31.87	46.23	36.45	6.44
	São Paulo	19.83	37.01	27.88	37.34	47.07	41.90	8.28
South	Paraná	31.27	48.97	40.76	49.85	58.32	54.40	11.58
	Santa Catarina	43.31	59.89	51.18	57.01	60.03	58.44	8.75
	Rio Grande do Sul	33.84	52.31	39.27	51.58	59.24	53.83	8.37
Midwest	Mato Grosso do Sul	12.31	30.44	22.70	34.08	37.34	35.95	21.50
	Mato Grosso	-16.33	8.40	0.00	5.59	26.33	19.29	9.06
	Goiás	20.16	36.34	26.20	40.65	37.28	39.39	8.85
	Distrito Federal	-12.56	10.69	0.31	9.67	28.00	19.82	6.17

Note: Illicit share change stands for a change in tax revenue due to a reduction of 10 percent in the illicit market share. It is the same for both scenarios.

Table A2 - Smoking behavior by Brazilian Regions, States and price categories (PC) - Cigarette consumption by price category across scenarios

Region	State Name	Baseline (units per day)		Scenario I (units per day)		Scenario II (units per day)		Scenario III (units per day)	
		PC2	PC3	PC2	PC3	PC2	PC3	PC2	PC3
North	Rondônia	18.1	12.1	18.0	10.5	15.9	7.8	16.6	12.0
	Acre	16.4	18.6	15.4	14.1	12.3	9.4	14.6	17.9
	Amazonas	9.0	6.2	8.4	4.7	6.7	3.1	8.0	5.9
	Roraima	10.8	9.1	8.7	5.7	6.3	3.0	9.1	8.4
	Pará	9.8	8.0	9.1	6.1	7.3	4.1	8.7	7.7
	Amapá	6.1	7.4	5.0	4.6	3.6	2.5	5.2	6.9
	Tocantins	9.2	8.8	8.3	6.5	6.6	4.2	8.1	8.4
Northeast	Maranhão	10.3	7.8	9.5	6.0	7.8	4.4	9.3	7.5
	Piauí	11.2	11.9	10.4	9.3	8.5	6.7	10.1	11.5
	Ceará	12.1	12.6	11.5	10.1	9.6	7.5	10.9	12.1
	Rio Grande do Norte	14.0	11.1	12.9	8.6	10.6	6.2	12.6	10.7
	Paraíba	9.7	10.4	9.4	8.7	8.0	6.6	8.8	10.2
	Pernambuco	10.8	9.8	10.0	7.6	8.2	5.5	9.7	9.4
	Alagoas	10.7	14.5	10.3	11.9	8.7	9.0	9.8	14.2
	Sergipe	12.0	10.1	10.8	7.6	8.7	5.4	10.7	9.7
	Bahia	13.3	12.6	12.1	9.8	10.0	7.1	12.2	12.3
Southeast	Minas Gerais	9.9	9.4	8.4	6.9	6.7	5.0	9.0	9.0
	Espírito Santo	6.3	7.2	5.6	5.6	4.6	4.2	5.6	6.9
	Rio de Janeiro	13.0	12.7	12.2	10.4	10.3	8.2	11.7	12.3
	São Paulo	13.2	14.6	11.8	11.8	9.8	9.1	12.8	14.8
South	Paraná	12.7	13.3	11.0	10.3	9.1	7.9	12.2	13.3
	Santa Catarina	12.0	13.0	9.7	9.3	7.7	6.7	11.2	12.6
	Rio Grande do Sul	13.4	12.0	11.4	9.1	9.3	6.9	12.5	11.8
Midwest	Mato Grosso do Sul	15.8	16.0	14.9	12.9	12.9	9.9	14.6	15.6
	Mato Grosso	13.0	15.8	13.9	15.1	12.7	12.7	12.5	16.1
	Goiás	17.9	15.6	16.4	11.8	13.8	8.6	16.2	14.8
	Distrito Federal	13.7	13.7	14.4	12.8	13.0	10.7	13.3	14.0

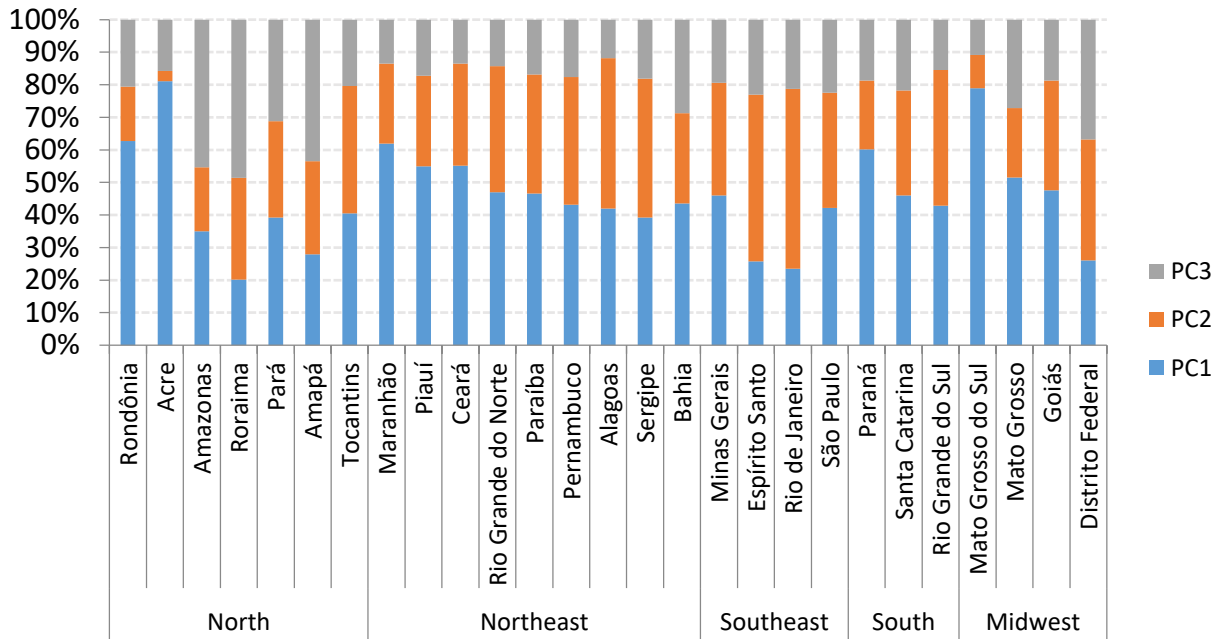
Table A3 – Tax burden and percentage tax revenue changes for scenario III by regions, states and price categories (PC) relative to the baseline

Region	State Name	Tax burden (%)		Tax revenue change (%)		
		PC2	PC3	PC2	PC3	Total
North	Rondônia	81.93	73.14	8.76	0.65	4.66
	Acre	79.42	70.76	12.44	5.05	5.96
	Amazonas	79.42	70.76	12.44	5.05	7.54
	Roraima	76.60	68.11	17.44	11.11	13.52
	Pará	79.42	70.76	12.44	5.05	8.61
	Amapá	76.60	68.11	17.44	11.11	13.05
	Tocantins	78.83	70.20	13.40	6.21	10.64
Northeast	Maranhão	78.58	69.96	15.92	6.83	12.83
	Piauí	78.58	69.96	15.92	6.83	11.84
	Ceará	79.66	70.98	15.15	6.03	11.89
	Rio Grande do Norte	78.58	69.96	15.92	6.83	13.50
	Paraíba	80.60	71.88	14.29	5.10	10.77
	Pernambuco	78.98	70.34	16.25	7.26	13.23
	Alagoas	79.77	71.09	13.57	4.19	10.75
	Sergipe	78.00	69.42	17.13	8.20	14.39
	Bahia	77.52	68.97	13.24	3.67	7.98
Southeast	Minas Gerais	75.08	66.70	19.57	10.02	15.78
	Espírito Santo	78.22	69.63	22.40	13.69	19.01
	Rio de Janeiro	79.22	70.57	17.82	8.27	14.77
	São Paulo	74.35	66.03	6.55	-4.46	1.39
South	Paraná	73.08	64.87	11.90	0.70	5.89
	Santa Catarina	71.80	63.70	19.30	8.61	14.23
	Rio Grande do Sul	73.76	65.49	17.16	6.31	13.97
Midwest	Mato Grosso do Sul	78.82	70.19	16.41	5.35	10.07
	Mato Grosso	83.36	74.51	7.60	-3.62	0.19
	Goiás	78.24	69.65	21.79	10.93	17.74
	Distrito Federal	82.23	73.43	6.22	-5.02	0.00

Table A4 - Tax burden changes across tax adjusted scenarios relative to the baseline (in basis points)

Region	State Name	Scenario I		Scenario II		Scenario III	
		PC2	PC3	PC2	PC3	PC2	PC3
North	Rondônia	-1.41	4.94	3.69	10.04	2.66	0.23
	Acre	2.59	8.94	7.69	14.04	4.16	1.85
	Amazonas	2.59	8.94	7.69	14.04	4.16	1.85
	Roraima	7.59	13.94	12.69	19.04	6.33	4.20
	Pará	2.59	8.94	7.69	14.04	4.16	1.85
	Amapá	7.59	13.94	12.69	19.04	6.33	4.20
	Tocantins	3.59	9.94	8.69	15.04	4.57	2.29
Northeast	Maranhão	3.80	10.10	8.90	15.20	4.52	2.21
	Piauí	3.80	10.10	8.90	15.20	4.52	2.21
	Ceará	2.39	8.79	7.49	13.89	4.20	1.93
	Rio Grande do Norte	3.80	10.10	8.90	15.20	4.52	2.21
	Paraíba	1.11	7.59	6.21	12.69	3.86	1.61
	Pernambuco	3.46	9.85	8.56	14.95	4.59	2.34
	Alagoas	1.80	8.10	6.90	13.20	3.72	1.33
	Sergipe	4.80	11.10	9.90	16.20	4.95	2.67
	Bahia	4.12	10.08	9.22	15.18	3.79	1.19
Southeast	Minas Gerais	8.26	14.18	13.36	19.28	5.49	3.03
	Espírito Santo	5.66	12.26	10.76	17.36	6.03	4.04
	Rio de Janeiro	3.26	9.70	8.36	14.80	4.63	2.42
	São Paulo	5.33	10.44	10.43	15.54	1.82	-1.38
South	Paraná	7.99	13.19	13.09	18.29	3.22	0.21
	Santa Catarina	11.36	16.73	16.46	21.83	5.31	2.57
	Rio Grande do Sul	8.69	14.23	13.79	19.33	4.60	1.87
Midwest	Mato Grosso do Sul	3.08	9.30	8.18	14.40	4.05	1.65
	Mato Grosso	-3.92	2.30	1.18	7.40	1.59	-1.03
	Goiás	5.12	11.59	10.22	16.69	5.51	3.40
	Distrito Federal	-3.03	2.96	2.07	8.06	1.35	-1.46

Figure A1 - Distribution of smokers by price category – all scenarios (in %)



Appendix B – Price adjustment mechanism

Let P_f be the cigarette pack factory value, that is, the tax-free price which already includes all associated costs for production, distribution, and profit margins for the associated parties. Considering B is the tobacco tax burden, the retail cigarette pack price in Brazil is given by:

$$P_r = \frac{P_f}{1-B}$$

Under the current and after-reform legislation, the tax basis is the retail price including taxes. Since the main objective of this research is to assess the Brazilian tax reform, changing the tax structure implies a change in the tax burden, B .

Considering P_f fixed, that is, the firms' production cost and profit per pack do not change with the tax reform, the retail price change due to a tax reform change can be expressed as follows:

$$\begin{aligned} \frac{\Delta P}{P} &= \frac{P_r^i - P_r^0}{P_r^0} = \left(\frac{P_f}{1-B^i} - \frac{P_f}{1-B^0} \right) \times \frac{1-B^0}{P_f} \\ &= \frac{1-B^0}{1-B^i} - 1 \\ &= \frac{B^i - B^0}{1-B^i} \end{aligned}$$

where the superscript 0 indicates baseline scenario values and i any of the reform scenarios. Therefore, the only sort of price changing is the tax burden change.

Below, the Figure B.1 shows how the final consumer price would behave given that $B^0 = 0.7$ as in the baseline scenario. It can be seen that if the new tax burden B^i is lower than the B^0 , the price will decrease. Otherwise, the price will increase. It also noticeable that, because the tax basis is the retail price (the final pack price the consumer faces) the price adjustment mechanism is nonlinear. In this case, for $B^i > B^0$, the change in prices is proportionally higher than the tax burden change and grows asymptotically as $B^i \rightarrow 1$.

Observations:

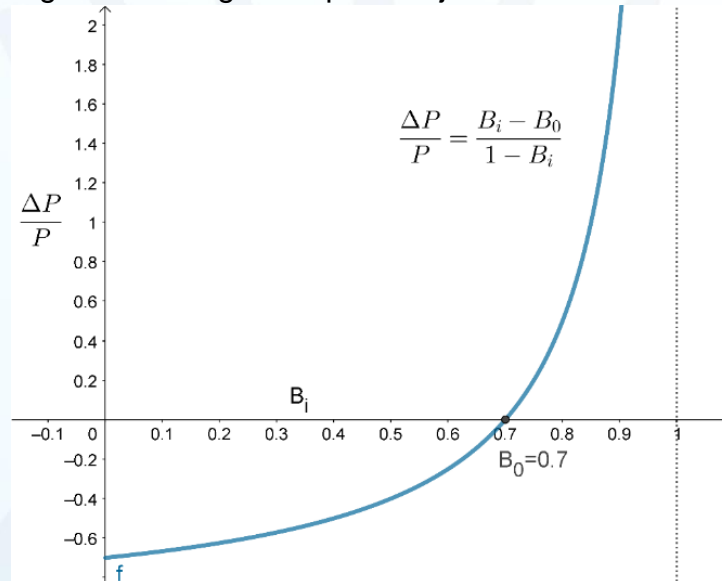
- i. for scenarios I and II, the tax burden, B^i , is just the sum of the *ad valorem* taxes;
- ii. for scenario III, since it considers a specific excise tax (*ad rem*) per pack, ℓ , and *ad valorem* taxes which add to τ , the tax burden is obtained as follows:

Let $B = \frac{\ell + \tau \times P_r}{P_r}$ and $P_f = P_r^0 \times (1 - B^0)$ be the tax burden and the cigarette pack factory value, respectively; the latter in terms of the baseline retail price. Thus, the retail price for this scenario is $P_r^i = \frac{P_r^0 \times (1 - B^0) + \ell}{1 - \tau}$, and the tax burden is given by

$$B^i = \tau + \frac{\ell}{P_r^i}$$

$$= \tau + (1 - \tau) \times \frac{\ell}{P_r^0 \times (1 - B^0) + \ell}$$

Figure B1 – Cigarette price adjustment mechanism



Appendix C – Tobacco related proposals in the National Congress

Proposals, Reports, Reporteur Opinions, Requests for public hearings and others, Written Declarations of voting, Substitutive Bills and Bills of Law presented before the National Congress related to tobacco and cigarettes (there are overlaps).

Table C1 – Themes related to tobacco and cigarettes presented before the National Congress

Year	Chamber of Representatives ¹²		Senate ¹³	
	Word: tobacco ("tabaco")	Word: cigarette ("cigarro")	Word: tobacco ("tabaco")	Word: cigarette ("cigarro")
2019	90	91	11	11
2018	86	48	12	11
2017	100	64	4	4
2016	39	43	2	2
2015	66	69	6	5
2014	32	39	2	2
2013	58	47	5	5
2012	50	57	3	4
2011	81	69	12	14
2010	30	35	4	4
2009	51	52	3	3
2008	42	76	8	8
2007	56	87	8	7
2006	28	27	2	2
2005	41	43	7	7
2004	64	69	8	8
2003	89	111	6	6
2002	23	25	2	1
2001	18	39	7	7
2000	7	27	6	6
1999 - 1964	88	358	71	70
TOTAL	1,154	1,491	189	187

¹² Information available at <https://www2.camara.leg.br/busca>

¹³ Information available at <https://www6g.senado.leg.br/busca/>