ANALYSIS OF TOBACCO TAXATION AND SIMULATIONS IN MEXICO USING LATINMOD

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Executive Summary

Since 2011, the specific component of the excise tax levied on cigarettes in Mexico has been set at $0.35 Mexican pesos per unit. The federal government has adopted a reform effective January 1, 2020 that would increase it to $0.494, updating the tax for inflation. However, this tax would need to increase to $1.35 to bring the total burden of indirect taxes up to 75 percent of the final retail price.

This study estimates the impact of both tax reforms on consumption and tax revenue. In addition, it examines the distributional effect if all revenue collected is used for cash transfers (subsidies) for households in poverty. A behavioral microsimulation is performed using the LATINMOD platform. To this end, price elasticities are estimated by expenditure tercile using the Deaton model. Overall, tobacco consumption drops by about 5 percent in reform 1 ($0.494) and 34 percent in reform 2 ($1.35), while expenditure on cigarettes increases by 7 percent and 27 percent, respectively. The increase in revenue is equivalent to 0.22 and 0.28 percentage points of GDP, making it possible to reduce poverty with transfers on health, medicines, or food, mainly for children and the elderly by up to 4.12 percentage points, and food poverty by up to 40 percent (from 14.99 percent to 8.98 percent). In addition, the redistributive effect of the tax system could reduce inequality by one additional point.

Key findings of the research include the following:

- Increasing tobacco tax benefits everyone: it reduces consumption and increases tax revenue in the country. An increase in the specific component of the excise tax to $1.35 per cigarette would increase the retail price and reduce consumption by 34 percent. Since expenditure on tobacco would be greater, revenue would increase by 38.2 percent.
- In Mexico, a tobacco tax reform would have a greater revenue impact on the rich than the poor. Over half (52 percent) of revenue would come from high-income households, while 12 percent of the burden would fall on poor households.
- Increasing the total taxes on cigarettes to account for 75 percent of the final retail price could generate 55.6 billion pesos in revenue.
- Tobacco tax revenue could help to reduce poverty, primarily among children and the elderly. If these resources are used in cash transfers, poverty among children and the elderly falls by 4.12 percentage points.
- Tobacco tax revenue would make it possible to reduce food poverty in Mexico by 40 percent. The tax levied could be used in a social policy to tackle food poverty, benefiting as many as 2 million families.

While increasing excise tax to $0.49 MXN per cigarette is a good first step, higher taxes are needed to effectively reduce consumption and generate dialogue about allocating more resources to fight tobacco-related diseases or administer cash transfers for households in conditions of food poverty. Although low-income smoking households would face higher cigarette prices, an increase in tax to $1.35 MXN per cigarette would increase revenue substantially, providing new funds for the government to use in programs to fight food poverty nationwide, benefiting at least 2.5 million families. The relevance of this reform therefore lies in that, in addition to bringing tobacco prices to an international level suggested by the WHO, Mexico would be in a position to offer subsidy programs that would operate in parallel with current programs to mitigate poverty and more effectively reduce tobacco use.

Contents

1. Introduction

The tobacco epidemic claims around 8 million lives each year worldwide. World Health Organization (WHO) statistics have warned that although tobacco prevalence has fallen globally, tobacco use has been sustained over the long term. In Latin America, middle- and low-income countries have been postponing the adoption of tax measures to increase the tax burden on tobacco. In 2019, the only countries where taxes account for over 75 percent of the final retail price are Argentina, Brazil, Chile, and Colombia. Countries like Argentina, Canada, Chile, Costa Rica, Honduras, Jamaica, and Peru have managed to reduce the affordability of such products (WHO, 2019). In general, most Latin American countries have maintained tax schemes with reduced tax on tobacco consumption, making it necessary to push for more adequate tax policy design to effectively impact tobacco consumption (WHO, 2015; Fuchs & Meneses, 2017).

In Mexico, the prevalence of tobacco use reached 17.6 percent of the 12 to 65-year-old population in 2016 and tobacco causes about 43,000 deaths a year (WHO, 2019; ENCODAT, 2017). In recent years, Mexico has demonstrated progress in implementing various measures established in the WHO Framework Convention on Tobacco Control, such as smoke-free areas, the promotion of cessation programs, advertising bans, and warning labels on products. However, although increased tax on tobacco products is the most effective way to reduce consumption, the excise tax rate on tobacco has remained unchanged in Mexico since 2011. In addition, the implementation of excise tax on products that are harmful to health is justified to the extent that the revenue can be used to fight the negative externalities of consumption, and therefore there is no reason why tobacco should constitute an exception.

A tobacco tax reform was recently approved for the economic package for tax revenue and expenditure submitted by President Andrés Manuel López Obrador for 2020. This economic package includes a readjustment of the specific component of the excise tax from 0.35 pesos to 0.494 pesos per cigarette (the first change since 2011). However, whether this change in the specific component is sufficient to provide a significant counterweight to the tobacco epidemic in Mexico has not yet been explored. Indeed, international evidence shows that countries that have implemented the most aggressive tobacco tax reforms have not only achieved a significant reduction in consumption, but also a substantial increase in revenue.

Tax revenue from tobacco consumption can be used to fund (fully or partially) government spending on healthcare, enabling the treatment of non-communicable diseases caused by the tobacco epidemic. However, currently, not all such revenue is earmarked for this purpose. On the other hand, international evidence has also suggested that in the event of an increase in tobacco tax, smoking households tend to cut spending on basic necessities (such as food, medicine, clothing, healthcare, and others) to cover the higher cost of tobacco (Husain, Datta, Virk-Baker, Parascandola & Khondker, 2018; John, Ross, & Blecher, 2012). As a result, it is also necessary to determine the extent to which this change may exacerbate poverty levels in the country and affect vulnerable population groups. It is therefore of interest to determine whether tax revenue from tobacco can be used for cash transfers for the poor through existing mechanisms to combat poverty.

Against this fiscal backdrop, this study simulates two tobacco tax reforms: 1) considering the reform proposed by the federal government (from 0.35 to 0.49 pesos per cigarette); and 2) postulating an increase in the specific component to 1.35 pesos per cigarette. This second scenario is consistent with international best practice and is based on total tax representing 75

percent of the final retail price, as recommended by WHO to achieve a consumption reduction (WHO, 2015).

In addition, this research discusses the effects on revenue collection and the impact this could have on various vulnerable groups (specifically, children and the elderly), assuming a social policy design that administers cash transfers to households living in conditions of extreme poverty. To this end, the research uses the LATINMOD fiscal policy microsimulator, based on the well-known microsimulation model for the European Union, EUROMOD, developed by the Institute for Social and Economic Research at the University of Essex (Oliva, 2018).

LATINMOD makes it possible to assess hypothetical scenarios, both for public transfers and tax reforms (for direct and indirect taxes), before they occur, and as a result constitutes a valuable tool for fiscal policy design. This study centers on changes in the specific component of the excise tax on cigarettes and considers the price elasticity of demand for cigarettes (by expenditure tercile) to estimate distributional changes in revenue.

This study therefore has the benefit of contributing to knowledge with further evidence on the tobacco economy, as it offers the first analysis in Mexico of the impact of two tobacco tax reforms. In doing so, the study provides a more accurate instrument with which to assess the consequences of a tax increase, including the impact of taxation on inequality, revenue, and vulnerable groups in the country.

The report is structured as follows. The second section presents a brief overview of empirical literature on the price elasticity of demand for tobacco, together with evidence on microsimulation and tobacco taxes. The third section explains the methodology employed. The fourth section presents the empirical results, showing firstly evidence of spatial variability in unit values and price elasticities, and then the effect of the proposed tax reforms on revenue, poverty (by vulnerable group) and inequality, based on a behavioral microsimulation model. Lastly, section five summarizes the study's main findings and offers policy recommendations based on the research findings

2. Evidence on microsimulation and tobacco taxation

This section is divided into two parts and first describes recent empirical literature on estimating tobacco elasticities for different countries, including Mexico, and various studies that employ microsimulation techniques to analyze tobacco taxes. Then a brief description of the LATINMOD platform used in this study is presented.

2.1 Recent evidence on elasticities

International evidence on the price of cigarettes shows that cigarettes have become cheaper in Mexico relative to prices in other countries (Jimenez-Ruiz, et al. 2008; PAHO, 2018). Even using Power Purchasing Parity (PPP) as a measure, cigarette prices in Mexico are below the average price among Latin American countries without considering the Caribbean countries (6.22 USD) with a price in Mexico of 5.67 USD (PAHO, 2018).

Official figures show that around 2017, tax revenue from tobacco exhibited an apparent increase, reaching 48.7 percent of healthcare needs for tobacco-related diseases. However, the data differs when comparisons are made in terms of gross domestic product (GDP). According to the Secretariat of Finance and Public Credit (SHCP), in 2017, revenue from smoking

accounted for 39.12 billion pesos, no more than 0.2 percent of GDP. In contrast, healthcare expenditure resulting from tobacco-related diseases accounted for 0.41 percent of GDP (81.13 billion pesos), double the revenue from tobacco tax for that year. The allocated amount is calculated to be less than 25 percent that of 2010, with a cut in healthcare spending on the order of 0.14 percentage points of GDP (approximately 27.7 billion pesos). In 2019, tobacco tax has remained unchanged, so the trend has been maintained. This shows a nominal increase in revenue, while as a share of GDP tobacco tax revenue has remained constant and stable from 2010 to 2018, according to official figures (CEFP, 2018; SHCP, 2018).

Elasticities play a key role in introducing dynamics into microsimulation results. Recent studies have estimated the elasticities of tobacco prices between income groups for low and middle-income countries (LMIC). Evidence from Bosnia and Herzegovina, Russia, Bangladesh, Indonesia, South Africa, Moldavia, Ukraine, Chile, and India has shown that the lowest income deciles exhibit greater elasticities than higher ones, even though in some countries (Bangladesh and South Africa, for instance), there is no clear gradient pattern. All these estimates are within a range of -0.4 to -0.9 (Fuchs, Orlic, & Cancho, 2019; Meneses, 2017).

In Latin American countries, the empirical evidence has shown that price elasticity tends to be below -0.5 (Guindon, Paraje, & Chaloupka, 2015). In 2016, the price elasticity of tobacco in Chile showed wide variation between deciles, standing at -0.64 for the poorest and -0.12 for the richest deciles (Fuchs & Meneses, 2017). Studies for Mexico show that long-term price elasticity is -0.25 (Sesma *et al.*, 2002; Olivera, Cermeño, Sáenz de Miera, Jiménez, & Reynales-Shigematsu, 2010), while studies using household surveys to estimate the elasticity of demand for tobacco found a total elasticity of -0.52, made up of a participation elasticity of -0.06 and a consumption elasticity of -0.46 (Jimenez-Ruiz et al., 2008), with the most recent evidence pointing to a total elasticity of -0.57 (-0.17 for participation and -0.40 for consumption), and by income tercile, -0.60 to -0.55, from the lowest to the highest respectively (Sáenz de Miera, Guerrero, Zúñiga & Ruiz, 2013).

2.2 Recent evidence on microsimulation

From the late 1950s, seminal work by Orcutt (1961) identified a need to implement microsimulation models that represent individuals, households or businesses within a socioeconomic system in order to determine the possible long-term effects of governmental actions. In the 1980s, a pioneering study by Atkinson, Bourguignon, and Chiappori (1988) broadened the field of application of microsimulation by comparing the impact of a tax reform in two countries. Developments in information technology and the proliferation of microdata have led to a surge in microsimulation models today. This section briefly outlines the literature on tax-benefit microsimulation models to assess fiscal policy on an ex-ante basis by analyzing the effects of a potential reform on the economic system before it takes place.

In Europe, EUROMOD was developed in the late 1990s to simulate regional fiscal policies (Sutherland & Figari, 2013), and has operated continuously for over two decades, developing various research projects coordinated by the European Commission to analyze and design public policy. Also currently operational is the InGRID project, which aims to integrate and study social, fiscal, and labor policies within the European Union (InGRID, 2019). Other major projects perform a yearly analysis of the distribution of income, poverty, social exclusion, and material deprivation between different groups, and social security systems across the European Union (EUROMOD, 2019). As far as transfer policy is concerned, the incorporation of the Guaranteed Minimum Income Program in Greece was based on EUROMOD (World Bank, 2015), and in

South Africa, the child support grant is continually updated by the government thanks to SAMOD simulations and is one the most important social policies for poverty reduction (Wright; Noble, Barnes, McLennan & Mpike, 2016) [1].

EUROMOD recently broadened its field of application to include various European countries' indirect tax systems in the microsimulator (De Agostini et al., 2017), with other independent static microsimulation models underpinned by EUROMOD following suit (like ECUAMOD, COLMOD, and SAMOD, for Ecuador, Colombia, and South Africa, respectively).

In Spain, the turn of the millennium saw the development of the Indirect Taxation Simulator of the Institute for Fiscal Studies (SINDIEF), an independent initiative that shows the effect of reforms both of VAT and excise tax (including for tobacco) on revenue, income distribution, and social welfare (Sanz, Romero, Castañer, Prieto & Fernández, 2004).

In Africa, a microsimulation model for Tanzania has been used to analyze the effect of an increase in tobacco tax under different scenarios (without including price elasticities of demand for tobacco), with the goal of finding the ideal scenario to curtail both poverty and the prevalence of tobacco consumption. The study concludes that the proposed changes to tobacco tax will lead to an additional 1.37 billion Tanzanian shillings (TZN) in revenue (Maskaeva, Bochkaeva, Mmasa, Msafiri & Iramba, 2019).

In Latin America, both collective and individual efforts have developed microsimulators that include an analysis of indirect taxes. In 2011, microsimulation models were developed for Brazil, Chile, Guatemala, Mexico, and Uruguay to analyze fiscal policies as independent models in each country, based on an open-source code in Excel and STATA (Urzúa, 2012). Similarly, Nora Lustig's Commitment to Equity program employs microsimulation techniques to analyze the progressivity and regressivity of taxes for various Latin American countries (Lustig & Higgins, 2013).

In Ecuador, Ramírez and Oliva (2008) developed the Indirect Taxation Microsimulator of the Department for Tax Studies (MIIDET), which enables an assessment of potential changes to the VAT rate based on an Almost Ideal Demand System (AIDS), while Rojas and Dondo (2017) employed microsimulation techniques to analyze the structure of VAT exemptions in the country. In Mexico, Huesca and Serrano (2005) used microsimulation techniques to analyze different VAT reforms and concluded that a system of differential tax rates will reduce the regressive effect of the tax, increase revenue, and strengthen redistribution mechanisms. With respect to tobacco tax reforms, Rodríguez-Iglesias, Schoj, Chaloupka, Champagne, & González-Rozada (2017) simulated a fiscal policy aimed at reducing tobacco consumption in Argentina under three different taxation scenarios, and confirmed that an increase in tobacco tax leads to an increase in government revenue even in the most conservative reform scenario.

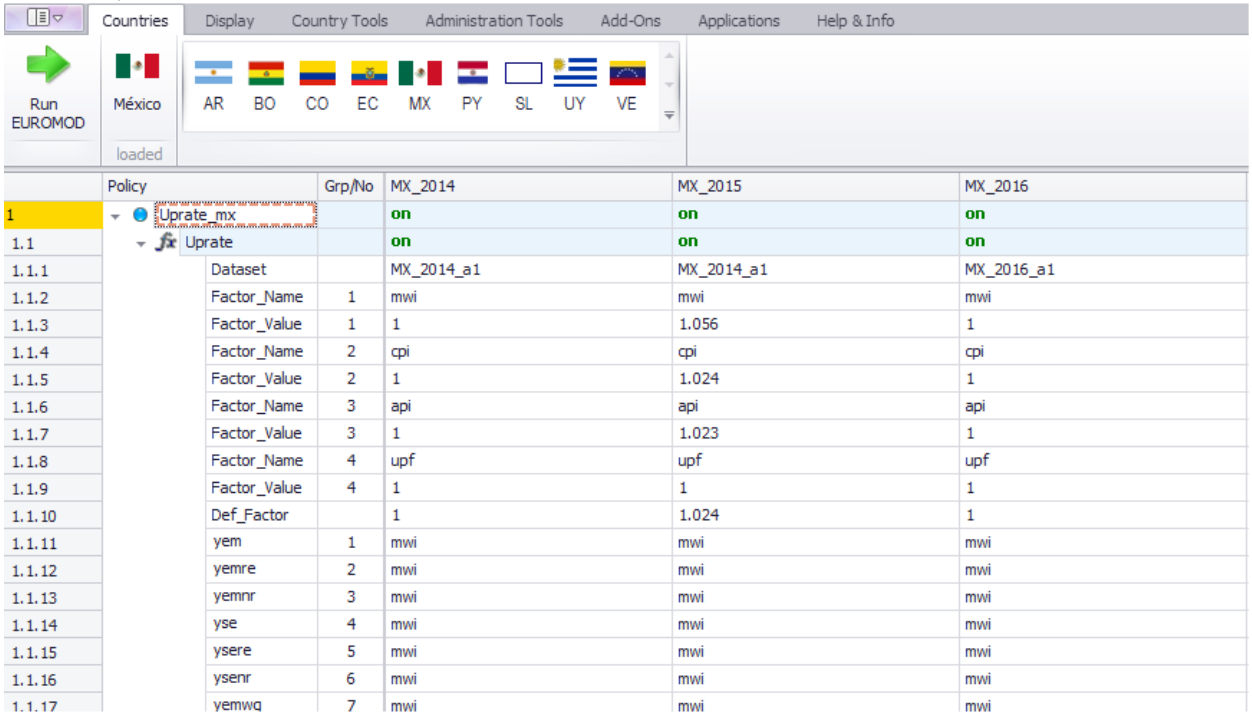
In sum, it is clear that both academics and policy-makers are increasingly turning to microsimulation models to design and evaluate fiscal policy. One of the most recent regional efforts is LATINMOD, which is briefly described in the following section.

[1] Samod is a static microsimulation model for South Africa, underpinned by the EUROMOD platform and programming.

2.3 The LATINMOD simulator

LATINMOD is the first regional microsimulator of fiscal policies to enable evaluation of the impact that the implementation of tax reforms or administration of public transfers will have on households before they happen. Although other simulators to evaluate fiscal policy do exist, they are based on aggregate data and therefore do not directly capture the effect on household welfare. LATINMOD uses the household as the unit of analysis. The platform operates based on microdata from national surveys on income and expenditure available in each country and configured tax regulations and operating rules of social programs. The programming process for LATINMOD includes the rules for the main taxes[2] and cash transfer programs in each country. LATINMOD identifies possible effects on different economic variables, including poverty, inequality, and tax revenue, in addition to the redistributive capacity of a tax system (Arancibia et al., 2019; Oliva, 2018).

To this end, LATINMOD includes a basic interface as shown below:



	Policy		Grp/No	MX_2014	MX_2015	MX_2016
1	Uprate_mx			on	on	on
1.1	Uprate			on	on	on
1.1.1		Dataset		MX_2014_a1	MX_2014_a1	MX_2016_a1
1.1.2		Factor_Name	1	mwi	mwi	mwi
1.1.3		Factor_Value	1	1	1.056	1
1.1.4		Factor_Name	2	cpi	cpi	cpi
1.1.5		Factor_Value	2	1	1.024	1
1.1.6		Factor_Name	3	api	api	api
1.1.7		Factor_Value	3	1	1.023	1
1.1.8		Factor_Name	4	upf	upf	upf
1.1.9		Factor_Value	4	1	1	1
1.1.10		Def_Factor		1	1.024	1
1.1.11		yem	1	mwi	mwi	mwi
1.1.12		yemre	2	mwi	mwi	mwi
1.1.13		yemnr	3	mwi	mwi	mwi
1.1.14		yse	4	mwi	mwi	mwi
1.1.15		ysere	5	mwi	mwi	mwi
1.1.16		ysenr	6	mwi	mwi	mwi
1.1.17		yemwq	7	mwi	mwi	mwi

For Mexico, LATINMOD operates based on the National Survey of Household Income and Expenditure (ENIGH) and incorporates the regulations for individual income tax, value-added tax (VAT), excise tax (Excise Tax on Production and Services, IEPS), and social security contributions in accordance with applicable law and different conditional cash transfer programs in place during the years studied.

3. Methodology

LATINMOD is a static microsimulator and does not incorporate any change in household behavior. To introduce changes in consumption, it is necessary to include assumptions about tobacco elasticity. Therefore, this section breaks down the steps followed to include dynamics in income distribution and estimate tobacco tax payment while taking into account behavior. To

[2] The structure for individual income tax can be programmed for all countries, while the indirect tax structure is only available for Argentina, Colombia, Ecuador, Mexico, and Venezuela.

this effect, it explains the methodological approach underpinning the price elasticity of demand model employed and the criteria for measuring poverty and inequality.

3.1. LATINMOD: description of database and processing parameters

LATINMOD-Mexico is based on data from the ENIGH 2016 survey conducted by Mexico's National Institute of Statistics and Geography (INEGI). The microdata contains a sample of 70,311 households and 257,658 individuals, which is representative of 33.4 million households and 122.6 million individuals. Since LATINMOD-Mexico was developed within the framework of EUROMOD, the ENIGH datasets were harmonized beforehand in accordance with the EUROMOD Modelling Conventions (EUROMOD, 2018). These feed the structure of the EUROMOD software. Because ENIGH was not designed to reflect tax paid by households, indirect imputation methods must be employed to reconstruct the tax system. This means that tax paid must be subtracted from the income and expenditure items reported by households based on the law applicable at the time of the survey. This way, the microsimulator is only fed the taxable base amount for each income and expenditure item to calculate taxes.

- *Construction of the taxable base for cigarettes and determination of quantities consumed by households.*

Household tobacco expenditure is reported in the ENIGH with a sample of 3,903 observations, which represent 1,861,014 households that consume tobacco. Although cigarette prices are not collected in the survey, it does give the amount of cigarettes purchased per week. However, since measurements are given in kilograms in the survey, a traditional rule for conversion was adopted, as found in the literature, by which each peso in cigarette expenditure equals 1.25 grams (Jimenez-Ruiz, De Miera, Reynales-Shigematsu, Waters, & Hernández-Ávila, 2008).

$$q_{t,h} = quantity * 1000/1.25 \quad (1)$$

Where $q_{t,h}$ is the quantity of cigarettes t consumed by the household h and the variable $quantity$ is the quantity of cigarettes purchased per week, given in kilograms. Once $q_{t,h}$ has been identified, the taxable base $b_{t,h}$ is calculated as follows:

$$b_{t,h} = \Big(\big(exp_{t,h}/1 + VAT\big) - \big(q_{t,h} * ieps_{spe}\big)\Big)/1 + ieps_{adv} \quad (2)$$

Where $exp_{t,h}$ is the expenditure on cigarettes reported by the household; VAT is the value-added tax rate (16 percent); $ieps_{spe}$ and $ieps_{adv}$ represent the specific and *ad valorem* components of the excise tax, respectively. Since $b_{t,h}$ is constructed with information reported by households, namely $exp_{t,h}$ and $q_{t,h}$, negative values were identified for $b_{t,h}$ in 206 observations.

The existence of negative taxable bases can be attributed to the structure of the data. It can be assumed that households reporting lower expenditure, yet excessively large cigarette consumption, purchase cigarettes from illicit businesses, thus evading tax. This phenomenon falls outside the scope of this study and, as a result, households exhibiting consumption with negative taxable bases have been excluded from the estimates. This produces a sample of 3,697 observations, which are representative of 1,768,388 tobacco-consuming households.

- *Programming of taxation policies and reform scenarios*

For the tax microsimulation, LATINMOD must be supplied with the parameters of the tax policy based on current law, and the hypothetical reform scenarios. Table 3.1 shows the current structure of the excise tax on cigarettes (S0) and two reform proposals. Both propose an increase only in the specific component of the tax, with the *ad valorem* component remaining fixed. Reform 1 (S1) is a conservative scenario, as it was suggested in an early version of the tobacco tax reform considers the current government's proposal, which is to increase the specific component from 0.35 to 0.49 pesos per cigarette. Reform 2 (S2), on the other hand, increases this to 1.35 pesos per cigarette (3.8 times its current level), with the goal of increasing the proportion of the tax burden in line with WHO recommendations to achieve an impact on consumption – that is, to a level at which the total amount of indirect taxes accounts for 75 percent of the final retail price (WHO, 2015).

Table 3.1. Structure of the tobacco tax in Mexico and tax reform scenarios

Tobacco excise tax	Current (S0)	Reform 1 (S1)	Reform 2 (S2)
Specific*	0.35	0.49	1.35
Ad valorem	160%	160%	160%

*/Note: Specific component of the excise tax given in Mexican pesos (MXN) per cigarette
Source: Authors' own work.

- *Static behavioral and non-behavioral microsimulation of tobacco tax.*

To incorporate behavior in income distribution, the price elasticity of demand by tercile, as described in section 3.2, was estimated using the STATA 15 statistical package. Given that an increase in tax leads to an increase in cigarette prices, the elasticity model makes it possible to determine the extent to which consumption will be reduced in scenarios 1 and 2.

As a result, household cigarette consumption will change, and these new distributions will replace the cigarette consumption originally reported by the household in LATINMOD, to provide a new estimate of taxes for each reform scenario. Consequently, this study reports two microsimulation processes: a) static and non-behavioral, for S0; and b) static and behavioral, for S1 and S2.

- *Estimation of change in tobacco consumption and expenditure.*

Based on the static non-behavioral microsimulation, LATINMOD estimates tobacco expenditure for the three scenarios. The rate of change in price Δp_s is obtained with the following formula:

$$\Delta p_s = (exp_{s1,2} - exp_{s0})/exp_{s0} \quad (3)$$

The next stage is to estimate the reduction in consumption (measured by the quantity of cigarettes). To this end, elasticities by tercile ε_i were employed in the following maximization function:

$$\Delta q_{t,h} = \max\left(q_{t,h} * \varepsilon_i * \Delta p_s, -q_{t,h}\right) \quad (4)$$

As a result, the change in the quantity consumed $\Delta q_{t,h}$ makes it possible to identify the new quantities of cigarettes the household will continue to purchase:

$$nq_{t,h_{S1,2}} = q_{t,h} - \Delta q_{t,h} \quad (5)$$

And the new unit price $up_{t,h}$:

$$up_{t,h} = \Big(\big(b_{t,h} * ieps_{adv} + (nq_{t,h_{S1,2}} * ieps_{spe_{s1,2}})\big) * VAT\Big) / nq_{t,h_{S1,2}} \quad (6)$$

Finally, the new expenditure on tobacco $nexp_{t,h_{S1,2}}$ is calculated based on expression (7), producing new values for quantities ($nq_{t,h_{S1,2}}$) and expenditure ($nexp_{t,h_{S1,2}}$) that correspond to the new distributions LATINMOD requires for the static behavioral microsimulation.

$$nexp_{t,h_{S1,2}} = up_{t,h_{S1,2}} * nq_{t,h_{S1,2}} \quad (7)$$

- *Transfer microsimulation*

To analyze the impact of cash transfer allocations on poor households, it has been assumed that all IEPS tax revenue collected will be used to this end. A study by CIAD (2018) states that a neutral tax reform makes it possible to allocate tobacco excise revenue to cash transfers to defray the cost of healthcare, milk, and food for poor households on the basis of a specific basket of goods; thus, the measure makes it possible to compensate for the negative income effect (crowding-out effect) of households that continue to consume cigarettes and face higher market prices as a result of the reform.

Presented in Table 3.2 below are three types of subsidies. The amount of each subsidy is based on households' mean expenditure on medicine, healthcare, and a food basket made up of eggs, beans, tortillas, and milk. Because the average expenditure figures are considered low (see Table 3.2 "Mean expenditure" and compare with the poverty line), it was decided to add to this figure the value of the minimum welfare line used by the National Council for the Evaluation of Social Development Policy (CONEVAL) for urban areas that same year. Thus, the full subsidy amount to be allocated in each scenario is broken down in Table 3.2.

Table 3.2. Subsidy modeling proposals

Type of subsidy*	Mean expenditure (a)	CONEVAL urban minimum welfare line (b)	Total subsidy amount (a) + (b)
1. Medicine	$170.00	$1,337.28	$1,507
2. Healthcare	$466.00	$1,337.28	$1,803
3. Food basket	$508.00	$1,337.28	$1,845

*/ Note: Subsidies are constructed by allocating the average expenditure on each consumable for households under the poverty threshold and adding the food poverty threshold in urban areas for 2016.
Source: Authors' own work.

The sole eligibility criterion to receive the subsidy was that the household was food-poor – in other words, below the food basket poverty line in the country ($1,337.28 MXN). Once both the transfer amount and eligibility criterion were defined, the parameters of the proposed social policy were configured in the LATINMOD system. However, the number of beneficiary households will depend on the total revenue collected from the tobacco excise tax. Since this amount determines the budget available for each scenario, LATINMOD conducts a random selection process based on the eligibility criterion to identify beneficiary households. In short, various microsimulation exercises are performed, combining the effect of tax reforms and subsidy allocation. Table 3.3 shows the combinations of subsidies.

Table 3.3. Combination of tobacco tax reforms and subsidies

Scenarios	Variation justification	Type of subsidy	Microsimulation combination
Reform 1 (S1)	Included in the 2020 economic package.	a) Expenditure on medicine b) Expenditure on healthcare c) Food basket	S1 a) S1 b) S1 c)
Reform 2 (S2)	Increase in the specific tax to raise the total tax burden on tobacco to over 75% of the final price.	a) Expenditure on medicine b) Expenditure on healthcare c) Food basket	S2 a) S2 b) S2 c)

Source: Authors' own work.

With the data on households and elasticity estimations, the increase (or variation) in tobacco tax revenue and the resulting reduction in consumption are estimated. Furthermore, in allocating tobacco tax revenue, revenue-neutral reforms are evaluated. Taking into account the proposals and alternative scenarios, LATINMOD is used to estimate the impact on poverty and inequality by income group (by tercile, in this case) for the six subsidy combinations described above. The first combination uses the subsidy for expenditure on medicine, the second covers healthcare, and the third is a transfer granted as a subsidy consisting of food stamps for milk, corn tortillas, beans, and eggs, which are the most frequently consumed goods in poor Mexican households (Huesca, Araar, Llamas & Calderón, 2019).

- *Poverty and inequality simulations with LATINMOD*

LATINMOD estimates poverty and inequality indicators based on household disposable per capita income. Disposable income is defined as market income plus cash transfers, minus social security contributions and taxes (income tax, value-added tax, and excise tax). Households are considered at risk of poverty when their equalized disposable income is below the poverty threshold. LATINMOD defines the poverty threshold as 60 percent of the median equalized disposable income of the country of reference.

Furthermore, the Gini index is used to estimate inequality (before and after the tax reform) for simplicity of interpretation. Therefore, the inequality calculations for the six combinations described in Table 3.3 use inequality in the baseline scenario (with gross income) as a benchmark to estimate change in the Gini index. The calculations are replicated by vulnerable group (female-headed households and households with children, elderly persons, and unemployed persons).

- *Poverty simulations based on CONEVAL*

LATINMOD's estimated measurement of relative poverty is useful in performing a comparative analysis between countries. In order to provide an analysis of poverty that is comparable with the official measurement performed by the National Council for the Evaluation of Social Development Policy (CONEVAL) in Mexico, the effect of cash transfer allocations on food-poor households was estimated. Following CONEVAL's own methodology, the transfer amount provided in Table 3.2 is added to the household's current income, and this amount is then divided

based on the household equalization scale. This makes it possible to determine the change in extreme poverty in Mexico for each of the six combinations described in Table 3.3.

3.2 Estimation of price elasticity of demand

This section explains the methodological approach to estimating the price elasticity of demand model used, both for the general model and for expenditure terciles. These estimates are used in expression (4) in section 3.1. with the aim of introducing behavior into income distribution and estimating the effects on revenue, inequality, and poverty in the LATINMOD microsimulator. It should be noted that elasticities were calculated with a data pool constructed based on five ENIGH surveys described below.

- *Description of the 2010-2018 data pool*

To estimate cigarette demand, ENIGH surveys were used from 2010, 2012, 2014, 2016, and 2018.[3] ENIGH microdata is cross-sectional and collected by INEGI every two years. The surveys follow a two-stage probability sampling design based on primary sampling units (PSUs), in which the home is the selected unit and the household the observed unit. In addition, the survey stratification takes into account the size of localities (urban or rural); the ENIGH surveys are therefore representative and results can be extended to the whole population.

These surveys record tobacco expenditure by households and, to that effect, have kept the sample design and collection instruments unchanged. Since ENIGH surveys do not report information on cigarette prices, cigarette expenditure ($exp_{t,h}$) is divided by the quantity ($q_{t,h}$) reported by households to calculate the unit value.

Table 3.4. Average cigarette consumption in Mexico, 2010-2018

Year	Households	Average monthly expenditure ($)	Average monthly quantity
2010	1,996,661	374.56	191.96
2012	2,356,522	445.46	225.23
2014	1,838,396	406.83	195.65
2016	1,861,014	374.09	194.41
2018	1,805,283	339.13	203.80

Source: Authors' own work using ENIGH 2010, 2012, 2014, 2016, and 2018 surveys.

- *Estimation for variability tests and Deaton's model*

Due to the lack of prices in surveys, they are estimated through unit values for tobacco. This means that the estimate could be skewed by the quality effect in consumption. The problem is that "clustering of the sample will usually reduce the precision as households within the same cluster are more similar to each other and hence reflect low variability" (John, Chelwa, Vulovic & Chaloupka, 2019). As a result, since the problem is the lack of price variation, the "quality effect" problem is present, which may lead to a "quality shading" effect when tobacco prices do

[3] INEGI implemented improvements in collecting household income data from 2016, calling into question the comparability of ENIGH surveys in measuring poverty over time. However, it should be noted that the data pool used considers only household expenditure (and not income) to calculate elasticities (and not poverty).

not lead to a reduction in demand as smokers simply switch to a cheaper brand of cigarettes. In addition, one must consider the problem of measurement error caused by misreporting expenditure or the true quantity of cigarettes purchased in surveys, for example. Deaton's model includes a series of steps (John *et al.*, 2019) to correct for these measurement errors.

First, the unit value is a calculated as a proxy for the price of tobacco, and there is the possibility of price variability between the clusters in the survey. Secondly, using analysis of variance (ANOVA), the total variation in unit values is divided into "within-cluster" and "between-cluster" variations. Then, a significant *F* statistic from the ANOVA model shows that unit values do vary across geographical space in the data. Then two regressions with clusters are specified, one to estimate the value of the price and another to determine the impact of the budget on tobacco consumption. The specification includes logarithmic variables of the unit price lnv_{hc} for tobacco, and w_{hc} as the log of tobacco expenditure; "Lnx" is the log of income, "Size" the log of household size, "Age" the log of the age of the head of household, "Education" is the head of household's schooling in years, "Adults" the number of adults in the household, "Males" the proportion of males in the household, "Gender" is the sex of the head of household, and "Work" the log of the number of workers in the family. The regression equations for the calculations for expenditure (8) and unit price (9) are given as follows:

$$w_{hc} = \alpha^0 + \beta^0 lnx_{ic} + \gamma^0 Z_{hc} + \theta ln\pi_c + (f_c + u_{hc}^0) \quad (8)$$

$$lnv_{hc} = \alpha^1 + \beta^1 lnx_{ic} + \gamma^1 Z_{hc} + \psi ln\pi_c + u_{hc}^1 \quad (9)$$

Equation (8) is the calculation for the model for the budget allocated to tobacco, as a typical demand model in which cigarettes (as a proxy for demand) are expressed as a function of household and individual income and characteristics, as described above, and for prices. Equation (9) explains the unit value of tobacco and confirms the presence of quality effects: if β^1 is positive and statistically significant, income responds as expected and quality effects are present, if ψ = 1 when UV = *p*, but there is a shading effect if ⇒ ψ < 1. After the unit price and expenditure models have been estimated, the last two steps are to apply two equations, (10) and (11), to remove the effects of household expenditure and the characteristics considered. Both models contain price information (subscript *c* as the number of households in cluster *c* and c^1):

$$y_c^1 = \propto^1 + \gamma ln\pi_c + u_c^1 \quad (10)$$

$$y_c^0 = \propto^0 + \theta ln\pi_c + f_c + u_c^0 \quad (11)$$

The two expressions show the mean unit value and mean demand for tobacco in the cluster after removing the effects of household expenditure and household characteristics, where the subscript *c* is the number of households in the cluster and c^1 the number of households reporting purchase of tobacco, for which elasticity must be calculated. Elasticities are obtained in the last and sixth step with the following formulae:

$$\widehat{\varepsilon_p} = \left(\frac{\hat{\theta}}{\bar{\omega}}\right) - \hat{\psi} \quad (12)$$

$$\widehat{\varepsilon_1} = 1 + \left(\frac{\widehat{\beta^0}}{\bar{\omega}}\right) - \widehat{\beta^1} \quad (13)$$

Where (12) is the expression for price elasticity with $\bar{\omega}$ as the mean share of total household expenditure on tobacco and $\hat{\theta}$, $\hat{\psi}$ are the estimated coefficients on unobserved prices in equations (8) and (9). Equation (13) is for the income elasticity of demand and $\widehat{\beta^0}$ y $\widehat{\beta^1}$ are the

respective coefficients, also from expressions (8) and (9). The price elasticities of cigarettes reported in the literature for a wide variety of developing countries range between -0.4 and -0.8, while expenditure elasticity estimates have ranged from 0.2 to 2.4 in recent years (John *et al.*, 2019).

4. Results

Presented below, first of all, is the analysis of price variability for the unit value of tobacco, followed by the estimation of models to calculate elasticities, for which equations (8) and (9) were followed, as described in the methodology. The next step is to estimate within-cluster regressions both for the unit value and budget share for tobacco expenditure.

4.1 Spatial variability test in unit values and own-price elasticities

High variability was found in the clusters for the 2010-2018 data pool. It was confirmed that unit values meet the spatial variation hypothesis. The ANOVA regression test shows that at least 62.9 percent (R^2 of 0.629) of variation is explained by between-cluster effects and the *F* statistic accepts the spatial variation hypothesis in prices.

Table 4.1. Testing spatial variation in log unit values
Mexico, 2016

F statistic	p-value	R-squared	n
1.32	0.000	0.629	10,874

Source: Authors' own work using ENIGH 2010, 2012, 2014, 2016, and 2018 surveys.

Table 4.2 below shows the results of Deaton's model for equations (8) and (9). The first column presents the unit value regression and, as expected, the expenditure coefficient (Lnx) is positively correlated and highly significant, indicating the presence of quality effects in tobacco consumption data.

Most of the other variables serve to reduce the quality effect, but they do not all exhibit significant coefficients. For example, the head of household's schooling has a positive effect in explaining the presence of quality effects. Gender and the number of adults in each household do not exhibit a statistical impact, indicating that regardless of the sex of the head of household and number of adults in the household, it is not price but quality that plays a determining role in the consumption or non-consumption of tobacco. The second column in Table 4.2 shows a negative regression of the budget share, as evidence that the amount allocated by households to tobacco drops significantly with household expenditure.

Table 4.2. Results of the unit value and budget model
Mexico, 2016

Variables	lnv	w
Lnx (Income)	0.150***	-0.026***
	(9.12)	(-21.88)
Size	-0.060**	-0.015***
	(-2.58)	(-8.85)
Age	-0.039	0.018***
	(-0.98)	(6.22)
Education	0.071**	-0.007***
	(2.62)	(-3.49)
Adults	-0.094	-0.001
	(-1.34)	(-0.17)
Males	-0.097*	0.007*
	(-2.05)	(2.09)
Gender	-0.028	0.004^{+}
	(-0.96)	(1.79)
Work	-0.016	-0.006**
	(-0.54)	(-2.84)
Constant	-0.296	0.235***
	(-1.45)	(15.53)
No. of Households	11090	11090
Adjusted R^2	0.1784	0.2190

T-statistics in parentheses.
$^{+}$p<0.10, * p<0.05, ** p<0.01, *** p<0.001

Source: Authors' own work using ENIGH 2010, 2012, 2014, 2016, and 2018 surveys.

Table 4.3 presents estimates of the price elasticity of demand for tobacco ($\widehat{\varepsilon_P}$) and income elasticity ($\widehat{\varepsilon_I}$) both for the general model and by expenditure terciles. It was observed that elasticity in the general model is significant with a coefficient of -0.662. The result of Table 4.3 indicates that for every 10 percent increase in the price of tobacco, a mean decrease of 6.6 percent will be observed in quantity of cigarettes consumed[4].. This is consistent with other studies for middle-income countries, where levels range from -0.4 to -0.8 (John *et al.*, 2019).

Disaggregating elasticities by tercile – socioeconomic group – reveals that the first tercile (the poorest group) exhibits an elasticity in consumption reduction of almost 4.8 percent for each 10 percent increase in price (with an estimate of -0.479), while a reduction of 7.26 percent was observed in the second tercile, and the third tercile (the high-income group) displayed an elasticity of -0.594, which translates into a 5.94 percent decrease in the event of 10 percent increase in price. All elasticities by tercile are statistically significant, with coefficients within the ranges suggested by the literature for middle-income countries.

[4] CIAD estimated conditional elasticity of cigarettes. The impact of higher prices on prevalence and the challenges and implications of including it in LATINMOD simulations will be addressed for future research.

Table 4.3. Estimates of price elasticity and expenditure elasticity of demand for cigarettes in Mexico, 2016

Variables	Total	Tercile 1	Tercile 2	Tercile 3
$\widehat{\varepsilon_P}$	-0.662*** [0.043]	-0.479*** [0.052]	-0.726*** [0.058]	-0.594*** [0.052]
	(-0.745 , -0.578)	(-0.581 , -0.376)	(-0.840 , -0.611)	(-0.696, -0.492)
No. of Households	11,090	3,697	3,697	3,696
No. of Clusters	6,113	2,656	2,823	2,887
$\widehat{\varepsilon_I}$	0.272*** [0.041]	0.293* [0.129]	0.684** [0.244]	0.231^{+} [0.122]
	(0.191, 0.353)	(0.040 , 0.546)	(0.206 , 1.163)	(-0.007 , 0.469)
No. of Households	11,090	3,697	3,697	3,696

Bootstrapped standard errors in brackets. 95% confidence intervals in parentheses.
$^{+}$p<0.10, * p<0.05, ** p<0.01, *** p<0.001

Source: Authors' own work using ENIGH 2010, 2012, 2014, 2016, and 2018 surveys.

The evidence shows a U-shape in price elasticities, with expenditure groups from a medium socio-economic level being most responsive, based on the Deaton method employed. Income elasticities, on the other hand, exhibit the expected sign with a good level of significance, with only the high tercile being relatively statistically significant. This is a reflection of the fact that quality effects may not be clear in this group, and it is possible that, in that year, high-income smoking households did not consider the quality aspect, unlike the two lower-income groups of consumers. On that basis, in the next section, corresponding microsimulations for the two tax reform scenarios are presented.

4.2 Revenue collection and demand for tobacco in each scenario in LATINMOD

This section presents the results of changes in tobacco tax reforms, indicating the effects on the quantities of cigarettes consumed, expenditure levels, and revenue, based on the LATINMOD microsimulator. The results shown here incorporate the effect of price elasticity by tercile explained in section 3.1, using the results from Table 4.3.

- *Variations in unit price, quantities and expenditure on tobacco*

Both tax reforms lead to a variation in the unit price of cigarettes. As shown in Table 4.4, this increase goes from $2.93 MXN (baseline scenario) to $3.20 in reform 1 and $5.28 in reform 2. Because the increase in tax results in an increase in the unit cost, the quantities consumed are reduced, yet the combined effect of price and quantity yields higher expenditure on cigarettes.

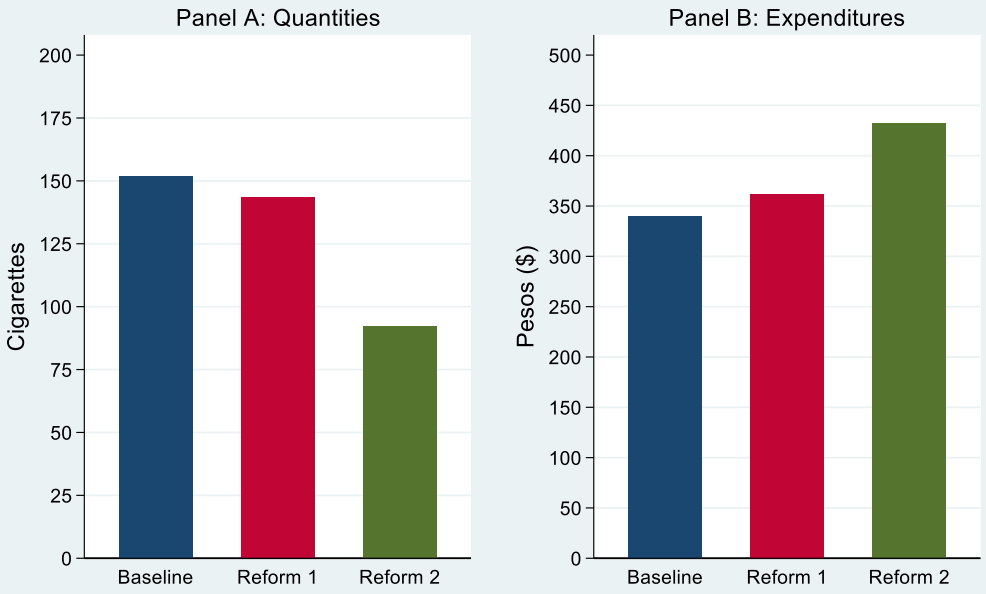
Table 4.4. Changes in unit price and quantities by expenditure tercile. Mexico, 2016 (monthly mean)

Scenario	Unit price	Variation in price	Total elasticity		Elasticity Tercile 1		Elasticity Tercile 2		Elasticity Tercile 3	
			-0.662		-0.479		-0.726		-0.594	
			Quantity	Variation	Quantity	Variation	Quantity	Variation	Quantity	Variation
Baseline	2.93		151.90		151.9		151.9		151.9	
Reform 1	3.2	0.09	142.57	-0.06	145.15	-0.04	141.67	-0.07	143.53	-0.06
Reform 2	5.28	0.80	71.08	-0.53	93.41	-0.39	63.25	-0.58	79.34	-0.48

Source: Own work based on the ENIGH 2016 survey and elasticity model.

Figure 1 shows these changes as a result of the implementation of tobacco tax reforms, assuming full pass through of the tax, and introduces behavior driven by elasticities of consumption in the microsimulation. As a starting point, Panel A shows the potential downward effect on the quantity of cigarettes consumed on average each month, which drops from 152 cigarettes in the baseline scenario to 143 cigarettes in reform 1, while in reform 2, a decrease in consumption of almost 40 percent was observed, with 92 cigarettes consumed on average per month.

Figure 1. Average cigarette consumption in each tax reform, Mexico 2016

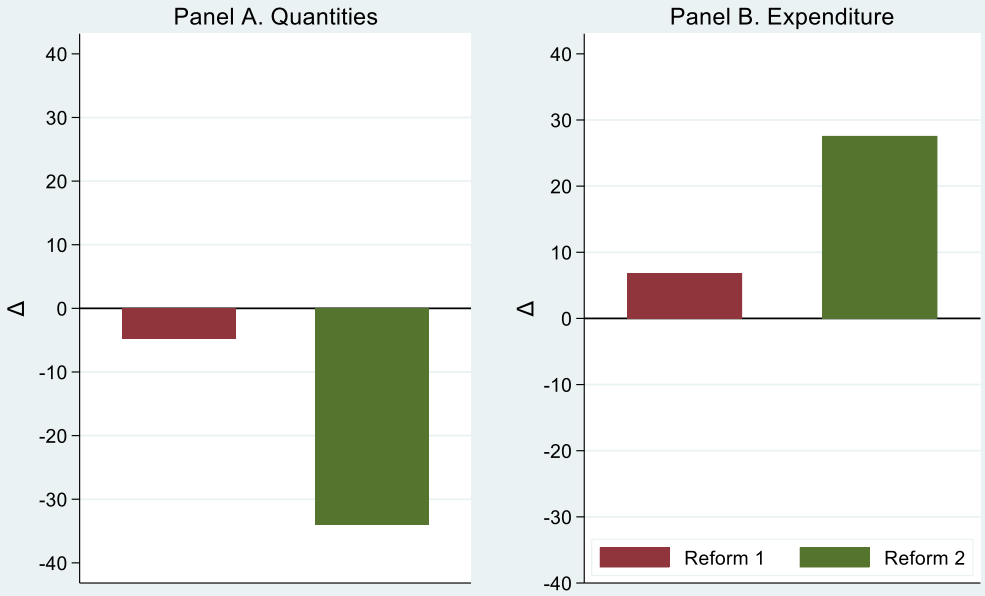


Source: Own work using LATINMOD.

Panel B in Figure 1, on the other hand, shows the increase in average monthly expenditure. With the baseline scenario as the starting point, reform 1 goes from around $340 MXN a month to $362 MXN, while reform 2 is more aggressive, raising the mean monthly expenditure on tobacco to around $431 MXN, which leads to the inference that this last reform will provide the most resources for the state (for a more detailed breakdown of cigarette expenditure, see Table A.1 in the appendix).

Figure 2 replicates this last figure but shows the changes as a percentage. In Panel A, reform 1 barely reduces the quantity consumed, with a decrease of less than 5 percent, whereas in reform 2, this figure stands at 34 percent. Expenditure on tobacco, in contrast, would increase in the two reforms by about 7 percent and by up to 27 percent, respectively.

Figure 2. Variation rates on cigarette consumption, Mexico 2016



Source: Own work using LATINMOD.

- *Variation in revenue collection*

Table 4.5 shows basic statistics to determine possible differences between the number of smoking households and the mean excise tax paid in each scenario. In reform 1, the tax paid has little effect on average, as it increases only 1.09 times (from 183 to 200 pesos), and the price effect has no impact on the number of smoking households.

Reform 2, on the other hand, increases the amount of tax paid to a greater extent, leading households that allocated just a small share of their budget to tobacco consumption to stop consuming due to the price effect. Thus, a small decline was observed in the number of tobacco-consuming households, of up to 0.50 percent (8,784 fewer households), but the mean tax paid would reach up to 1.39 times the baseline situation, with tax payments reaching 254 pesos.

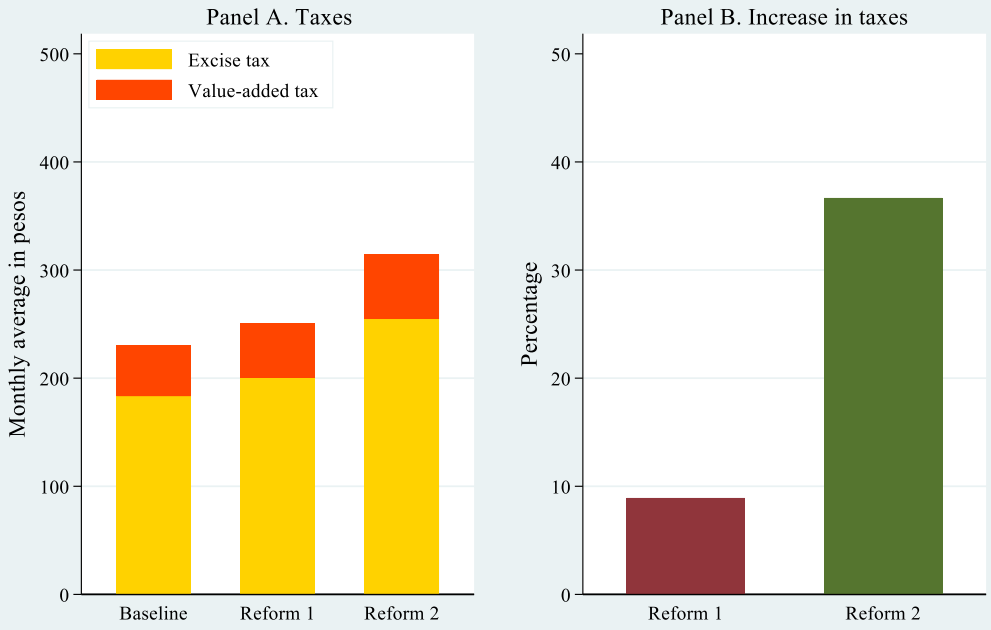
Table 4.5. Descriptive statistics for tobacco consumers and mean excise tax paid

Scenarios	Households	Δ Consumers	Mean IEPS	Number of times the mean	Std. Dev.
Baseline	1,768,388	-----	183.34	1.00	203.59
Reform 1	1,768,388	0.00	200.47	1.09	221.62
Reform 2	1,759,594	-0.50	254.71	1.39	284.17

Source: Authors' own work using LATINMOD.

So far, it is clear that both tax reforms reduce the quantities consumed while increasing the mean excise tax paid. As a result, it is worth exploring the combined effect on revenue across the tobacco tax structure. Panel A in Figure 3 shows the share of taxes paid, both for value-added tax (VAT) and the Excise Tax on Production and Services (IEPS), with the mean total payment for both taxes increasing from $230 MXN in the baseline scenario to $250 MXN and $314 MXN in reforms 1 and 2, respectively. Thus, Panel B illustrates the change in revenue in these reforms, with respect to the baseline situation. It can be seen that reform 1 produces an increase in tax revenue of only 8.9 percent, while the increase is about 37 percent in reform 2.

Figure 3. Revenue from tobacco tax, Mexico, 2016



Source: Own work using LATINMOD.

The values in Table 4.6 complement the analysis in Figure 3 and focus on revenue from excise tax, both in millions of pesos (mdp) and as a percentage of GDP for 2016. In reform 1, revenue totals almost 44,000 mdp (0.22 percent of GDP), while in reform 2, public revenue from tobacco excise rises to over 55,000 mdp (0.28 percent of GDP) – an increase of 38.2 percent.

Table 4.6. Effect of tobacco excise tax reforms on revenue: Mexico, 2016 (millions of pesos)

	$	% GDP	Delta
Baseline	40,236.20	0.20	-
Reform 1	43,994.11	0.22	9.3%
Reform 2	55,621.29	0.28	38.2%

Source: Authors' work based on INEGI and LATINMOD estimates.

Although the price elasticity of demand by tercile is used to incorporate behavior in income distribution -and these in turn is used as an input data into the platform-, LATINMOD produces results by per capita income deciles without inducing any bias in the results or loss of statistical inference value. Therefore, table 4.7 shows the effect of excise taxes, assuming full pass through of the tax, calculated in terms of contribution by per capita income decile. It can be seen that the tax burden falls most heavily on high-income groups. Indeed, 52 percent of revenue comes from deciles 8, 9, and 10, while around 12 percent falls on deciles 1, 2, and 3.

Table 4.7. Public revenue contribution from tobacco excise tax by decile, Mexico, 2016 (percentage)

		Tobacco reforms	
Deciles[+]	**Baseline**	Reform 1	Reform 2
1	2.08	2.14	2.22
2	3.37	3.38	3.22
3	6.32	6.33	6.18
4	8.01	8.04	7.75
5	8.04	8.05	7.90
6	8.69	8.76	8.88
7	11.14	11.18	11.34
8	13.77	13.71	13.77
9	15.88	15.81	15.53
10	22.70	22.60	23.20
Total	100.00	100.00	100.00
Revenue*	40,236.20	43,994.11	55,621.29

Notes: [+]/ LATINMOD provides results by decile, with deciles constructed based on per capita income.
*/ Revenue in millions of pesos.
Source: Own work based on LATINMOD.

The increase in revenue is the effect of the change in the price of tobacco. Table 4.8 shows the presence of variability in the price smokers pay based on their economic capacity. This makes it possible to determine the change in tobacco prices by decile. The price per cigarette increases from $2.92 MXN to $3.19 MXN in reform 1 and $5.28 MXN in reform 2. The table indicates that the tax burden in reform 1 is more uniform across income groups, but there is little change in revenue as a result; reform 2, on the other hand, produces a heavier tax burden, with the price more than doubling for decile one, while for the rest of the income groups, the change would be smaller (from 58 percent to 96 percent).

Table 4.8. Change in cigarette prices by decile. Mexico, 2016

Deciles+	Reform 1	Reform 2
1	9.09	122.73
2	10.34	86.21
3	10.71	89.29
4	7.14	85.71
5	7.32	58.54
6	12.00	96.00
7	6.90	79.31
8	11.11	88.89
9	10.34	82.76
10	10.00	73.33
Total	10.3	82.8
New price (cigarette)	3.19	5.28

Note:
+/ LATINMOD provides results by decile, with deciles constructed based on per capita income.
*/ Cigarette price before the reform = $2.82 (prices in pesos)
Source: Own work based on LATINMOD

4.3 Analysis of poverty and inequality by vulnerable group

This section compares the reduction in poverty and inequality that each reform could achieve with respect to the baseline scenario, assuming that total excise revenue is allocated to a cash transfer program for food-poor households. The poverty figures are calculated in two ways: a) poverty as estimated by LATINMOD (which uses half the median income as the poverty threshold); and b) food poverty in the country according to CONEVAL (which accounted for 15 percent of households in 2016). The figures are shown in Tables 4.9 and 4.10, respectively. Table 4.9 shows that overall poverty stands at 25.2 percent in the baseline scenario (column b), with elderly persons hardest hit (33.1 percent), followed by those with children (30 percent) and those of working age (21.3 percent); the population exhibited a poverty gap index of 34.3 percent. Assuming households receive a cash transfer, with reform 1 (as proposed by the current government), poverty can be reduced by up to 2.8 percentage points, which would benefit 2 million households (see columns d and e).

The group that would benefit most from this reform would be households with children, for which poverty is reduced by 3.1 percentage points with subsidies in medicine, up to 3.35 percentage points with either healthcare or food subsidies. In addition, the poverty level decreases in households with at least one elderly person by 3, 3.4, and 3.36 percentage points respectively for each type of transfer.

Table 4.9. Basic poverty indices in LATINMOD microsimulations (with tax benefits)

Basic poverty indices (a)	Baseline (b)	Reform 1 ($0.49 per cigarette)			Reform 2 ($1.35 per cigarette)		
		Type of transfer			Type of transfer		
		Medicine (c)	Healthcare (d)	Food (e)	Medicine (f)	Healthcare (g)	Food (h)
Population	25.22%	22.61%	22.44%	22.45%	22.0%	21.77%	21.81%
Children	29.89%	26.78%	26.54%	26.54%	26.02%	25.78%	25.84%
Working age	21.31%	19.05%	18.96%	18.97%	18.53%	18.36%	18.40%
Economically active population	17.80%	15.85%	15.77%	15.77%	15.41%	15.28%	15.29%
Elderly persons	33.13%	30.14%	29.73%	29.76%	29.61%	29.0%	29.0%
*Poverty line**	2,039.92	2,042.47	2,044.31	2,044.66	2,041.95	2,043.13	2,043.40
Poverty gap	34.34%	28.48%	29.51%	29.63%	26.30%	27.74%	27.81%
Total number of beneficiary households	-	2,432,764	2,033,375	1,987,087	3,075,718	2,570,775	2,512,253

*/ Note: The poverty line is given in Mexican pesos.
Source: Own work using LATINMOD.

Table 4.10. Food poverty reduction as defined by CONEVAL

Indicator	Reform 1 ($0.49 per cigarette)			Reform 2 ($1.35 per cigarette)		
	Households	%	Δ	Households	%	Δ
Food poverty 2016	5,015,133	14.99		5,015,133	14.99	
With a transfer of $1,507 a month	3,424,053	10.23	-31.75%	3,005,440	8.98	-40.1%
With a transfer of $1,803 a month	3,542,012	10.58	-29.42%	3,156,214	9.43	-37.1%
With a transfer of $1,845 a month	3,549,495	10.61	-29.22%	3,175,115	9.49	-36.7%

Source: Own work using LATINMOD and CONEVAL 2016.

The heavier tax burden in reform 2 results in more revenue to be distributed in subsidies, reducing poverty levels and gaps more substantially, as can be seen in Table 4.9, columns (f), (g), and (h). In this scenario, the greatest decline in poverty is brought about by healthcare transfers, which reduces the poverty index, both for children and the elderly, by 4.12 percentage points.

Based on the official measurement of poverty, Table 4.10 shows that in 2016, 15 percent of households lived in conditions of food poverty. After running the three types of transfers, reform 1 reduces the level of poverty by around 30 percent, as 10.2 percent, 10.5 percent, and 10.6 percent of households would be food-poor, respectively. With reform 2, on the other hand, 8.9 percent, 9.4 percent, and 9.5 percent of households would continue to live in poverty, with each transfer respectively. This illustrates the impact of a greater increase in revenue.

Table 4.11. Basic inequality indices in LATINMOD microsimulation (with tax benefits)

Basic inequality indices	Baseline	Reform 1 ($0.49 per cigarette)			Reform 2 ($1.35 per cigarette)		
		Type of transfer			Type of transfer		
		Medicine	Healthcare	Basic food basket	Medicine	Healthcare	Basic food basket
Original income	0.5432	0.5432	0.5432	0.5432	0.5432	0.5432	0.5432
Disposable income	0.4942	0.4830	0.4832	0.4832	0.4800	0.4804	0.4805

Source: Authors' calculations using LATINMOD.

Lastly, Table 4.11 offers estimates of inequality as a result of the tobacco tax reforms, using the traditional Gini index. It can be easily noted that the current tax system reduces inequality by almost 5 points, falling from the pre-tax level of 0.543 to 0.494. If reform 1 is implemented, the baseline inequality level of 0.543 can be reduced by a little over 1 additional Gini point, and with reform 2, by granting subsidies to cover medicine and the shortfall in income below the food poverty threshold, it could be reduced to a maximum: to 0.480. These levels of inequality have not been reported in Mexico for at least 25 years, since the 1992-1994 period.

5. Conclusions and recommendations

Mexico is facing radical changes under its new government in a context of moderation in the use of public resources. A fiscal policy based on tobacco control has been lacking in the country for almost a decade, resulting in a need for a substantial adjustment in tobacco prices to minimize the affordability of cigarettes, thus reducing consumption while increasing revenue from this channel.

This study analyzes two tobacco tax reforms in Mexico using the LATINMOD tool to estimate the effect of reforms on consumption and revenue, accounting for changes in household behavior by introducing tobacco price elasticities. The elasticity of demand for cigarettes is -0.662, meaning that a 10 percent increase in cigarette prices effectively reduces consumption by 6.6 percent. However, this effect is not homogeneous and varies by income group. The lowest income group exhibited the lowest elasticity (-0.479), while the highest elasticity was observed in tercile 2 (-0.726), followed by the high-income group (-0.594). The elasticity slope in Mexico appears to be U-shaped and appears not to follow the pattern shown by evidence from other regions where lower-income groups clearly exhibit greater sensitivity to price variations, which is reflected in changes in consumption. There may be many reasons for this, one being the pattern of consumption. Evidence from around the world has shown that most smokers come from lower-income strata. By contrast, in Mexico, smoking is most prevalent among higher-income groups. Further research in this regard would provide a deeper insight into this aspect of consumption in Mexico.

This reform analysis has revealed that tax increases that raise prices reduce consumption and increase tax revenue. However, not all reforms are the same. In a scenario with a tax increase as per the reform included in the 2020 Tax Package (reform 1), public revenue would increase

by just 9 percent (0.22 GDP points), expenditure on tobacco would increase by around 7 percent, and demand for cigarettes would drop by less than 5 points. On the other hand, a reform in keeping with WHO recommendations – that is, an increase that leads to a significant reduction in consumption (reform 2) – would reduce the quantity consumed by around 34 percent. This reform could grow public revenue by 38 percent (0.28 GDP points), with 52 percent of the tax burden falling on high-income groups (deciles 8, 9, and 10).

Thus, if policy-makers still have misgivings about the distributional impact of the measure, a tax increase gives them the tools to avoid placing the heaviest burden on more vulnerable groups. For example, if the full amount levied from the tobacco excise tax was used for cash transfers for food-poor households, this would reduce poverty among children and the elderly by up to 4.12 percentage points.

Furthermore, based on CONEVAL's official estimate of poverty in Mexico, in 2016, 14.99 percent of households lived in conditions of food poverty. A social policy that grants $1,507 MXN a month to these households would reduce food poverty by up to 40 percent, lifting 2 million households out of food poverty (with 8.98 percent of households remaining in food poverty).

In addition, the inequality index would fall by one more point, as the redistributive effect of the tax system in 2016 reduces the Gini index from 0.5432 to 0.4942, while with the tax reforms, this could fall to 0.4800.

Thus, this study offers a chance for policy-makers to make the decision to further increase tobacco tax in Mexico based on the second reform, as this would further reduce consumption while growing public revenue such that resources could be used not just to fight tobacco use, but also poverty and inequality in the country.

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Appendix.

Table A.1. Descriptive statistics: breakdown of tobacco expenditure. (monthly mean in pesos)

Variable	Scenario		
	Baseline	Reform[1]	Reform [2]
Expenditure on cigarettes	339.97	361.96	431.63
VAT[1]	46.89	49.93	59.54
Retailer's profit margin[2]	28.38	30.21	36.03
Specific IEPS[3]	53.17	70.29	124.54
Ad valorem IEPS[4]	130.18	130.18	130.18
Taxable base	81.36	81.36	81.36

Source: Own work based on LATINMOD
Notes:
1/ 16% value-added tax.
2/ 10.72% retailer's profit margin (Sáenz de Miera et al., 2013)
3/ Specific IEPS of 0.35, 0.49, and 1.35 pesos per cigarette in the baseline scenario, reform 1, and reform 2, respectively.
4/ 260% *ad valorem* IEPS.

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