

RESEARCH REPORT

A GENERAL EQUILIBRIUM ANALYSIS OF THE MACROECONOMIC IMPACTS OF TOBACCO TAXATION



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Key messages

- Increasing tobacco tax to raise the price of a pack of cigarettes to 90.2 pesos would lead to a 26 percent decline in consumption.
- An increase in the specific component of excise tax to 1.50 pesos per cigarette would raise public revenue by 49.3 percent, reaching 0.39 GDP points.
- The production chain of the tobacco industry has low interaction with other economic sectors.
- Investing the revenue from this new proposal to cover tobacco-related costs in the health sector would produce a net gain of 32,285 jobs across different sectors of the economy.
- Tobacco tax revenue can be allocated to improve the health and quality of life of those worst affected by smoking-related diseases (and COVID-19).
- Increasing the tax per unit to 1.50 pesos per cigarette would bring the total tax burden above the minimum recommended by the WHO. The new total tax burden would account for 76 percent of the retail price of 90.2 pesos per pack, with no major impact on macroeconomic variables (such as employment, imports, exports, etc.) in the country.

Executive summary

Smoking is a substantial health and economic burden in Mexico and places significant strain on public health services in a country where tobacco tax fails to meet these costs. The tobacco industry is a tiny sector of Mexico's economy that creates just 0.01 percent of jobs. Given the sector's share of the economy, an increase in tobacco tax would not result in significant job losses, and under certain conditions is likely to create jobs in other more dynamic sectors.

This research shows the macroeconomic impacts of tobacco taxation for the first time in Mexico. Specifically, the study estimates the impact of updating the specific component of tax on cigarettes in Mexico and raising tax to meet the WHO recommendation of a minimum total tax burden of 75 percent of the retail price within a general equilibrium framework, taking into account the effect on household tobacco consumption, government revenue, employment, and foreign trade.

An increase in the per-unit tax from 0.4944 pesos per cigarette, the rate introduced in January 2020, to 1.35 pesos would cause a 24.6 percent drop in tobacco consumption (from 57.779 to 46.596 billion pesos), while revenue from IEPS (excise tax on production and services) on tobacco would increase by 45.5 percent (an additional 946.8 million pesos). The Mexican economy would see a marginal fall in employment of 0.095 percent or 686 jobs. A second proposed reform, by which the per-unit tax would be increased from the baseline rate of 0.49 pesos to 1.50 pesos per cigarette, would result in a 26 percent reduction in consumption (from 57.779 to 46.223 billion pesos) and a 49.3 percent increase in revenue from tobacco (an additional 1.025,9 billion pesos). This new reform would cause a very small decline in employment, no greater than 0.102 percent (725 jobs). The analysis shows that these jobs could be quickly recovered through an active policy of investing this tax revenue into more productive sectors of the economy, for example the health sector. Allocating the funds to public health would result in a net gain of 32,285 jobs across the national economy.

The results show that the increase to 0.4944 pesos per cigarette, which went into effect in 2020, brought the total tax burden on cigarettes to 70 percent of the retail price, which had a moderate effect on consumption while the

impact on all other economic variables was minimal. However, a potential per-unit tax increase to 1.50 pesos per cigarette would raise the tax burden to 76 percent of the retail price (and a pack of cigarettes would retail at 90.2 pesos), just above the minimum total tax recommended by the WHO, which is 75 percent. The remaining key macroeconomic variables in Mexico would be largely unaffected, and as this research shows, any undesirable effect could be compensated for by using the additional tax revenue in more dynamic sectors of the economy.

The evidence from this research indicates that the selective tobacco tax reform introduced in January 2020 had no negative impacts on the Mexican economy and instead produced benefits in terms of revenue and public health. In light of the Mexican government's need to fund health care (and in the context of COVID-19), a proposal to increase the total tax burden on cigarettes above the WHO recommendation of 75 percent of the retail price would yield benefits for the Mexican economy as a whole. Therefore, this research first looks at an increase in tax to 1.35 pesos per cigarette (which would increase the tax burden to 75 percent of the retail price) and then examines an increase to 1.50 pesos (a tax burden of 76 percent).

The findings support the idea that tobacco tax reforms should earmark taxes to improve the health and hence the quality of life of the most vulnerable and those most affected by smoking-related diseases.

1. Introduction

In Mexico, smoking is a serious public health problem that kills approximately 43,000 people annually. According to the 2015 Global Adult Tobacco Survey (GATS), 14.3 million adults aged 15 and older in Mexico consume tobacco, which represents an increase in the prevalence of tobacco use from 15.9 percent to 16.4 percent between 2009 and 2015. In 2016, the prevalence of tobacco use in Mexico was 17.6 percent among those aged between 12 and 65 years (Reynales et al., 2017).

Taxing tobacco is the most effective policy to reduce cigarette consumption (WHO, 2010; Guerrero, 2010). The World Health Organization (WHO) recommends that the total tax burden for tobacco (the sum of VAT and excise taxes) account for 75 percent of the final retail price of a pack of cigarettes (WHO, 2015). Ideally, for the sake of efficiency, any excise tax reform for tobacco should focus on the specific component to achieve a greater reduction in consumption (Ranson, et al. 2000; WHO, 2010).

In Mexico, an update of the specific component of the excise tax on production and services (IEPS) came into effect on January 1, 2020, establishing a levy of 0.4944 pesos per cigarette and thus increasing the tax burden to 70 percent of the retail price. Huesca et al. (2020) estimate that this reform would increase tobacco tax revenue by 8 percent. Despite this, tobacco tax revenue remains insufficient to cover the financial burden that tobacco use currently imposes on the public health system. Moreover, tobacco tax revenue is still not earmarked for the purpose of tobacco-related health care costs.

In line with other evidence worldwide, tax increases in Mexico lead to lower consumption of tobacco products and greater public health benefits, while boosting revenue (Huesca et al., 2020; CIEP, 2020). One argument against tobacco taxation is the impact on the economy as a whole and on employment, even though there is no evidence supporting such idea (Warner, 2000; WHO, 2016). This study examines the characteristics of Mexico's tobacco industry and how it would react to potential reforms in tobacco taxation across the chain of production. This is important to estimate the full impact of tobacco tax on the economy and variables like output, employment, prices, sales, imports and exports, government revenue, and other related macroeconomic indicators. To the authors' knowledge, it is the first general equilibrium model for the tobacco sector in Mexico.

In particular, two scenarios are simulated. The first scenario simulates a reform consistent with the WHO recommendation that countries impose a total tax burden of 75 percent on cigarettes. The second is based on an initiative put forward in 2020 in the Chamber of Deputies by the Health and Treasury Commission, which would increase the specific excise tax on tobacco to 1.50 pesos per cigarette, thus raising the tax burden to 76 percent. Key findings include a 24 percent reduction in tobacco consumption and minimal effects on employment in the first scenario, with a change of -0.068 percent in total employment and no other sector experiencing a loss of employment greater than one percent. The second scenario results in a 26 percent fall in consumption and the marginal impacts across the remaining macroeconomic variables.

Even more importantly, a second simulation exercise assumed that all tobacco tax revenue is allocated to the public health sector as a subsidy. In this case, the small negative impact on employment would be reversed in the vast majority of sectors, and, in the aggregate, this would produce a significant net gain in jobs. These findings point to another potential benefit of introducing increases in tobacco tax as they reduce consumption and raise more revenue with no adverse impacts on key macroeconomic variables.

Section 2 summarizes the key features of the tobacco industry in Mexico in recent years and the context in which it operates. Section 3 describes the tobacco industry in the Mexican social accounting matrix (SAM). Section 4 outlines the main characteristics of the model used. Section 5 discusses the consequences of taxing tobacco in line

with the WHO recommendation (according to which countries should impose a total tax burden of 75 percent) and the initiative proposed in the Congress of the Union and the Chamber of Deputies in 2020 (Cámara de Diputados, 2020) in terms of demand for tobacco and employment, both in the aggregate and by sector. Section 6 explores the effect when tobacco tax revenue raised is allocated to the health sector. Lastly, section 7 discusses the chief implications of the model and offers the main conclusions of the research and public policy recommendations.

2. The tobacco sector in Mexico

The tobacco industry is a relatively small sector of the Mexican economy. This section presents the main characteristics of the sector in terms of production, consumption, revenue, and employment. The information presented here is then used as an input for the SAM and the general equilibrium model. This section briefly describes the tobacco sector in Mexico (for both unmanufactured and manufactured tobacco) and outlines the current tax structure for cigarettes.

Tobacco cultivation and production (unmanufactured)

Tobacco accounts for a relatively minor share of Mexico’s agricultural sector. For a decade, the total area devoted to growing tobacco has remained stable at 0.04 percent, on average, of the total area under cultivation. In 2008, tobacco crops occupied 5,900 hectares, a figure that had increased to 6,600 by 2018 (see Table 2.1), when tobacco production stood at 15,181 tons (a 32 percent increase with respect to 2008). In 2018, Mexico was ranked as the seventh largest producer in the Americas, behind Brazil, United States, Argentina, Cuba, Guatemala and Canada¹.

Table 2.1. Tobacco cultivation area and production in Mexico

Year	Total area under cultivation (millions of hectares)	Tobacco cultivation		Tobacco production (tons)
		(thousands of hectares)	(%)	
2008	16.4	5.9	0.04	11,442
2009	14.7	4.3	0.03	7,822
2010	16.2	4.0	0.02	6,983
2011	14.2	4.5	0.03	9,648
2012	16.0	7.0	0.04	15,235
2013	16.2	7.4	0.05	15,145
2014	16.8	7.3	0.04	15,119
2015	16.5	6.7	0.04	12,999
2016	16.7	7.0	0.04	15,864
2017	16.5	7.5	0.05	17,243
2018	16.1	6.6	0.04	15,181

Source: Authors’ calculations based on FAOSTAT, 2020.

¹ In 2018, the world’s five largest producers of tobacco were China, Brazil, India, the United States, and Indonesia, together accounting for 68 percent of global production (FAOSTAT, 2020).

From 2009 to 2011, tobacco producers attempted to transition toward other high-profitability crops through the Productive Restructuring Program (*Programa de Reversión Productiva*), which the federal government promoted in accordance with WHO Framework Convention on Tobacco Control (FCTC) policies. Consequently, and despite the 2011 introduction of a tax reform that raised the specific component of the excise tax on production and services (IEPS), as explained below, an uptick in tobacco production (15,235 tons) can be observed from 2012, with production close to decade-high levels.

Value of manufactured tobacco output and the industry wage bill

The tobacco manufacturing sector in Mexico is one of the smaller industries in terms of economic units, value added, and employment. According to economic censuses (ECs), establishments in the tobacco industry account for less than 0.1 percent of economic units both nationally and in the manufacturing sector (see Table 2.2). Similarly, the tobacco industry represents less than one percent of the total value of domestic production, while its share of the manufacturing industry reached only 1.08 percent in its highest year, 2013. Furthermore, the tobacco sector employs just 0.01 percent of workers nationally and 0.05 percent of workers in the manufacturing sector.

Table 2.2. Share of the tobacco industry in production and employment

Year	Economic units		Gross value added (GVA)		Working population (thousands of workers)	
	% of national total	% of manufacturing sector	% of national total	% of manufacturing sector	% of total employment	% of manufacturing sector
1998	0.021	0.022	0.7118	0.9775	0.14	0.21
2003	0.002	0.018	0.0004	0.0012	0.03	0.13
2008	0.001	0.011	0.0005	0.0019	0.02	0.09
2013	0.001	0.010	0.3137	1.0814	0.01	0.06
2018	0.001	0.008	0.2753*	0.9488*	0.01	0.05

*Note: Adjustment of national GVA and manufacturing sector GVA based on the economic growth rate and assuming that GVA in tobacco remained the same in real terms.

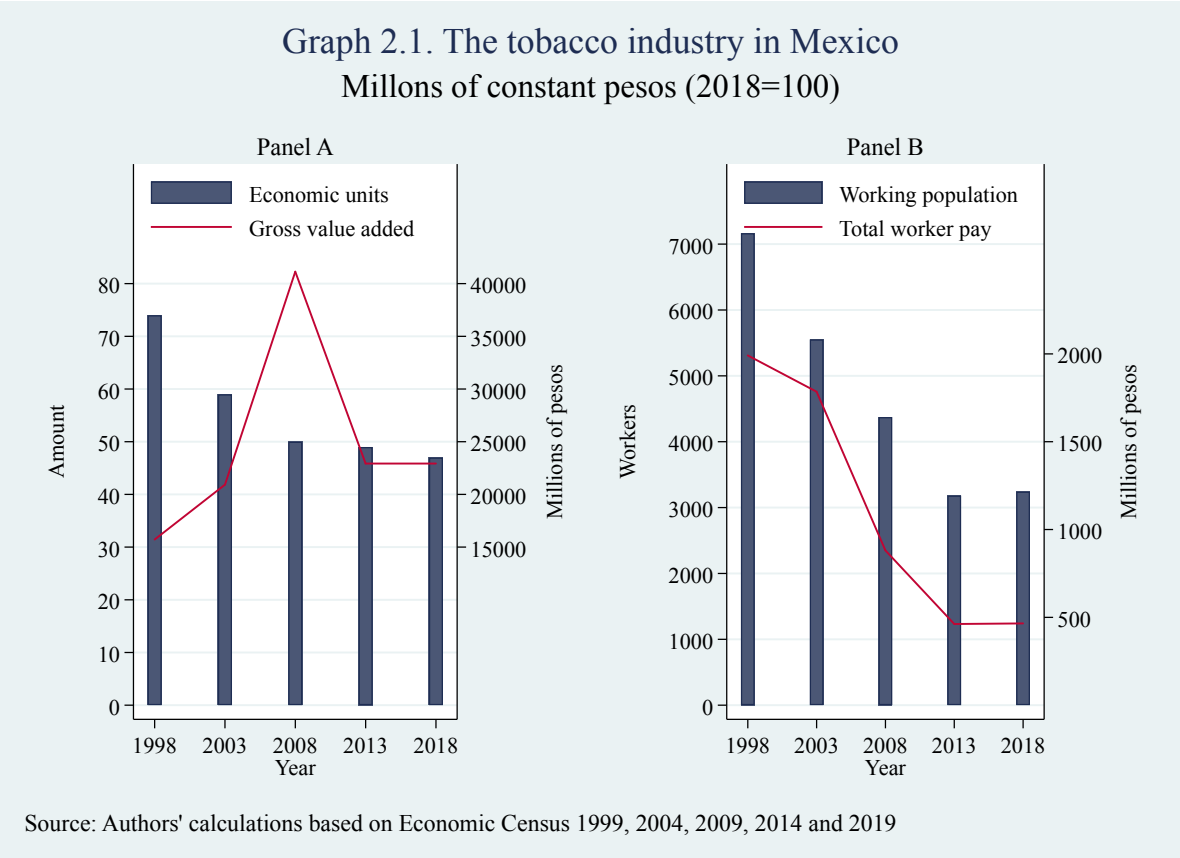
Source: Authors' calculations based on 1998, 2003, 2008, 2013, and 2018 economic censuses.

Similar to other countries, the tobacco manufacturing industry is small in Mexico and is currently undergoing a process of consolidation. This same finding was observed comprehensively at the international level across a wide range of countries by Mirza, Rodríguez-Iglesias, and Blecher (2019). In the late 1990s, the tobacco industry reduced the number of economic units devoted to production, while the value of aggregate output jumped from 15 to 40 billion pesos in constant 2013 values. Panel A in Graph 2.1 shows a 32 percent decrease in economic units in Mexico in the 1998–2008 period (from 74 to 50, respectively).

While the number of companies producing tobacco remained largely unchanged, from 2008 a fall was observed in the value of production. This decline may be driven by two factors: 1) the international crisis in 2008, which in Mexico was felt more strongly in 2009; and 2) the failure of the tobacco cultivation restructuring process in Mexico between 2009 and 2011.

Graph 2.1 shows that the reduction in the number of economic units resulted in fewer jobs. While both the working population and total wage bill in the industry fell dramatically, the roots of this decline in jobs and the wage bill for the sector can be traced back another decade. In 1998 the tobacco industry employed approximately 7,000 workers, who earned a total of 2 billion pesos, which represented just 5 percent of the gross value added (GVA) in the census. In 2008, the industry generated around 4,400 jobs, while its wage bill dropped to 880 million pesos.

This trend continued in 2013 and 2018, with around 3,200 workers and a lower wage bill. These cutbacks in the labor factor and the fact that labor accounts for a lower share of profit distribution point to the existence of technological change in the sector to the detriment of workers.



In sum, the tobacco industry in Mexico has concentrated production into fewer economic units, with a relative decline in the gross value of its output, which has translated into a fall in total compensation paid for labor.

Import and export of cigarettes in Mexico

Mexico has a trade surplus in cigarettes. In the period examined, from 2010 to 2019, a downward trend was observed in cigarette exports, while cigarette imports reached their lowest level in 2015 (3.19 tons), followed by an upturn to levels similar to 2010. Furthermore, in 2019 the basic efficiency of the ratio between monetary value and trade volume in tons was very similar and close to one (0.9647 for exports and 0.9641 for imports). These numbers indicate that imported tobacco is not much more expensive than tobacco produced domestically.

In Mexico cigarette imports are subject to a tariff of 67 percent, and cigarettes are exempt from export duty. In 2019, 70 percent of the value of exports served the Canadian market, 15 percent the Colombian market, and 11

percent other Central American markets (Guatemala, Costa Rica, Nicaragua, El Salvador, Honduras, and Panama). Most imports, on the other hand, came from the United States (37 percent), Ukraine (31 percent), and Turkey (16 percent).

Table 2.3. Volume and value of cigarette imports and exports in Mexico
Millions of constant US dollars (2018=100)

Year	Exports		Imports	
	Tons	\$	Tons	\$
2010	246.94	337.04	12.65	17.27
2011	248.97	328.73	9.33	12.31
2012	256.42	325.05	10.22	12.96
2013	248.36	303.32	5.66	6.91
2014	203.23	238.64	4.17	4.90
2015	171.96	196.46	3.19	3.65
2016	161.70	179.76	5.51	6.13
2017	173.00	181.48	7.59	7.96
2018	188.81	188.80	10.36	10.36
2019	185.43	178.79	10.79	10.41

Source: Authors' calculations based on the Secretariat of Economy's Online Tariff Information System (SIAVI), 2010-2019.

Domestic cigarette consumption

The household surveys reveal a pattern of consumption in which although fewer households purchase tobacco, their mean monthly cigarette consumption is greater. In 2010, 1.9 million Mexican households reported expenditure on tobacco, a figure that dropped to 1.8 million by 2018. This means prevalence declined from 6.8 percent to 5.2 percent, respectively (see Table 2.4). Average consumption increased from 192 to 204 cigarettes a year (equivalent to 9.6 and 10.2 packets of 20 cigarettes, respectively), while average monthly expenditure dropped from 374 pesos to 339 pesos, which may suggest a cheaper tobacco market over the 2010–2018 period.

Table 2.4. Households with expenditure on cigarettes in Mexico

Year	Households		Average cigarette consumption	Average monthly expenditure (pesos)
	Tobacco-consuming	% of national total		
2010	1,996,661	6.8	191.96	374.56
2012	2,356,522	7.5	225.23	445.46
2014	1,838,396	5.8	195.65	406.83
2016	1,861,014	5.6	194.41	374.09
2018	1,805,283	5.2	203.8	339.13

Source: Authors' calculations based on INEGI (2020a).

Tax structure and revenue from IEPS on tobacco

In Mexico, cigarettes and other tobacco products are subject to two indirect taxes: value-added tax (VAT) and the excise tax on production and services (IEPS). Since its introduction in 1980, IEPS has been levied *ad valorem*, but the tax structure underwent a significant change in 2010 when, for the first time, a specific component of 0.04 pesos per cigarette was introduced. The following year saw the approval of a substantial increase of this specific component to 0.35 pesos, which remained unchanged from 2011 to 2019. The most recent reform of the specific component of IEPS provided for an adjustment in line with annual inflation over the period, setting the rate at 0.4944 pesos per cigarette and thus increasing the total tax burden (VAT and IEPS) on tobacco from 67 to 70 percent of the retail price. This remains below the 75 percent recommended by the WHO.

Table 2.5. Income from excise taxes in Mexico (2010–2020)
Millions of constant pesos (2018=100) and percentage of GDP

Year	Total IEPS		IEPS on prepared tobacco	
	\$	% of GDP	\$	% of GDP
2010	6,321.20	-	38,128.90	0.20
2011	-102,262.10	-0.5	40,596.00	0.20
2012	-167,303.30	-0.8	42,974.30	0.20
2013	-9,400.60	-	43,297.60	0.20
2014	135,387.20	0.6	41,874.70	0.20
2015	417,979.30	1.9	43,521.80	0.20
2016	460,570.30	2.0	42,651.50	0.20
2017	386,104.20	1.7	41,066.80	0.20
2018	347,435.50	1.5	41,451.80	0.20
2019	443,894.00	1.9	40,952.50	0.20
2020*	488,941.42	2.1	45,047.42	0.22

*Note: Estimated

Source: Authors' calculations based on Federal Public Treasury Accounts 2000–2019 (SHCP, 2020) and GDP implicit price indices, base year 2018, INEGI, 2010–2019.

From 2013, IEPS reforms in Mexico focused on increasing tax rates on goods other than tobacco. As a result, although aggregate revenue from excise taxes increased in the 2014–2019 period, this was mainly due to an increase in the consumption of high-calorie foods and the elimination of Mexico's gasoline subsidy.² Revenue from IEPS on tobacco, however, has remained constant at 0.20 percent of GDP since 2010. Thus, the share of tobacco taxes in total IEPS revenue decreased, dropping from 31 percent in 2014 to 9 percent in 2019 (see Table 2.5). With the reform of cigarette taxes that came into effect in 2020, IEPS revenue from tobacco is expected to rise to 0.22 GDP points (Huesca et al., 2020).

² Subsidizing gasoline at this level produced a negative tax balance as it was a heavy strain on Mexico's public treasury.

3. Intersectoral relations in Mexico's tobacco industry: social accounting matrix

Drawing from the primary information in the SAM, data was obtained to input into the applied general equilibrium model (AGEM), and this data made it possible to identify the structure of the tobacco industry in Mexico and its relationship with other sectors of the economy. Table 3.1 shows that the gross value of output (GVO) is 25.114 billion pesos (in 2013), of which 75.6 percent is the value added by the industry itself, 24.3 percent is intermediate consumption, and 0.1 percent is taxes paid by the industry.

Table 3.1. Cost structure of the tobacco industry in Mexico, 2013

	Tobacco industry	
	Millions of pesos	%
Agriculture	446	7.3
Industry	1,568	25.7
Services	2,623	43.0
Tobacco	1,462	24.0
A. Intermediate consumption	6,098	24.3
B. Value added	18,989	75.6
C. Taxes	27	0.1
D. Total output	25,114	100.0

Source: Authors' calculations using the SAM from National Account System statistics, 2013.

As far as demand for intermediate goods is concerned, the tobacco industry purchases 24 percent of goods from itself, while 43 percent comes from the services sector, 25 percent from other industrial sectors, and only 7.3 percent from the agricultural sector.

3.1 Share of wages and consumption in the tobacco industry

The SAM provides data to determine the wages paid to the sector as well as household expenditure on tobacco in the country. This information makes it possible to examine how households put this money back into the system through expenditure on other products and services. Table 3.2 shows wages and pay received by workers in cigarette production as well as final private consumption of cigarettes across the economy.

In line with the previous section, tobacco industry wages (i.e., the wage bill) account for a small percentage of the total output of the Mexican economy (1.13 percent). This figure is low compared to the other 26 sectors considered in the analysis of the Mexican economy. Mexico is no outlier, as this is similar to figures observed in other countries (for instance, Pakistan, as reported by Ghaus et al., 2018).

As a share of total private household consumption across the whole economy, private consumption of tobacco is even lower (0.53 percent). This reflects lower domestic consumption in the tobacco industry than other sectors.

Table 3.2. Share of pay and wages in the tobacco industry in Mexico (millions of pesos)

Categories	2013 value
Wages	284
Total output of tobacco sector	25,114
Wages as share of total output of Mexican economy	1.13%
Household expenditure on tobacco*	57,799
Total household expenditure	10,878,000
Tobacco expenditure as share of total household expenditure	0.53%

*Note: Including taxes.

Source: Authors' calculations using the SAM from National Account System statistics, 2013.

Two aspects are worth highlighting. Firstly, the tobacco sector is the smallest of all the sectors examined in terms of GVO and employment (see Tables 3.3 and 3.4). The tobacco sector has a GVO of 25.114 billion pesos, just 0.09 percent of the total GVO of the Mexican economy (see Table 3.3). Note that commercial sectors jointly account for as much as 45.5 percent of GVO (other services, commerce, financial services, and transportation).

Table 3.3. Gross value of output in Mexico (millions of pesos)

Rank	Sector	\$	%
1	Other services	4,708,358	17.0
2	Commerce	3,402,433	12.3
3	Financial services	2,846,003	10.3
4	Construction	2,151,668	7.8
5	Oil	2,016,284	7.3
6	Transport equipment	1,833,942	6.6
7	Transportation	1,632,047	5.9
8	Food	1,609,171	5.8
9	Electrical machinery	1,443,653	5.2
10	Agriculture	780,161	2.8
27	Tobacco	25,114	0.1

Source: Authors' calculations using the National Account System statistics, 2013.

Total worker pay in the industry is just 284 million pesos, making it the sector with the lowest wage share in the SAM. The tobacco sector represents only 0.007 percent of total wages in the economy, while commercial sectors account for 72 percent. This places the tobacco sector last in order of importance (see Table 3.4).

**Table 3.4. Worker pay in the Mexican labor market
(millions of pesos)**

Rank	Sector	\$	%
1	Other services	1,875,139	51.38
2	Commerce	359,071	9.84
3	Construction	317,574	8.70
4	Transportation	249,326	6.83
5	Financial services	143,951	3.94
6	Electrical machinery	118,062	3.24
7	Agriculture	81,548	2.23
8	Gas, water, and communications	68,955	1.89
9	Transport equipment	65,706	1.80
10	Food	63,047	1.73
27	Tobacco	284	0.01

Source: Authors' calculations using the National Account System statistics, 2013.

Secondly, the tobacco sector has very limited interaction with other sectors (see Table 3.5), with intermediate sales accounting for 6.3 percent of output; the bulk of production (93.7 percent) is sold as final sales. This is very important to understand the results as the way in which household consumption responds to changes in (tobacco) prices is critical in explaining changes not just in demand for tobacco but also household expenditure on other goods.

In other words, demand for tobacco products in Mexico plays a decisive role. Any impact analysis based on input-product models or any analysis in which prices are determined solely by supply fail to factor in the effect of demand on the Mexican economy. In an AGEM, supply and demand interact, making it possible to consider not just production costs and interdependence between sectors, but also the effects of changes in final demand.

**Table 3.5. Sales in the tobacco sector in Mexico
(Millions of pesos)**

Sales	\$	%
Intermediate	1,493	6.3
Final	22,322	93.7

Source: Authors' calculations using the National Account System statistics, 2013.

4. Methodology

To understand the effects of tobacco taxation in Mexico, this report employs an applied general equilibrium model (AGEM) and simulates potential tax reforms. These models have traditionally been used to evaluate tax reforms because they make it possible to estimate changes not only in the industry in question (in this case, the tobacco industry) but also in other sectors of the economy. Also, AGEMs incorporate the demand side of the economy, enabling the evaluation of effects on consumption as well as production. Moreover, with a model of this kind it becomes possible to evaluate the effects of tax reforms on variables like employment, production, prices, sales, imports and exports, and public revenue, among other macroeconomic indicators.

Due to the nature of the data available in Mexico, the model cannot distinguish between the primary and tobacco manufacturing sectors. Hereinafter this report will use the term “tobacco sector” to refer to the concept of manufacturing tobacco.

In Mexico, AGEMs have been used to analyze trade liberalization, climate change, and redistribution and anti-poverty policies, among other issues (see Dávila et al., 2018). However, there are few studies that use the AGEM technique to discuss tax reform; notable contributions are those of Kehoe and Serra (1983) and more recently Sobarzo (2011). In this context, this analysis of tobacco taxation in Mexico with the AGEM technique is, to the authors’ knowledge, the first attempt to analyze various tax alternatives and evaluate not just the effects on public revenue but also the resulting macroeconomic impacts.

The general characteristics of the model, as adapted to the Mexican economy, are as follows:

1. **Level of aggregation:** The AGEM includes a total of 27 production sectors, each sector producing a single commodity (principal product criterion), a part of which is intended for the domestic market, with the remainder being exported (see Table A.1 in Appendix A). Of these 27 sectors, 21 are tradable while the remaining 6 sectors produce services mainly for domestic markets.
2. **Dimensions:** The model includes two factors of production, capital and labor, which are mobile between sectors. The model assumes that capital is fully employed and therefore its price adjusts to equilibrate the market. On the labor market the AGEM assumes that the cost of labor (wages) is fixed, and hence employment (endogenous unemployment) adjusts to equilibrate the market. It is assumed that there is one representative consumer and one rest of the world (ROW).
3. **Production:** All production activities combine (composite) intermediate inputs in fixed proportions, yet composite goods combine with some degree of elasticity of substitution between domestic and foreign goods. Sectors also combine labor and capital by means of a Cobb-Douglas (CES) production function to generate added value (net output), which in turn combines in fixed proportions with the aggregate of intermediate inputs (see Figure A.1 in the appendix). In the model, the price of labor is fixed and quantity adjusts to equilibrate the market.
4. **Foreign trade:** Each sector produces a share for domestic markets and exports the remainder to the rest of the world (ROW). Exported commodities face a downward-sloping demand curve that depends, among other things, on price elasticity of demand. On the import side, the small country assumption was adopted and domestic and foreign commodities were considered imperfect substitutes, as per the Armington assumption. The numeraire was chosen by setting the consumer price index at one.

5. Final demand: There is a single representative consumer that demands goods according to a Cobb-Douglas utility function. The same assumption is adopted for government and investment behavior.
6. Government income: The social accounting matrix (SAM) incorporates the full tax system of the Mexican economy: production taxes, the IEPS excise tax on sales, value-added tax (VAT), and income tax (known as ISR).

4.1 Data

A SAM was constructed for the Mexican economy using information from the System of National Accounts (SCN, in Spanish), which publishes figures. In the SCN, each branch of production encompasses a highly diverse range of companies and goods. Therefore, although the value of the output for each branch is known, this figure cannot be broken down into prices and quantities. The AGEM requires us to break figures down into prices and quantities for the functions used (for example, the demand function). This is dealt with in the general equilibrium as follows. Let V be the value, P the price, and Q the quantity, giving us:

$$V = P*Q,$$

and since in our matrix we only know the value of V , we assume that $P = 1$, and thus

$$V = (1)Q,$$

such that if we assume that for all goods and factors $P = 1$, then the values are equal to the quantities (the numeraire was chosen by setting the consumer price index at one).

In carrying out a simulation (e.g., a tax on one or more goods), prices and quantities change iteratively until a new equilibrium is found, on the basis that in all markets supply should equal demand³.

Described below is an example to illustrate how this model works and can be interpreted with respect to tobacco, with an increase in taxes that results in a 35 percent price increase in tobacco products. This example is used to explain, briefly, the values produced by the model.

In the baseline scenario (before simulating the tax), the value of household tobacco consumption in the SAM stood at 57,799 billion 2013 pesos (Table 3.2). This can be interpreted as “before the tax increase, households demanded 57,799 billion units of tobacco at one peso each.” Now, as a result of a higher tax, prices and quantities across all markets change until a new equilibrium is found. If we assume a 35 percent increase in prices, to understand the change in quantities, it is necessary to calculate the nominal values of the solution SAM in constant prices (certain prices exist in the baseline scenario and these prices change in the solution scenario). In other words, once nominal values are converted in the solution SAM into real values, we obtain the changes in quantities. In tobacco

³ Note that each sector (good) is the aggregate of perhaps hundreds of industries (goods), but in our model, households demand a single good, for example “transport equipment”, which includes the output of many industries but which, in our model, is treated as only one good.

example, the value in constant prices is 43,858, meaning that as a result of the tax, the price to the consumer increased by 35 percent and the quantity of “tobacco”⁴ demanded by consumers fell by 26 percent.

5. Analysis of results: revenue raised is allocated in the same proportion

5.1 Effects by sector

The general equilibrium model shows that the tobacco tax increase results in tiny changes both at the sector level and in the aggregate, with variations between sectors of the Mexican economy. The spillover effects are as expected: very small in absolute terms in total employment in the country and by sector. Appendix B.1 presents the results for employment, broken down by economic sector.

The model analyzes both supply and demand, and in Mexico this is important because 93.7 percent of total sales in the tobacco sector are final, with intermediate sales accounting for just the remaining 6.3 percent. In other words, one major determining factor of the final impacts in the results is the change in consumer demand and government spending. The production chains of Mexico’s tobacco industry play only a very marginal role in the remaining economic sectors.

In a scenario in which the government continues to spend the additional revenue on the same goods – that is, a scenario in which the government’s expenditure pattern remains unchanged – the sectoral impacts are very low in all cases, given that, with the exception of the tobacco sector, no negative impact greater than one percent is observed in either reform scenario. In the tobacco sector, employment falls by 21.3 percent (around 693 jobs if percentages are calculated with figures from the 2018 economic census) in the first scenario and 22.6 percent in the second (just 726 jobs).

With the exception of electricity and financial services, private expenditure contracts for the all other goods (no impact on expenditure is observed for minerals and construction). This fall in expenditure across most sectors of the Mexican economy largely explains the slight contraction in employment in nearly all sectors (Table 3.5). The near-total lack of interaction means that most change in sectoral employment is due to the impact of tobacco tax on household expenditure, which is reflected not just in final demand for tobacco but also final demand for other goods. Table B.2 shows how private household expenditure adjusts in response to an increase in tobacco tax. It is also important to highlight the fact that government expenditure increases as a result of greater tobacco tax revenue, which creates employment in different sectors, partially offsetting the effect of the decrease in private spending.

It is therefore necessary to conduct an additional empirical exercise in the sector or branch of activity in which the revenue obtained is spent, in order to calculate the benefit of offsetting this minor loss of employment in other economic sectors. One key sector in this regard is health care, and it is this empirical exercise that is presented in Section 6.

⁴ In these models, aggregation is a problem that becomes more significant the larger, or the more aggregated, an industry or good is in the model. Fortunately, with tobacco this is not a serious problem as the industry includes a relatively small number of products, many of which are very similar to each other.

5.2. Aggregate effects

In a scenario in which the government continues to spend the additional revenue on the same goods – in other words, without changing its expenditure pattern – the effect on key macroeconomic variables is very small. The effect on global employment is marginal, in the order of -0.095 and -0.102 percent for scenarios 1 and 2, respectively⁵ (Table 5.1). The aggregate effects on other macroeconomic variables are also minimal and in no case exceed one percent. In particular, foreign trade flows – total imports and exports in the economy – exhibit a very small change of -0.026 and -0.028 percent, which can largely be explained by changes in private household spending. Similarly, aggregate employment in the country sees a decline of -0.095 and -0.102 percent, respectively, for scenarios 1 and 2. Total tax revenue increases by 0.081 and 0.084 percent, respectively, meaning that a tobacco tax increase results in an increase in total tax revenue. In turn, this means that the fall in revenue resulting from the drop in expenditure in other sectors is more than offset by the increase in revenue from IEPS on tobacco.

Table 5.1.
Aggregate impacts of tobacco tax in Mexico (percentage change)

Variable	Scenario 1 (\$1.35)Δ%	Scenario 2 (\$1.50)Δ%
Exports	-0.026	-0.028
Imports/*	-0.017	-0.019
Employment	-0.095	-0.102
Price in wages	0	0
Price in capital	-0.001	-0.002
Tax revenue	0.081	0.084

Note: * With no substitution effect.

Source: Authors' calculations using the results from the model and SAM from national accounts, INEGI, 2013.

As a result of the higher tax, the retail price of tobacco increases by 32 and 35 percent respectively. This leads to a fall in household demand for tobacco of 24.6 and 26 percent, respectively (Table 5.2).

⁵ The AGEM assumes that wages remain unchanged (fixed), so employment adjusts to achieve equilibrium in the labor market. In this case, employment declines only very marginally. In the capital market, on the other hand, the AGEM assumes that the amount of capital is fixed and to achieve equilibrium it is the price of capital that changes, exhibiting a small decline of -0.001 and -0.002 percent (see Table 5.1).

**Table 5.2. Impact of tobacco tax in Mexico
(percentage change)**

Indicator	Δ Scenario 1 (\$1.35)	Δ Scenario 2 (\$1.50)
Final consumption of tobacco	-24.6	-26.0
Retail price	32.0	35.0
Manufacturer sales	-21.2	-22.4
Tobacco exports	0.005	0.005
Tobacco imports*	-24.3	-25.7
Employment in the sector	-21.3	-22.6
Tax revenue associated with the tobacco industry	45.5	49.3

Note: * With no substitution effect.

Source: Authors' calculations using the results from the model and SAM from national accounts, INEGI, 2013.

Note that the decline in manufacturer sales is not equal to the decline in household demand. This can be explained by the fact that manufacturer sales are measured net of consumer taxes, while household consumption is recorded at market prices, therefore including consumer taxes.

Tobacco imports decrease by 24.3 and 25.7 percent, but this is due to the fact that the tobacco tax is payable not just on domestic production but also on tobacco imports, so there is no substitution between domestic and imported tobacco.

Table 5.3 shows these changes in absolute terms and 2018 values.⁶

**Table 5.3. Impacts on the tobacco sector in Mexico
(absolute change)**

Variable	Unit of measurement	Δ Scenario 1 (\$1.35)	Δ Scenario 2 (\$1.50)
Final consumption of tobacco*	Thousands of packets	-491.7	-519.8
Tobacco exports	Thousands of dollars	9.4	9.4
Tobacco imports**	Thousands of dollars	-2,525.5	-2,669.4
Employment in the sector	Jobs	-693.1	-726
Tax revenue associated with the tobacco industry	Millions of dollars	946.8	1,025.9

Note: * The change in annual consumption is the total number of packets no longer purchased by all daily smokers as a result of the impact of the tax. ** With no substitution effect.

Source: Authors' calculations using ENCODAT 2017; the 2018 economic census, and the SAM from national accounts, INEGI, 2013.

⁶ The SAM pertains to 2013. The percentage changes obtained in the AGEM are used together with data from the 2018 economic census to show the changes, in absolute terms, of some relevant variables in 2018 values.

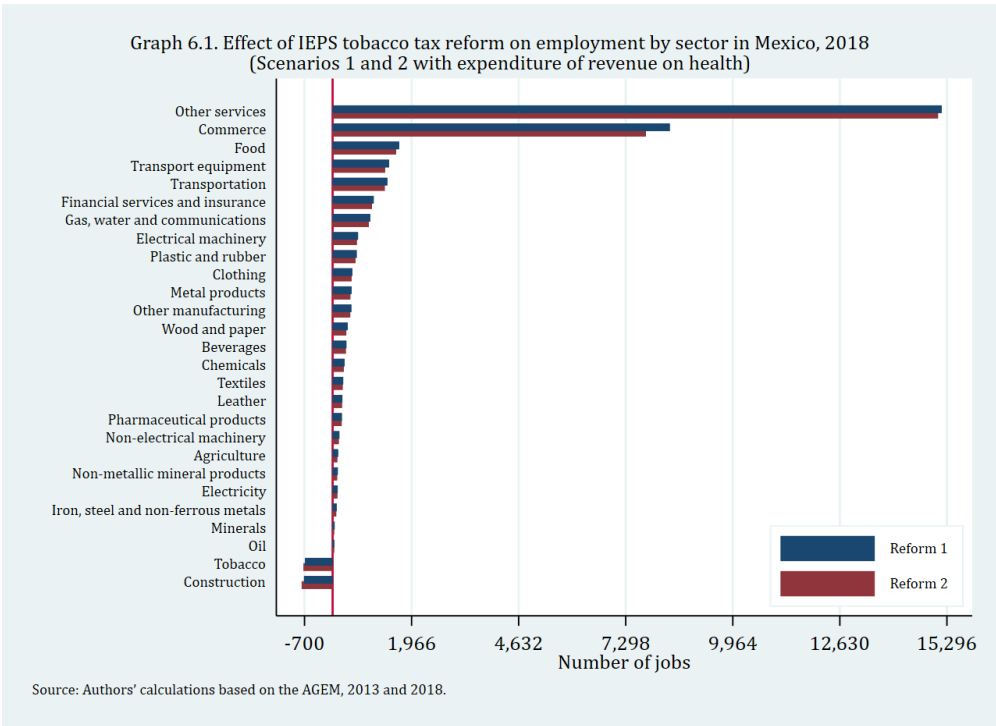
In sum, the main finding is that an increase in tobacco tax has very little impact on employment, partly due to the limited number of jobs in the tobacco sector compared to other sectors and partly because there is no significant interaction with the remaining sectors of the economy. Most effects are the result of adjustments in household expenditure and the proportion of household and government spending.

6. Analysis of results: health sector subsidy

Like in the previous exercise, scenarios 1 and 2 have been simulated, but this time assuming that all revenue from these tax reforms is allocated to the public health sector as a subsidy. In order to gain a clear insight into the impacts of these fiscal policies, their impacts on relevant economic indicators are determined in terms of employment, exports and imports, and domestic consumption once all revenue raised by the government is allocated to certain goods or sectors by way of a cash transfer or subsidy.

6.1 Sectoral effects

The sectoral effects on employment are much more varied than in the previous exercise (Table B.3 in Appendix B). According to scenario 1, only 2 of the 27 sectors experience a loss of employment: construction (-713 jobs) and tobacco (-686 jobs). The remaining 25 sectors help to create jobs, with the greatest impact observed in the “other services” sector (which includes all the subsectors in the health care field), where 15,167 new jobs are generated. In the aggregate, and based on the 2018 economic census, there is a global net gain of 33,725 jobs. Graph 6.1 illustrates the sectoral adjustments in employment, taking into consideration percentage changes in the model and applying them to the 2013 and 2018 economic censuses to gain an idea of the extent of the changes between the two years.



As a result of the high impact on branches of the economy associated with “other services” (which include health care services like hospital services and, to a lesser extent, other areas like education, social welfare, business support, waste handling and housing), increases are also observed in commerce (8,396 new jobs), the food sector (1,659 new jobs), transportation and activities associated with financial services (1,363 and 1,023, respectively). They are followed by other sectors with substantial job growth as a result of this fiscal policy: transport equipment (1,407 new jobs); gas, water, and communications, with 938 jobs; plastic and rubber and electrical machinery (with 1,232 jobs between them); clothing (492 jobs), beverage production, pharmaceuticals and other manufacturing (1,038 jobs between them). These are followed by sectors where jobs are created to a lesser extent: metal products, leather, textiles, chemicals, electricity, and non-electrical machinery. Together, all these sectors see a total of 1,572 new jobs.

Summarizing results in scenario 2 (table B.5 in Appendix B) the sectors that would experience a negative impact in terms of job creation are the tobacco sector itself (-725 jobs) and the construction sector (-771 jobs). In total, 1,496 jobs would be lost, in comparison to 33,781 jobs gained (a net gain of 32,285 jobs).

The greatest positive impact in terms of job creation as a result of fiscal policy and the allocation of funds to health care was observed in the health sector itself and in commerce, where most jobs were generated (Graph 6.1).

Like in the exercise described in Section 5, when revenue raised by the government is allocated to the health sector through subsidies paid out to households, the sectoral impacts on employment can be largely explained by changes in household expenditure and the proportion of household and government spending. Household expenditure expands in all sectors (except tobacco) and government expenditure is reduced in the four sectors it interacts with (wood and paper; gas, water and communications; financial services; and other services⁷) (Table B.4).

This expenditure by households on the health sector has a knock-on effect, with a greater positive impact across a range of sectors associated with hospital services and commerce, which are labor-intensive and as a result increase net employment in the Mexican economy (see Tables B.3 and B.5 in Appendix B).

6.2 Aggregate effects

The aggregate effect of the tax increase remains small even when the resulting revenue is channeled into health care. Employment across the economy as a whole increases by 0.12 percent in both scenarios (Table 6.1). Both exports and imports undergo changes of less than one tenth of a percentage point, at 0.034 and 0.033 percent in the first scenario and 0.021 and 0.02 percent in the second.

⁷ Government allocation of funds to healthcare takes the form of a production subsidy for the health sector, resulting in lower prices for healthcare goods.

**Table 6.1. Aggregate impacts of tobacco tax in Mexico
when revenue is transferred to the health sector as a subsidy
(percentage change)**

Variable	Scenario 1 (\$1.35)Δ%	Scenario 2 (\$1.50)Δ%
Exports	0.034	0.033
Imports/*	0.021	0.02
Employment	0.123	0.119
Price in wages	0	0
Price in capital	-0.001	-0.001
Tax revenue	-1.491	-1.509

Note: * With no substitution effect.

Source: Authors' calculations using the SAM from national accounts, INEGI, 2013.

One difference with respect to the scenario in which resources continue to be allocated in the same proportion as before the tax increase is that, when revenue is allocated to health care, public revenue falls by -1.49 percent in scenario 1 (specific tax component of 1.35 pesos per cigarette), whereas in scenario 2 (with a specific component of 1.50 pesos per cigarette), public revenue falls by -1.51 percent.⁸ These small decreases in public income can be explained by the transfer of resources to the health sector. The health sector subsidy results in a very different household expenditure adjustment pattern both in the private expenditure vector and in the proportion of household and government spending.

A very similar decline in tobacco consumption is observed in both scenarios, at 24.5 and 26 percent with tax reforms that increase the tax burden on packets of cigarettes to 75 and 76 percent respectively. As far as the international trade of tobacco is concerned, without considering the substitution effect in the product, the effects on exports are negligible, with changes not exceeding 1 percentage point, while a 24 and 25 percent change in imports is observed in each of the two reforms, respectively (Table 6.2).

Lastly, revenue increases by 45.5 percent and 49.3 percent with each reform. This has shown that the 1.50-peso reform generates more revenue and is much more efficient than the first scenario. This would raise even more funding for public health in Mexico.

It should also be noted that an applied general equilibrium model (AGEM) appears to be well suited to analyzing this phenomenon, as the bulk of the impacts on the tobacco sector and the remaining sectors are the result of changes in household expenditure and not necessarily linkages between sectors, whereas with input-product models, for example, prices are determined solely by supply. Their use is even more surprising if we consider that fiscal reform has been the subject of ongoing public debate in Mexico for decades and that AGEMs were originally designed precisely to analyze tax reforms.

⁸ The new effect on total revenue in the country is likely explained by a crowding-out effect due to intersectoral relations in which companies associated with sectors within healthcare that have benefited from demand for services have adjusted their expenditure as a result of the subsidy granted, and by a general decrease in private companies operating in the health sector, which may be causing lower tax payments as part of the expenditure adjustment.

Table 6.2. Impacts of the tobacco tax on the tobacco sector in Mexico when revenue is transferred to the health sector as a subsidy (percentage change)

Variable	Δ% Scenario 1	Δ% Scenario 2
Final consumption of tobacco	-24.550	-25.954
Tobacco exports	-0.058	-0.059
Tobacco imports/ *	-24.290	-25.681
Employment in the tobacco sector	-21.147	-22.367
Revenue associated with the tobacco industry	45.5	49.3

Note: * With no substitution effect.

Source: Authors' calculations using the SAM from national accounts, INEGI, 2013.

This study employs a model in which supply and demand interact and is, therefore, superior to studies that use only input-product models that are based on production costs and sectoral interdependence and do not account for the effects of changes in final demand, which, as previously noted, is highly relevant in the case of tobacco.

The tobacco industry does not contribute to job creation in the same way as tobacco and cigarette sales, which cause significant harm to the population. Certain characteristics of the tobacco industry in Mexico have given rise to changes in production dynamics since 2011. Over this period, the industry has benefited, chiefly, from two situations: 1) the tax structure on tobacco products has remained unchanged, and 2) the number of jobs has decreased as production levels appear to have increased. This suggests that the industry has become more efficient and has achieved greater production capacity with fewer resources, resulting in a fall in the total wage bill and greater profits along the entire production chain.

The fiscal reform that came into effect in 2020 was therefore simply a realignment that barely sufficed to offset average inflation since 2011. This increase accounts for just eight percent of tax revenue from excise tax on cigarettes (Huesca et al., 2020).

7. Conclusions

This research presents, for the first time, a simulation of tax reforms in the tobacco industry in Mexico employing an applied general equilibrium model. An increase in tobacco tax has minimal impacts on the Mexican economy. The net effect on employment is minuscule, and the direction of this effect depends on how the funds raised by the tax are used. The main findings of the study are relevant in the context of a tax reform introduced in January 2020. However, it has been shown by the evidence and this research that this reform is late in coming and that the Mexican government's growing need for health care funding calls for a proposal that increases this burden and follows, at a minimum, the WHO recommendation to increase the total tax burden to over 75 percent of the retail price of cigarettes.

The Mexican tobacco industry has shown a trend toward concentration into fewer economic units producing less tobacco. There is a downward trend in the added value of the tobacco industry's output. The technological

restructuring of the tobacco industry in Mexico has gone hand in hand with a fall both in total worker pay and in the gross value of output. Around the world – and Mexico is no exception – debates on tobacco tax increases have pitted arguments concerning the harmful effects of the tobacco sector against concerns relating to the economy in general. In this context, the evidence points to a clear concentration process that began before the tax reforms were implemented in Mexico. The analysis of the impact of new cigarette tax increases shows that fiscal policy on tobacco is not just effective in reducing tobacco consumption but can also generate additional revenue that can be channeled into priority sectors, which may even lead to a net increase in employment across the economy.

This research report analyzes tobacco tax reforms that increase the specific component of selective tobacco tax in line with best tobacco tax practices. Two scenarios are presented: firstly, the WHO recommendation, which would raise the specific tax to 1.35 pesos per cigarette, and secondly, the recent initiative put forward in 2020 in the Chamber of Deputies, which would raise the specific tax to 1.50 pesos per cigarette.

Although all sectors of the economy would see marginal falls in employment as a result of higher tobacco taxes, this is easily reversed if the revenue raised is used to stimulate the health sector. This would result in a net gain in employment.

In the 1.35 pesos scenario, final tobacco consumption is reduced by 24.6 percent while tax revenue associated with the tobacco industry increases by 45.5 percent. Nationally, there would be a marginal decline in employment, close to zero percent (0.095 percent), while employment in the tobacco sector would fall by just over 21 percent, or 686 lost jobs, which is very little in terms of the Mexican economy as a whole.

In a reform that would raise the specific tax to 1.50 pesos per cigarette, consumption would decline by 25.9 percent and tobacco revenue would increase by 49.3 percent. This reform would lead to a fall in employment of over 22.3 percent in the tobacco sector, equivalent to just 725 lost jobs. These jobs could be easily recovered through a subsidy for the health sector, resulting in a net gain of over 32,285 new jobs in the national economy (see Table B.5 in the appendix).

These results suggest there exists a good margin for increasing tobacco tax beyond the 2020 update of 0.49 pesos per stick. In addition, if tobacco tax revenue is allocated as a direct health care subsidy, this would deliver a double dividend by further discouraging consumption and increasing revenue by almost 50 percent, with little impact on key macroeconomic variables in Mexico, which could in any case be offset in more dynamic sectors while promoting health, employment, and development.

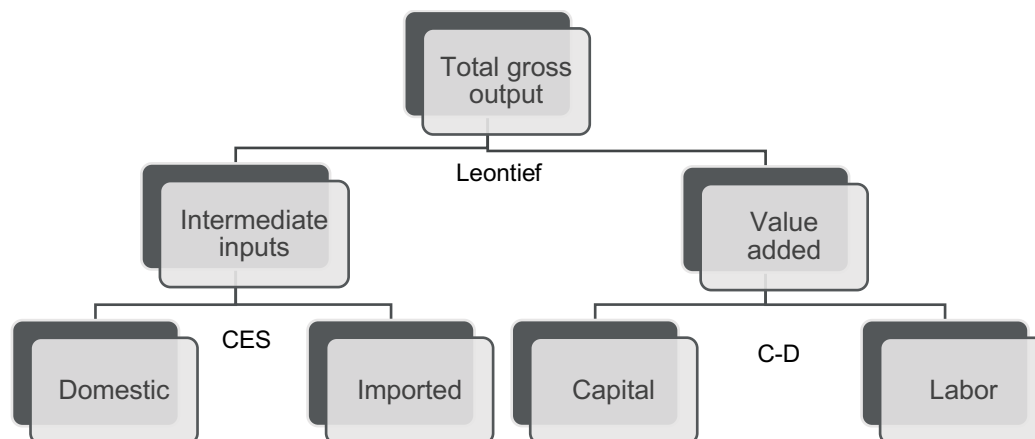
References

- Armington, P. (1969). A theory of demand for products distinguished by place of production. *Staff Papers, International Monetary Fund*, 16(1), 159-178.
- Cámara de Diputados (2020). Gaceta Parlamentaria [Parliamentary Gazette]. “Iniciativa con proyecto de decreto por el que se reforman diversas disposiciones de la Ley del Impuesto Especial sobre Producción y Servicios en materia de impuesto a bebidas azucaradas, alcohol, tabaco y comida chatarra para la compensación al daño a la salud de los mexicanos, suscrita por diputadas integrantes del grupo parlamentario de Morena” [Bill initiative reforming various provisions of the Excise Tax on Production and Services Law with regard to taxes on sugary drinks, alcohol, tobacco and junk food to compensate for damage to the health of Mexicans, endorsed by deputies from the Morena parliamentary group]. Art. 2.1, 2.2, 2.3. <http://gaceta.diputados.gob.mx/PDF/64/2020/abr/INIS-21-ABR/Ini-Morena-22.pdf>
- Dávila, A., Sobarzo, H., & Valdes, M. (2018). Mexico y el TLCAN: Escenarios de política comercial. Simulaciones con un modelo de equilibrio general aplicado [Mexico and NAFTA: Trade policy scenarios. Simulations with an applied general equilibrium model]. *El Trimestre Económico*, 85(340).
- De Dios, D., Madera, J. A., & Da Silva, L. (2019). Reconversión productiva del tabaco en México, un acercamiento desde la etnografía institucional [Productive restructuring of tobacco in Mexico, an approach from institutional ethnography]. *Extensão Rural*, 26(1), 26-50.
- FAOSTAT. (2020). FAOSTAT. Food and Agricultural Organization of the United Nations. <http://www.fao.org/faostat/en/#data/QC>
- GATS. (2017). Global Adult Tobacco Survey, Mexico 2015. Washington, D.C.: PAHO.
- Ghaus, K., Asif, M., Sabir, M., Saleem, W., Ali, A., & Aamir, N. (2018). Macroeconomic impacts of tobacco use in Pakistan (Research report). <https://tobacconomics.org/wp-content/uploads/2019/01/Macroeconomic-impact-of-Tobacco-in-Pakistan.pdf>
- Guerrero, A., Madrazo, A., Cruz, J., & Ramírez, T. (2010). Identificación de las estrategias de la industria tabacalera en México [Identifying the strategies of the tobacco industry in Mexico]. Colección de Documentos de Trabajo, Centro de Investigación y Docencias Económicas (CIDE), 152p.
- Huesca, L., Llamas, L., Araar, A., & Molina, O. (2020). Análisis del impuesto al tabaco en México y simulaciones de reforma usando LATINMOD [Analysis of tobacco taxation and simulations in Mexico using LATINMOD]. CIAD.
- Instituto Nacional de Estadística y Geografía (INEGI). (2020a). Encuesta Nacional de Ingresos y Gastos de los Hogares. Microdatos 2010, 2012, 2014, 2016, y 2018 [National Survey of Household Income and Expenditure. Microdata 2010, 2012, 2014, 2016, and 2018]. <https://www.inegi.org.mx>
- Instituto Nacional de Estadística y Geografía (INEGI). (2020b). Censos Económicos. Tabulados 1999, 2004, 2009, 2014, y 2019 [Economic Censuses. Tables for 1999, 2004, 2009, 2014, and 2019]. <https://www.inegi.org.mx>
- Kehoe, T., & Serra, J. (1983). Applied general equilibrium with endogenous unemployment: An analysis of the 1980 fiscal reform in Mexico. *Journal of Public Economics*, 22, 1-26.
- Mirza M., Rodriguez-Iglesias G., Blecher, E., (2019). Why Tobacco Control Doesn't Hurt Farmers: Decoupling Domestic Cigarette Consumption and Leaf Production, A Tobacconomics White Paper. Chicago, IL: Tobacconomics, Health Policy Center, Institute for Health Research and Policy, University of Illinois at Chicago.
- Ranson, K., Jha, P., Chaloupka, F. J., & Nguyen, S. N. The effectiveness and cost-effectiveness of price and other tobacco control policies. In Jha P. & Chaloupka F.J. (Eds.), *Tobacco control in developing countries*. Oxford: Oxford University Press. 2000. pp. 427-447.

- Reynales, L. M., Zavala-Arciniega, L., Paz-Ballesteros, W. C., Gutiérrez-Torres, D. S., García-Buendía, J. C., Rodríguez-Andrade, M. A., Gutiérrez-Reyes, J., Franco-Núñez, A., Romero-Martínez, M., & Mendoza-Alvarado, L. (2017). *Encuesta Nacional de Consumo de Drogas, Alcohol y Tabaco 2016-2017: Reporte de Tabaco* [National survey on drug, alcohol, and tobacco consumption 2016-2017: Tobacco report]. Mexico City, Mexico: INPRFM (Instituto Nacional de Psiquiatría Ramón de la Fuente Muñiz), Instituto Nacional de Salud Pública, Comisión Nacional Contra las Adicciones [National Commission Against Addictions], Secretaría de Salud [Secretariat of Health].
- Rodríguez-Iglesias, G., & Chaloupka, F. (2017). Best practices for tobacco tax policy in Latin America. A Tobacconomics policy brief. Chicago, IL: Tobacconomics, Health Policy Center, Institute for Health Research and Policy, University of Illinois at Chicago.
- Secretaría de Hacienda y Crédito Público (SHCP). (2020). Estadísticas oportunas de finanzas públicas [Timely public finance statistics]. <http://www.shcp.gob.mx/>
- Sistema de Información Arancelaria Vía Internet (SIAVI). (2020). Secretaría de Economía [Secretariat of Economy]. <http://www.economia-snci.gob.mx>
- Sobarzo, H. (2011). Tax reform in Mexico: A general equilibrium assessment. *Applied Economic Letters*, 18(7).
- Warner K. E (2000). "The economics of tobacco: myths and realities", *Tobacco Control* 2000; 9:78-89.
- World Health Organization. (2015). *WHO report on the global tobacco epidemic 2015: Raising taxes on tobacco*. World Health Organization.
- World Health Organization. (2016). U.S. National Cancer Institute and World Health Organization. *The Economics of Tobacco and Tobacco Control*. National Cancer Institute Tobacco Control Monograph 21. NIH Publication No. 16-CA-8029A. Bethesda, MD: U.S. Department of Health and Human Services, National Institutes of Health, National Cancer Institute; and Geneva, CH: World Health Organization.
- World Health Organization. (2019). *WHO report on the global tobacco epidemic 2019*. World Health Organization.

Appendix A

Figure A.1. Sectoral production functions.



Source: Authors' analysis, 2013.

Table A.1. Sectoral breakdown of the social accounting matrix

Sectors	
1. Agriculture	15. Plastic and rubber
2. Oil	16. Non-metallic mineral products
3. Minerals	17. Iron, steel, non-ferrous metals
4. Electricity	18. Metal products
5. Construction	19. Non-electrical machinery
6. Food	20. Electrical machinery
7. Beverages	21. Transport equipment
8. Tobacco	22. Other manufacturing
9. Textiles	23. Commerce
10. Clothing	24. Transportation
11. Leather	25. Gas, water, communications
12. Wood and paper	26. Financial services and insurance
13. Pharmaceutical products	27. Other services
14. Chemicals	

Source: Authors' analysis, using the SAM from national accounts, INEGI, 2013.

Table A.2. Values of parameters for the Armington assumption in Mexico, 2013

	Production sector	Armington elasticities	Export elasticities
1	Agriculture	3.0	2
2	Oil	0.5	3
3	Minerals	0.5	3
4	Electricity	1.0	3
5	Construction	0.5	-
6	Food	1.125	2
7	Beverages	1.125	2
8	Tobacco	1.125	2
9	Textiles	1.125	2
10	Clothing	1.125	2
11	Leather	1.125	2
12	Wood and paper	1.125	3
13	Medicine	0.5	3
14	Chemicals	0.5	3
15	Plastic and rubber	0.5	3
16	Non-metallic minerals	0.5	3
17	Non-ferrous minerals	0.5	3
18	Metal products	0.5	3
19	Non-electrical machinery	0.375	3
20	Electrical machinery	0.375	3
21	Transport equipment	0.375	3
22	Other manufacturing	0.375	3
23	Commerce	-	-
24	Transportation	1.0	2
25	Gas, water, and communications	1.0	2
26	Financial services	1.0	-
27	Other services	1.0	-

Source: Authors' calculations using the SAM from national accounts, INEGI, 2013.

**Table A.3. Breakdown of employment and gross value of output (GVO), 2013
(millions of pesos)**

Sector	GVO	Wages
1 Agriculture	780,161	81,548
2 Oil	2,016,284	28,487
3 Minerals	432,317	23,961
4 Electricity	367,019	13,928
5 Construction	2,151,668	317,574
6 Food	1,609,171	63,047
7 Beverages	285,304	11,276
8 Tobacco	25,114	284
9 Textiles	115,770	13,411
10 Clothing	151,358	21,893
11 Leather	71,146	7,921
12 Wood and paper	293,507	21,000
13 Pharmaceutical products	156,132	10,249
14 Chemicals	701,661	25,315
15 Plastic and rubber	278,608	20,743
16 Non-metallic minerals	230,441	14,277
17 Non-ferrous minerals	552,718	11,381
18 Metal products	343,413	27,359
19 Non-electrical machinery	260,089	24,706
20 Electrical machinery	1,443,653	118,062
21 Transport equipment	1,833,942	65,706
22 Other manufacturing	246,995	30,703
23 Commerce	3,402,433	359,071
24 Transportation	1,632,047	249,326
25 Gas, water, and communications	697,879	68,955
26 Financial services	2,846,003	143,951
27 Other services	4,708,358	1,875,139

Source: Authors' calculations using the SAM from national accounts, INEGI, 2013.

Appendix B

**Table B.1. Impact of tobacco tax on employment by sector in Mexico.
(without allocating revenue as a subsidy for the health sector)**

Sectors	Percentage change in employment Scenario 1	Percentage change in employment Scenario 2
Agriculture	-0.175	-0.187
Oil	-0.173	-0.185
Minerals	-0.160	-0.171
Electricity	-0.180	-0.193
Construction	-0.121	-0.130
Food	-0.174	-0.186
Beverages	-0.174	-0.186
Tobacco	-21.397	-22.616
Textiles	-0.156	-0.167
Clothing	-0.160	-0.171
Leather	-0.155	-0.166
Wood and paper	-0.183	-0.195
Pharmaceutical products	-0.150	-0.160
Chemicals	-0.187	-0.199
Plastic and rubber	-0.152	-0.162
Non-metallic mineral products	-0.147	-0.158
Iron, steel, non-ferrous metals	-0.182	-0.194
Metal products	-0.151	-0.161
Non-electrical machinery	-0.163	-0.174
Electrical machinery	-0.133	-0.142
Transport equipment	-0.170	-0.182
Other manufacturing	-0.128	-0.137
Commerce	-0.173	-0.185
Transportation	-0.160	-0.171
Gas, water, and communications	-0.173	-0.185
Financial services and insurance	-0.173	-0.185
Other services	-0.033	-0.037
All sectors	-0.095	-0.102

Source: Authors' calculations, using the SAM from national accounts, INEGI, 2013.

**Table B.2. Impact of tobacco tax on household expenditure in Mexico
(without allocating revenue as a subsidy for the health sector)**

Goods	Scenario 1 (% change)	Scenario 2 (% change)
Agriculture	-0.009	-0.009
Oil	0.003	0.004
Minerals	0.000	0.000
Electricity	-1.34E-04	-2.76E-04
Construction	0.000	0.000
Food	-0.007	-0.007
Beverages	-0.007	-0.008
Tobacco	-24.614	-26.018
Textiles	-0.016	-0.017
Clothing	-0.023	-0.025
Leather	-0.018	-0.019
Wood and paper	-0.014	-0.015
Pharmaceutical products	-0.016	-0.017
Chemicals	-0.006	-0.006
Plastic and rubber	-0.012	-0.013
Non-metallic mineral products	-0.015	-0.016
Iron, steel, non-ferrous metals	-0.004	-0.004
Metal products	-0.011	-0.012
Non-electrical machinery	-0.006	-0.007
Electrical machinery	-0.006	-0.007
Transport equipment	-0.008	-0.009
Other manufacturing	-0.015	-0.016
Commerce	-0.009	-0.010
Transportation	-0.022	-0.024
Gas, water, and communications	-0.018	-0.019
Financial services and insurance	0.003	0.003
Other services	-0.075	-0.081
Total	-0.923	-0.976

Source: Authors' calculations, using the SAM from national accounts, INEGI, 2013.

**Table B.3. Impact on employment by sector in Mexico in scenario 1
(assuming that revenue is spent on a subsidy for the health sector), 2018**

Sectors	Percentage change in employment (%) (A)	Working population (B)	Structure (%) (C)	Change in no. of jobs (D)
Agriculture	0.056	245,968	0.93	138
Oil	0.086	49,335	0.19	42
Minerals	0.034	148,016	0.56	50
Electricity	0.132	95,179	0.36	126
Construction	-0.097	734,568	2.77	-713
Food	0.149	1,113,551	4.19	1,659
Beverages	0.180	189,818	0.71	342
Tobacco	-21.147	3,242	0.01	-686
Textiles	0.120	219,961	0.83	264
Clothing	0.147	335,021	1.26	492
Leather	0.140	173,552	0.65	243
Wood and paper	0.094	400,064	1.51	376
Pharmaceutical products	0.249	92,066	0.35	229
Chemicals	0.129	229,907	0.87	297
Plastic and rubber	0.150	399,487	1.50	599
Non-metallic mineral products	0.050	257,236	0.97	129
Iron, steel, non-ferrous metals	0.077	131,683	0.50	101
Metal products	0.099	479,121	1.80	474
Non-electrical machinery	0.086	194,800	0.73	168
Electrical machinery	0.104	608,503	2.29	633
Transport equipment	0.112	1,255,939	4.73	1,407
Other manufacturing	0.099	471,839	1.78	467
Commerce	0.113	7,429,763	27.97	8,396
Transportation	0.144	946,566	3.56	1,363
Gas, water, and communications	0.175	536,083	2.02	938
Financial services and insurance	0.163	627,842	2.36	1,023
Other services	0.165	9,192,347	34.61	15,167
All sectors	0.123	26,561,457	100.00	33,725

Note: Columns B, C, and D are the authors' own estimates, determined by using information from the 2018 economic census by applying the percentage changes given by the model in column A.

Source: Authors' calculations, using national accounts, INEGI, 2013, and Economic Censuses, INEGI 2018.

**Table B.4. Impact of a tobacco tax on private spending in Mexico
(assuming that revenue is spent on a subsidy for the health sector)**

No.	Sector	Household expenditure in scenario 1	Household expenditure in scenario 2
1	Agriculture	0.068	0.069
2	Oil	0.100	0.101
3	Minerals	0.000	0.000
4	Electricity	0.083	0.084
5	Construction	0.000	0.000
6	Food	0.100	0.101
7	Beverages	0.126	0.128
8	Tobacco	-24.546	-25.950
9	Textiles	0.121	0.122
10	Clothing	0.129	0.129
11	Leather	0.122	0.123
12	Wood and paper	0.130	0.131
13	Pharmaceutical products	0.175	0.176
14	Chemicals	0.126	0.128
15	Plastic and rubber	0.142	0.143
16	Non-metallic mineral products	0.165	0.166
17	Iron, steel, non-ferrous metals	0.118	0.120
18	Metal products	0.131	0.133
19	Non-electrical machinery	0.118	0.119
20	Electrical machinery	0.119	0.120
21	Transport equipment	0.126	0.127
22	Other manufacturing	0.125	0.126
23	Commerce	0.109	0.110
24	Transportation	0.127	0.127
25	Gas, water, and communications	0.179	0.180
26	Financial services and insurance	0.101	0.102
27	Other services	1.097	1.108

Source: Authors' calculations, using the SAM from national accounts, INEGI, 2013.

Table B.5. Impact on employment by sector in Mexico in scenario 2 (assuming that revenue is spent on a subsidy for the health sector) 2018.

Sectors	Percentage change in employment (%) (A)	Working population (B)	Structure (%) (C)	Change in no. of jobs (D)
Agriculture	0.047	245,968	0.93	116
Oil	0.078	49,335	0.19	38
Minerals	0.026	148,016	0.56	38
Electricity	0.124	95,179	0.36	118
Construction	-0.105	734,568	2.77	-771
Food	0.142	1,113,551	4.19	1,581
Beverages	0.173	189,818	0.71	328
Tobacco	-22.367	3,242	0.01	-725
Textiles	0.113	219,961	0.83	249
Clothing	0.141	335,021	1.26	472
Leather	0.134	173,552	0.65	233
Wood and paper	0.085	400,064	1.51	340
Pharmaceutical products	0.244	92,066	0.35	225
Chemicals	0.121	229,907	0.87	278
Plastic and rubber	0.143	399,487	1.50	571
Non-metallic mineral products	0.043	257,236	0.97	111
Iron, steel, non-ferrous metals	0.068	131,683	0.50	90
Metal products	0.092	479,121	1.80	441
Non-electrical machinery	0.078	194,800	0.73	152
Electrical machinery	0.099	608,503	2.29	602
Transport equipment	0.104	1,255,939	4.73	1,306
Other manufacturing	0.093	471,839	1.78	439
Commerce	0.105	7,429,763	27.97	7,801
Transportation	0.137	946,566	3.56	1,297
Gas, water, and communications	0.168	536,083	2.02	901
Financial services and insurance	0.156	627,842	2.36	979
Other services	0.164	9,192,347	34.61	15,075
All sectors	0.119	26,561,457	100.00	32,285

Note: Columns B, C, and D are the authors' own estimates, determined using information from the 2018 economic census and applying the percentage changes given by the model in column A.

Source: Authors' calculations, using economic censuses 2018 and using the SAM from national accounts, INEGI, 2013.