Extended cost - benefit analysis of tobacco consumption in Mexico

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Extended Cost-Benefit Analysis of Tobacco Consumption in México

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1. Executive Summary

The literature on tobacco has shown that smoking has a negative effect on health and overall well-being. It has also shown that one of the most effective policies to reduce tobacco use is to increase tobacco taxes and prices. However, tobacco consumption is inelastic, which means that an increase in price does not translate into a reduction in consumption as equal as the increase in prices, and this is why the net effects of a policy to increase the price of tobacco is not clear.

The effect of a tax increase will depend on the sensitivity of consumers to higher prices which will determine the magnitude of the impact on revenues, as well as the increase in the benefits. Tobacco taxes have two main objectives: to discourage tobacco use to improve health and well-being; and to raise revenue for the public sector (ideally to at least to cover the externalities of tobacco use).

Results show that raising tobacco taxes in Mexico effectively reduces consumption by making people stop buying cigarettes (quitting) or preventing new smokers from starting to smoke. Tax increases reduce consumption, and also reduce medical expenses for each income group and at all levels of elasticity. The benefits are greatest in reduced medical expenses, which outweigh for each income group and level of elasticity any negative effects resulting from an increase in tobacco spending.

The implementation of a higher cigarette tax would have a progressive effect on the distribution of income, since it would allow the population to increase their income levels, by reducing cigarette expenses, and reduce healthcare costs from tobacco-related illnesses, while enabling them to be more productive.

Within the framework of a highly restricted fiscal space, the extensive economic costs from smoking and the progressiveness of the tax should be seriously considered by policymakers in increasing the cigarette tax rate.

2. Introduction

According to the World Health Organization (WHO), smoking is the leading cause of death in the world, and one that can be avoided. In 2018, around eight million people died from tobacco consumption related diseases (World Health Organization, 2019).

Around one third of the world population smokes, which may translate into a health crisis given that the great majority of these individuals will require medical treatment for tobacco-related illness and diseases, such as lung cancer, heart conditions and even diabetes and hypertension. The number of people that die from smoking-related causes in the Americas is of about 1.5 million. Half that number are people living in Latin America and the Caribbean.

In Mexico, the prevalence of tobacco consumption has been steady throughout the period 2009-2015, representing around 16 percent of the population: 25 percent of men and 8 percent of women (Organización Pánamericana de la Salud; Instituto Nacional de Salud Pública, 2017). Based on the National Survey on Drug, Alcohol and Tobacco Consumption (ENCODAT), 3,000 people die every year due to tobacco-related diseases (8.4 percent of the total number of deaths) (Instituto Nacional de Salúd Pública, 2017).

Tobacco consumption has become a huge problem, and WHO has recommended that it should be tackled through policies aiming to directly reduce the demand of this product (World Health Organization, 2003). One of these policies implies taxing tobacco consumption, and as a result, increasing its price. There is evidence in countries of all income levels showing that an increase on tobacco price results in a reduction of demand, tobacco consumption among minors, and a proclivity of relapsing among those people who have quit smoking at any given point. Studies show that a 10 percent increase in cigarette prices results in a 4-5 percent decrease in demand (World Health Organization, 2003).

However, the counter argument to the policy of taxing tobacco products is that increasing the price of tobacco products result in a regressive measure as the percentage of total expenditure incurred by lower-income smoking households tends to be higher than those with a higher income.

This cost-benefit analysis shows that if the indirect effects are taken into consideration, especially health effects resulting from reduced cigarette smoking, this statement is not correct. Among the benefits is the reduction in medical bills and an increase in years of healthy life, which all translate into financial benefits for people and their households.

This cost-benefit analysis is based on an assessment of different price increase scenarios, considering price elasticity for different income groups. The tobacco consumption price elasticity ratio will define how sensitive the different income groups are to increases in the price of tobacco products. An analysis of the optimal tobacco tax is included. Such optimal tobacco tax is defined as the taxing level that would result in the tax collection that is necessary to cover the health costs incurred by consuming tobacco in Mexico.

2.1 Document layout

The Study is divided as follows: Section Two describes taxes on tobacco products in Mexico, as well as the cost-benefit ratio of this policy. Section Three presents the research objective. Section Four describes the methodologies used while Sections Five and Six show the data used and the results obtained, respectively. The final section discusses the policy implications.

2.2 Study objective

The objective of this research is to conduct a thorough cost-benefit analysis of tobacco consumption in Mexico, estimating the financial, social, and health costs incurred by consuming tobacco as well as the mid-term impact of reducing these costs resulting from the increase in tobacco taxes.

3. Taxes on Tobacco

3.1 Taxes on tobacco in Mexico

There are three taxes on cigarettes in Mexico, which have been subjected to changes over the years. This section includes an explanation of each of these taxes, as well as the main changes that have taken place over time.

3.1.1 Value Added Tax

Value Added Tax (VAT) is a tax levied on goods and services sold in Mexico[1]. This tax is levied on a staggered basis, that is, it is based on the added value that each stage of the production or distribution chain adds to the product or service. For cigarettes, VAT is applicable to all products manufactured in Mexico as well as those that are imported.

The Value Added Tax Law (Cámara de Diputados del H. Congreso de la Unión, 2020) was introduced in December 1978, but was not effective until January 1988. The main changes in the rate are shown in Table 1.

1 Except on some products such as food and drugs.

Table 1 Vat Rate Evolution

Period	General tate	Border rate
1980-1982	10%	10%
1983-1987	15%	15%
1988-1991	15%	6%
1992-1994	10%	6%
1995-2009	15%	10%
2010-2013	16%	11%
2014-2018	16%	16%
2019-	16%	8%

SOURCE: (Cámara de Diputados del H. Congreso de la Unión, 2020)

3.1.2 Import taxes

The Import Tax is imposed on products that are imported into Mexico. This tax was first introduced in 1988 and has undergone just one change. The initial rate on imported cigarettes was 20 percent on the value of a pack and increased to 67 percent in 1999 (SE, 2018).

3.1.3 Excise taxes

The Impuesto Especial a Producción y Servicios (IEPS) is a type of tax that is not only intended to collect taxes as such, but also correct the negative external factors resulting from consuming some products. IEPS imposes taxes on alcoholic beverages, gasoline, junk food, and cigarettes, among other products.

IEPS is applied at retail or when products are imported.

Over time, the IEPS rate on cigarettes has undergone several changes and revisions in its structure. This type of tax has changed from an ad valorem tax to a mixed tax with a specific component and an ad valorem component. The main changes on the IEPS to cigarettes are summarized in Table 2.

Table 2 IEPS Rate Evolution

Years	General rate	Popular cigarettes rate	Tax per cigarette	Notes
1981-1985	139.3%	20.9%	NA	Producers whose production is less than 40,000 cigarette packs per year, whose brands and tobacco is of Mexican origin do not pay IEPS. This measure was abolished in 1990, where producers payed 25% of the IEPS rate, 50% in 1991, 75% in 1992 and 100% from 1993 onwards.
1986-1988	180.0%	25.0%	NA	
1989-1994	160.0%	25.0%	NA	
1995-1999	85.0%	25.0%	NA	
2002	105.0%	60.0%	NA	The concept of popular cigarettes disappears and a process to gradually homogenize both rates starts. This process will end in 2005 with a rate of 110.0%.
2003	107.0%	80.0%	NA	
2004	110.0%	100.0%	NA	
2005-2006	110.0%	110.0%	NA	
2007	140.0%	140.0%	NA	
2008	150.0%	NA	NA	
2009	160.0%	NA	NA	
2010	160.0%	NA	.04 pesos per cigarette	
2011-2019	160.0%	NA	.35 pesos per cigarette	
2020-	160.0%	NA	.4944 pesos per cigarette	Starting 2020, the tax per cigarette will be updated yearly according to inflation.

SOURCE: (Cámara de Diputados del H. Congreso de la Unión, 2020)

In addition to the changes on the tax rate shown above, the Ley del Impuesto Especial sobre Producción y Servicios (LIEPS) introduced several measures aimed at improving tax collection and management. The most relevant measures are listed below:

- Since 1992, cigarette producers and importers must report the sale price to the Sistema de Administración Tributaria (SAT), as well as the value of each product sold and/or imported, via electronic means.
- Since 1999, cigarette importers must be registered in an Importers Roster List managed by SAT.
- From 2005-2014, cigarette packs were required to have a Stamp Duty. In 2014, the Stamp Duty was replaced by a security code that must meet the technical specifications and security measures so defined by SAT.

3.1.4 Tobacco Control Law

A new Tobacco Control Law was introduced in June 2008 in order to protect the population against the harmful effects of smoking tobacco, safeguard the rights of non-smokers, and reduce tobacco consumption, among others. Some of the measures approved under this Law were:

- Packs of cigarettes must bear labels stating health risks, which must cover at least 30 percent of the front area of the pack, 100 percent of the back, and 100 percent of one of its sides.
- Cigarette advertising was banned, unless it is displayed on adult magazines or commercial establishments where minors are not allowed.
- Smoke-Free spaces were created.

3.2 Tobacco tax costs and benefits

An analysis conducted to make an estimation of the optimal tax on tobacco in Mexico shows that, even after 10 years, a former smoker faces a higher risk of getting sick compared to those people who have never smoked in their lives (Cantú, 2013). Therefore, preventive measures must be prioritized, and although price increases via tax are effective as preventive measures, once a person starts smoking, the policy with the highest – or most efficient – cost-benefit is a price increase via taxes.

This public policy may achieve two goals: 1) higher income for the Government that should be used to improve the public health system; and 2) a change in consumption patterns when the price increases (cigarette consumption is inelastic, but not perfectly inelastic). Evidence shows that constant increases in tobacco taxes generate significant gains in the population health, savings in health costs, and reductions in health system inequalities (Cantú, 2013).

Cantú (2013) showed that the difference between what the tobacco industry contributes to the economy and the cost of externalities generated by tobacco consumption (for example, the diseases related to tobacco and productivity losses) was $12,586 Negative Million MXN. In other words, the externalities are greater than the contributions made by the industry to the economy. The findings also suggest that a specific tax of $22 MXN per pack of cigarettes helps reduce the number of smokers by 10.4 percent.

Another study In Mexico, concluded that if Mexico increased cigarette prices by 50 percent, this price increase in cigarettes would translate into 12.8 million life years gained, 8,828 millions of dollars in disease costs averted, and an additional tax revenue of 2,900 million dollars (Global Tobacco Economics Consortium, 2018).

The same evidence is observed in other regions. For example, an analysis of the distributive consequences of the financial and health effects of a special tax on cigarettes in China was conducted (Verguet, et al., 2015). The study of distributional impacts by income quintiles focused on the lowest income group of the population. The methodology used was an extended cost-effectiveness analysis to estimate the improvement in health, measured in gained life years; the additional income collected through taxes; and the effect on the household expenditure by increasing the cigarette price by 50 percent as a result of the special tax being fully transferred to consumers. The study focused solely on the male population as it represents a higher percentage of smokers in the country. The average of tobacco demand price elasticity was of -0.38, which is supposed to vary in -0.64 in the quintile of the lowest income, to -0.12 in the quintile of the highest income. The finding was that, as a result of the 50 percent tax increase, the lowest income quintile gained one-third of the total 231 million additional life years during a 50-year life span.

In terms of tax revenue collection, the tax increase resulted in 703 trillion USD in additional revenues with 24 percent of these revenues coming from the highest income quintile and 14 percent coming from the lowest income quintile. On the other hand, the tax increase resulted in an increase of the average household tobacco expenditures. However, considering only the lowest income quintile, the expenditures decrease. In summary, this policy may be beneficial for the poor as it entails both financial and health benefits in the lowest income quintiles.

Blakely, et al., (2015) estimated the impacts on health, inequalities in health services, and the costs incurred and to be incurred by the health system in New Zealand as a result of constant increases in the tobacco tax (10 percent Year of 2011-2013 vs. a no-increase situation since 2011).

This study considered the ethnic inequalities of the disease burden related to smoking and non-communicable disease (NCD) in New Zealand. Therefore, 16 smoking-related diseases were concurrently modeled using national data on sex, age, and ethnicity in order to estimate the Quality-Adjusted Life Year (QALYs) and the savings in the health system based on the remaining life years of the population in 2011. The results showed a gain of 260,000 QALYs in 2011 among the groups exposed to tobacco tax increases versus those groups where there was not any increment. The model also showed that there were savings of 2,250 Million USD in costs in the health system. The per capita gains by QALYs were 3.7 times more for the Maori (indigenous peoples) vs. those that are not part of the Maori community since the Maori population is more prone to smoking and is more sensitive to the price.

In a study for the Russian Federation, when considering the benefits of reducing the medical costs and an increase in working years, the financial effects of an increase in tobacco prices translate into positive and progressive effects (Fuchs, Matytsin, & Obukhova, Tobacco Taxation Incidence: Evidence from the Russian Federation, 2018).

In Latin American countries, Fuchs & Meneses (2017) found that, with a tobacco consumption price elasticity ranging on -0.64 for the lowest income decile to -0.12 for the highest income decile in Chile, low income groups may experience positive effects as a result of an increase in tobacco price. This means that taxes may have progressive distributive effects, providing greater benefits among the lowest income groups. These effects were estimated by calculating changes in the income gains coming from the tobacco expenditure, medical expenditure reduction, and life year loss reduction.

3.3 Smoking financial costs

Epidemiological studies have concluded that smoking cigarettes affects almost every organ in the body (U.S. Department of Health and Human Services, 2004). Measuring these effects in financial terms is a way to assess the direct and indirect costs of smoking.

More than 51,000 Mexicans die each year due to smoking-related diseases. This accounts for 76 percent of all the deaths in Mexico in 2017 (Institute for Health Metrics and Evaluation, 2017), without considering the collateral damage experienced by non-smokers.

> *Smoking causes a negative impact on society by losing life and productive years, as well as the financial burden borne by smokers, their families, healthcare suppliers, insurance companies, and employers* (World Health Organization, 2011).

There are several cost estimation techniques available based on perspective, focus or objective (WHO, 2011). For this study, as mentioned in the reference terms, the Fuchs, Matytsin, & Obukhova (2018) methodology is used, which includes two financial effects:

- **Direct effects:** Attributable to Health Costs
- **Indirect effects:** Productivity Loss

Pichon-Riviere, et al., (2016) estimated the direct costs of healthcare services in Mexico.

3.3.1 Direct costs: Health service costs

Seven causes of medical costs attributable to the estimation were included to quantify the financial impact of smoking: heart diseases, chronic obstructive pulmonary disease, second-hand smoking and other causes, lung cancer, other types of cancer, strokes, pneumonia or influenza.

The estimation of direct costs attributable to smoking was obtained from Instituto de Efectividad Clínica y Sanitaria, (2017) and Pichon-Riviere, et al., (2013).

3.3.2 Indirect costs: Productivity loss

Death rate, number of deaths, morbidity, and disease rates are influenced by smoking in two ways: Year Life Loss (YLL) due to an early mortality in the population, and Year Lost Due to Disability (YLD) due to smoking. The productivity cost is related to morbidity, which in turn is listed as an indirect cost. This cost represents the value of the productivity loss resulting from those people that are found to be disabled due to smoking-related diseases. It is estimated by determining the change in the income earned by paid work (World Health Organzation, 2019).

In this study, productivity loss is understood as a reduction in active work life years, which are estimated using the YLL.

4. Methodology

4.1 Elasticity

The price elasticity of tobacco consumption is estimated via an artificial panel data retrieved from the Encuesta Nacional de Ingresos y Gastos de los Hogares (ENIGH) 2016 and 2018 using the Deaton model.

The two-part model considers the estimation of two types of sequential elasticities:

1. The prevalence elasticity refers to the prorated change in the smoking prevalence as a result of a proportional change in the cigarette price (smoking probability).
2. The conditional elasticity is the prorated change in the number of smoked cigarettes as a result of a change in the cigarette price (elasticity intensity).

The two-part model allows itemizing the cigarette consumption analysis in: i) using all the ENIGH information about smokers and non-smokers in order to observe how likely is that one of the household members reports having smoked based on the different characteristics of each of the members. In general, this estimation is made through a probit or logit model; ii) analyzing the level of cigarette consumption among the households showing any tobacco consumption. The elasticity is estimated by an econometric model for continuous variables that fits the data better.

In this case, the probit model of the first stage is defined as follows:

Equation 1

$$ln\, yd_i = \beta_0 + \beta_1 price + \beta_3 X_i + \epsilon_i$$

Where yd_i is a dichotomic variable where $yd = 1$ is any household member that reported having consumed cigarettes, and $yd = 0$ is the opposite. The price refers to the unit value of a pack of cigarettes and X_i is a set of characteristics pertaining to the household and its members.

The second stage is estimated following John, Chelwa, Vulovic, & Chaloupka (2019) methodology, which is based on the almost ideal demand system (AIDS) developed by Deaton and Muellbauer in 1980. This methodology corrects for the identification problem by using the data from household surveys to estimate elasticities assuming the prices of the great majority of products in middle- and low-income countries vary on a geographical basis.

The geographical variation of price is the result of facing commuting costs and other factors, such as border taxes. Therefore, the commuting costs may be used as an instrumental variable since it is the main factor affecting prices that in turn affect demand. The variable used as instrumental is called unit value.

4.1.1 Deriving the Unit Values

The unit values are derived from the ENIGH. It is used as a proxy of price and is derived from the following equation:

Equation 2

$$U_{hc} = \frac{X_{hc}}{q_{hc}}$$

where x_{hc} is the expenditure on household h located in cluster c, U_{hc} is the unit value on household h located in cluster c and q_{hc} is the quantity of cigarettes on household h located in cluster c.

The variable used to identify the clusters in ENIGH for this study is the primary sample unit (unidad primaria de muestreo (UPM) in spanish), since it gave more spatial variability compared to localities, municipalities or states. Also, there were enough observations of households that report smoking per UPM.

4.1.2 Testing for spatial variation in unit values

After obtaining the unit value, spatial variation is tested. This is done by using Analysis of Variance (ANOVA) to divide the total variation in unit values into within cluster variations and between cluster variations. A significant large Fstatistic implies that unit values vary across clusters.

4.1.3 Obtaining cluster level demand and unit values

Once spatial variability within the chosen cluster is established, household level demand and unit values are stripped of the effects of household expenditure and household characteristics, and the average across clusters is computed. The stripping and averaging are done to estimate elasticity at the cluster level using cluster demand and cluster unit value stripped of all other factors. So, the following equations were solved:

Equation 3

$$\hat{y}_c^1 = \frac{1}{n_c^+} + \sum_{h=1}^{n_c^+} (lnv_{hc} - \hat{\beta}^1\, lnx_{hc} - \hat{\gamma} Z_{hc})$$

Equation 4

$$\hat{y}_c^0 = \frac{1}{n_c} + \sum_{h=1}^{n_c} (\mathrm{w}_{hc} - \hat{\beta}^0\, lnx_{hc} - \hat{\delta} Z_{hc})$$

where n_c is the number of households in cluster *c* and n^+ is the number of households reporting purchase of the tobacco products for which elasticity is estimated. $\hat{y}^0$ and $\hat{y}^0$ do not have the *h* subscript because they represent cluster averages and they are the estimates of, respectively, cluster average unit value and cluster average demand after removing the effects of household expenditure and household characteristics.

4.1.4 Obtaining cluster level demand and unit values.

Finally, the Deaton method applies quality correction formulas in obtaining the estimate of the price elasticity of demand:

Equation 5

$$\hat{\epsilon}_c = \left(\frac{\hat{\theta}}{\widehat{\omega}}\right) - \widehat{\varphi}$$

In this case, every step from the probit model, spacial variability and price elasticities were estimated for the whole sample built from ENIGH 2016 and 2018 and for three groups of income which were divided according to household total spending. All of the amounts considered for this analysis were deflated and brought to 2018 Mexican pesos.

4.2 Optimal tax

The optimal tax is the tax rate where the income earned by special tobacco tax is equal to the cost attributable to tobacco consumption. For this reason, the costs are broken down into two types:

1. **Health costs:** These are the costs related to health-related expenses attributable to tobacco consumption-related diseases.
2. **Productivity loss:** These are the costs related to the productivity loss in the work space due to early deaths or smoking consumption-related disabilities.

To estimate the optimal tax, a reverse engineering exercise was conducted by following the next steps:

1. Obtaining the market share of different cigarette brands.
2. Obtaining the average retail price of 6 brands with the highest market share, and the average retail price of all the other brands.
3. With the information from the first two steps, the average weighted price of a pack of cigarettes is calculated.
4. VAT of the value obtained from the previous step is deduced.
5. The retail markup is deduced from the value obtained from previous steps.
6. The excise tax is deduced from the values obtained during the previous

steps.

7. Once the itemized information was obtained during the previous steps, it is possible to obtain the earnings coming from the special tobacco tax using sale data.
8. Using the elasticity calculated in this document, the change in the tax necessary to collect the needed income to cover the cigarette consumption-related costs was estimated.

4.3 Extended cost-benefit analysis

By following the methodology of Fuchs, Matytsin, & Obukhova (2018), this research estimates the tobacco consumption price elasticity by income group in order to analyze the impact of increasing tobacco taxes.

The elasticities estimation for each income group provides information to determine where a given tax policy on tobacco consumption translates into progressive or regressive effects. The change in tobacco consumption patterns at households obtained via the price elasticity is used to calculate the change in medical expenses, as well as the change in work active life years.

Based on the elasticity, the following equations measure the change in tobacco expenditure (2), changes in medical expenses (3), and an increase in the work active life years. All of them use the elasticity for the change in the tobacco expenditure estimations.

Equation 6

$$\Delta Expenditure_{ij} = \frac{\left((1 + \Delta P)(1 + \epsilon_j * \Delta P) - 1\right) * \omega_{ij}}{Total\ expenditure_{j0}}$$

Where P is the price change, E_{ij} is the price elasticity per income group j, and w_{ij0} is the expenditure ratio of the households destined to tobacco consumption in the period 0. The change in household tobacco expenditure per income group is presented as the total and average expenditure ratio per income group in order to quantify the general impact.

Equation 7

$$\Delta Medical\ expenses_{ij} = \frac{\left((1+\epsilon_j * \Delta P) - 1\right) * \ Disease\ cost_i}{Total\ expenditure_{j0}}$$

Where the cost of treating tobacco-related diseases per each income group i, is obtained from administrative data from the health sector. The cost of medical expenses incurred due to tobacco-related diseases is distributed via income groups i, based on the ratio of tobacco-consuming households per group i. Therefore, this equation shows the income earnings related to medical expense reductions resulting from a reduction of tobacco consumption in the long term.

Equation 8

$$Work\ life\ years_i = \frac{YLL * \ Number\ of\ smokers_1}{Population_1}$$

To estimate the increase of work life years is, the life year loss resulting from the tobacco-related diseases i, is distributed among the income groups based on the number of households consuming tobacco in each income group. In this way, it is possible to estimate the changes in income per income groups.

5. Data

The data used to estimate the optimal tax, the elasticity, costs and benefits of an increase in the tobacco price are listed below.

- **Health costs:** The calculations were based on Pichon-Riviere, et al., (2013).
- **Productivity loss:** The data was retrieved from the Comisión Federal de Mejora Regulatoria (2012), less the inflation effect.
- **Market share:** The market share of each tobacco brand was calculated based on the data retrieved from the Encuesta Nacional de Consumo de Drogas, Alcohol y Tabaco 2017 (Instituto Nacional de Salúd Pública, 2017).
- **Retail price:** The retail price of each cigarette brand is the average price reported by the Instituto Nacional de Estadística y Geografía (INEGI) to calculate inflation for July 2018 as part of the most recent data (Instituto Nacional de Estadística y Geografía, 2018).
- **Retail margin:** Own estimations based on Waters, Sáenz de Miera, Ross, & Reynales Shigematsu (2010), calculated at the PAHO Workshop in DC.
- **Cigarette sales:** The data corresponding to the sales reported in the monthly manufacturing industry survey for 2018 (Instituto Nacional de Estadística y Geografía, 2018), less exports, plus imports, reported by the Mexican Ministry of Economy for the same year (Secretaría de Economía, 2018).
- **Household Data:** Using data from the ENIGH, an artificial data panel was created from information of the 2008-2018 period. The ENIGH is a survey conducted every two years from different samples. To build an artificial data panel, it is necessary to use a time steady variable to obtain unique groups that may be matched across the different rounds of the survey. Therefore, the Date of Birth variable was used to get a 455-observation panel. Likewise, data from the 2016 and 2018 versions of the ENIGH were used to make an estimate of the elasticity-price in two stages. In this case, the complete samples were used, and the 2016 data was updated with inflation.
- **YLL** are calculated by using the Longest Possible Individual Life Expectancy

less the Age of Death (Institute for Health Metrics and Evaluation, 2019).

6. Results

6.1 Elasticity

The prevalence and conditional average price elasticity is obtained for all the population and for three income groups. Both, the first and second stage, are estimated for the total sample of households from 2016 and 2018. The estimations are shown on Table 3.

The average elasticity results are similar to those found by Waters, Sáenz de Miera, Ross, & Reynales Shigematsu (2010), and Jimenez-Ruiz et al. (2008).

Elasticity is higher, in an absolute value, for the low-income group of households. This means that these are more sensitive to increases in cigarette prices. Additionally, the households with the highest income have a lower elasticity and thus, are less sensitive to changes in tobacco prices.

Table 3 Elasticity by income group 2018

	Price elasticity first stage	Price elasticity second stage	Total price elasticity
Average	-0.00014	-0.4239	-0.4240
Low income	-0.00046	-0.5836	-0.5868
Middle Income	-0.00015	-0.5415	-0.5416
High Income	0.00011	-0.4665	-0.4663

The average elasticity is lower than the ones in the different income groups, because the Deaton methodology was calculated separately, resulting in fewer clusters for each income group. Further research could give more clarity as to why the average elasticity is outside the income group elasticities range. However, the simulations done in this study include lower and higher bounds of the elasticities estimated which capture the variability shown in Table 3.

6.2 Status quo: Optimal price

The status quo estimations – a 160 percent ad valorem rate as well as a specific 0.35 MXN tax per cigarette – generate income of 47,611 Million MXN. This estimation is greater in 12.1 percent than the revenue from tobacco taxes reported by the Secretaría de Hacienda y Crédito Público (SHCP) in 2018.

The sales obtained from the *Encuesta Mensual de la Industria Manufacturera* (EMIM) and the *Secretaría de Economía* are 1,890 million of packs of cigarettes in 2018. The weighted average price per pack of cigarette is of 48.77 MXN. Tax burden including VAT and IEPS is 65.5 percent of the final price, as shown in Table 4.

Table 4 Status Quo

Concept	Pesos
Retail price before IEPS	11.37
IEPS per pack of cigarettes	25.19
Retail price after IEPS	36.56
Retail markup per pack	5.48
Retail price before VAT	42.04
VAT per pack	6.73
Retail price	48.77
Sales (million of packs)	1,890
IEPS revenue (millions)	47,611.0
VAT revenue (millions)	12,714.2
Total revenue (millions)	60,325.3
IEPS as % of price	51.7%
Total tax as % of price	65.5%

6.3 Cost-benefit analysis

To conduct the cost-benefit analysis of an increase in the price of tobacco, several simulations are considered. However, given that the elasticities of the three income groups for 2018 are used, Table 5 shows the descriptive results of the baseline scenario for total expenditure, tobacco expenditure percentage, medical expenses percentage, and life year income loss.

Table 5 Baseline Descriptive Results

	General	Group 1	Group 2	Group 3
Total monthly expenditure	31,913	10,912	24,169	60,659
Tobacco consuming households	5.34%	3.39%	5.20%	7.42%
Cigarette expense	0.20%	0.22%	0.20%	0.18%
Portion of medical expenditure for smoking	7.21%	13.45%	9.28%	5.27%
Income lost: Work years	0.19%	0.08%	0.02%	0.01%

*Quarterly information

Based on the information shown in ENIGH, the households in Mexico have an average quarterly expenditure of $31,913 MXN. The low income group spends $10,912 MXN, the middle income group spends $24,169 MXN while the high income group spends $60,659 MXN. The high income group spends 5.5 times more than the low income group.

The number of smoking households concentrates in the third income group, but the cigarette expenditure as a percentage of the total expenditure is slightly higher in the first income group. Additionally, low income households spend 13.45 percent of its income in tobacco consumption related medical services, compared to 5.26 percent from households with the highest income.

The income loss resulting from life year loss has a bigger effect on low income households since these households lose 0.08 percent of their income as a result of work disabilities and tobacco consumption related diseases. The loss among the highest income groups is 0.01 percent.

6.4 Simulations: Optimal tax

The direct cost estimations for 2018 is 79,991 Million MXN while the indirect costs account for 11,025 Million MXN[2]. This translates into a total cost of 91,026 Million

[2] Data retrieved from Cantú (2013), adjusted by inflation.

MXN.

An optimal tax is defined as the tax rate needed for the income coming from IEPS to cover both direct and indirect costs, with the limitation that costs are fixed and the analysis doesn't consider the decrease in costs that a decrease in consumption might entail.

To prevent a tax increase from turning into a change in the consumption of more affordable brands, only the specific component of IEPS is changed, leaving the ad valorem component at 160 percent. The estimation results are shown in Table 6.

Table 6 Optimal tax

Concept	Status quo	Optimal tax	Variation
Retail price before IEPS	11.37	11.37	0.00%
IEPS per pack of cigarettes	25.19	55.19	119.09%
Retail price after IEPS	36.56	66.56	82.06%
Retail markup per pack	5.48	9.98	82.06%
Retail price before VAT	42.04	76.54	82.06%
VAT per pack	6.73	12.25	82.06%
Retail price	48.77	88.79	82.06%
Elasticity	NA	-0.42	NA
Sales (millions of packs)	1,890	1,226	-35.13%
IEPS revenue (millions)	47,611.01	67,661.79	42.11%
VAT revenue (millions)	12,714.24	14,633.38	15.09%
Total revenue (millions)	60,325.25	82,295.17	36.42%
IEPS as % of price	51.65%	62.16%	20.34%
Total tax as % of price	65.50%	75.95%	15.96%

Assuming the direct and indirect costs are fixed, the maximum IEPS collection for cigarettes account for 67,662 Million MXN. This amount is insufficient to cover the direct and indirect costs, which are 91,026 Million MXN. Based solely on the

IEPS collection, 23,364 Million MXN are missing to cover such costs. When considering the total collection – that is, IEPS plus VAT – 8,349 Million MXN would still be missing. This simulation uses a scenario of a 160 percent ad valorem component and a specific component of 1.85 MXN per cigarette, which is the point where revenue collection will fall as consumption of cigarettes decreases. However, this simulation shows that increasing the tax burden through an increase in the specific IEPS component to 1.85 MXN per cigarette results in a tax burden increase, moving from 65.50 percent to 75.95 percent of the total price. This increase translates in a 35.13 percent sales reduction and an increase in the IEPS revenue of 42.11 percent. Moreover, the VAT revenue increases by 15.09 percent, which translates in an increase of total revenue (IEPS plus VAT) of 36.42 percent. The increase in taxes translates to an increase in retail price of 82.06 percent.

6.5 Cost-benefit analysis

In this sub-section of the report, the distribution effects are calculated based on Equation 6 - change in the tobacco expenditure; Equation 7 - change in medical costs; and Equation 8 - change in life years, plus the data shown in Table 7. The mean elasticity is the result from the estimation of elasticity-price in two stages as shown in Table 3. The low and high elasticity levels are the result of reducing or increasing the value of the medium elasticity by 20 percent. The results assume full pass through of the tax increase to the consumers.

Table 7: Elasticity range by income group 2018

	Average	Low income	Medium income	High income
Low elasticity	-0.353	-0.489	-0.451	-0.389
Medium elasticity	-0.424	-0.587	-0.542	-0.466
High elasticity	-0.509	-0.704	-0.649	-0.560

The results from this estimation will be used to obtain the aggregated effect of a tax policy on tobacco, which will be estimated as follows:

Effect on Income = Change in Tobacco Expenditure + Reduction in Medical Expenses + Income Increase.

Two scenarios will be presented in this document:

1. An increase in tobacco price that updates the tax based on inflation. This means an 8 percent increase in the price of tobacco. This policy has been implemented starting in 2020. Each year, the specific component of the IEPS will be updated by inflation.
2. An increase in the cigarette price to arrive at 75 percent of tax coverage, adding two taxes: VAT and the excise tax. With this structure, a 58 percent price increase is required to reach the 75 percent tax coverage[3].

Both scenarios are calculated for all three ranges of elasticity and income groups.

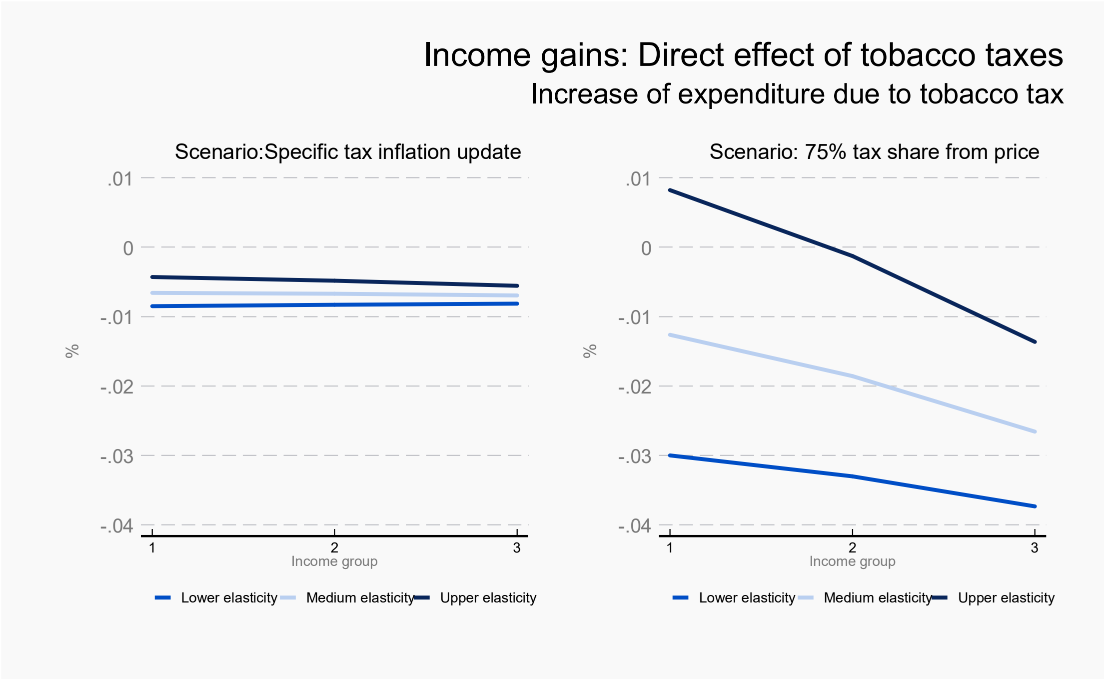
6.5.1 Direct effect on the price due to tax increase

The change in cigarette expenditure is calculated based on Equation 6 and Table 7, assuming full pass through of the tax increase to the consumers. The results are shown in Figure 1, which show that for the first scenario, which is a modest increase of 8 percent, does not result in reduced cigarette consumption for any of the income groups. However, in the second scenario, with the upper elasticity level, the low income group experiences a positive effect on its income from the increase in cigarette price. This happens given the 58 percent price increase would cause the lowest income households to reduce their tobacco expenditure by increasing their available income – creating a progressive effect.

For groups two and three, even a 58 percent increase does not result in cigarette consumption reduction due to their elasticity being lower.

[3] This percentage structure was obtained from the simulation exercise conducted in the PAHO Workshop.

Figure 1 Income gains: Direct effect of tobacco taxes



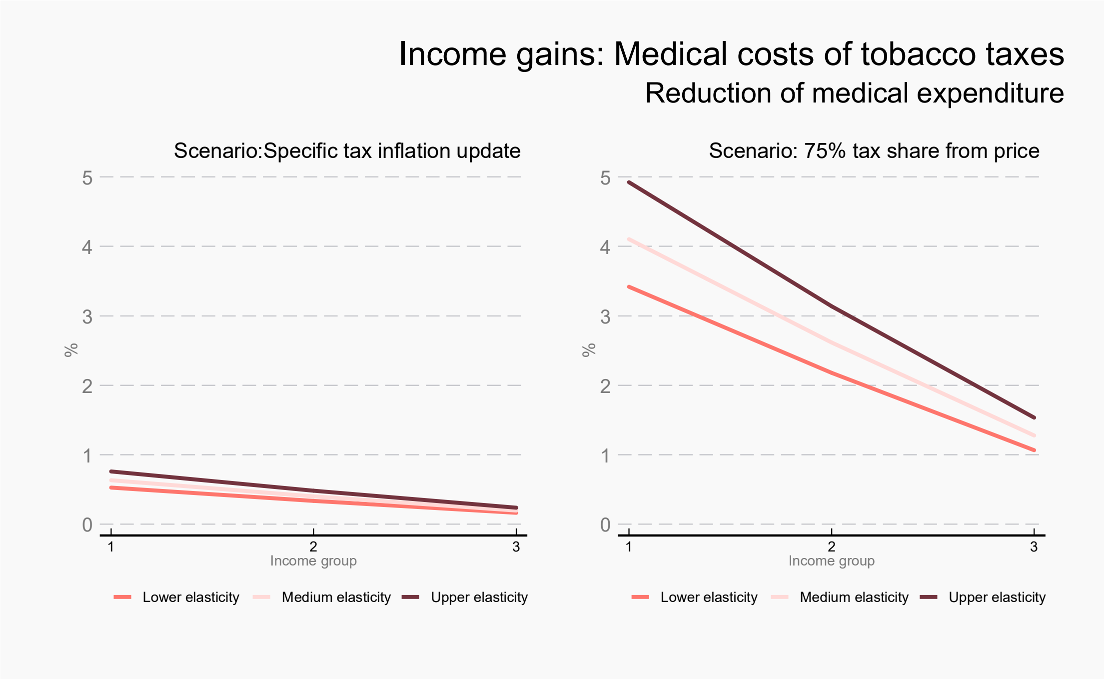
6.5.2 Medical expenses

The results for medical expenses are shown in Figure 2. The calculations result from Equation 7 and Table 7. The results show that for the first scenario there is a reduction in medical expenses and an increase in income, especially in low income households for three the three levels of elasticity.

The effect on medical expenses reduction is greater in the second scenario where gains in income for poorer household can represent between 3.5 percent to 4.9 percent of their income, while for richer household this gains are between1 percent and 1.5 percent.

The effects for lower income households are bigger because they spend more in health and their tobacco price elasticity is higher.

Figure 2 Income gains: Medical costs of tobacco taxes

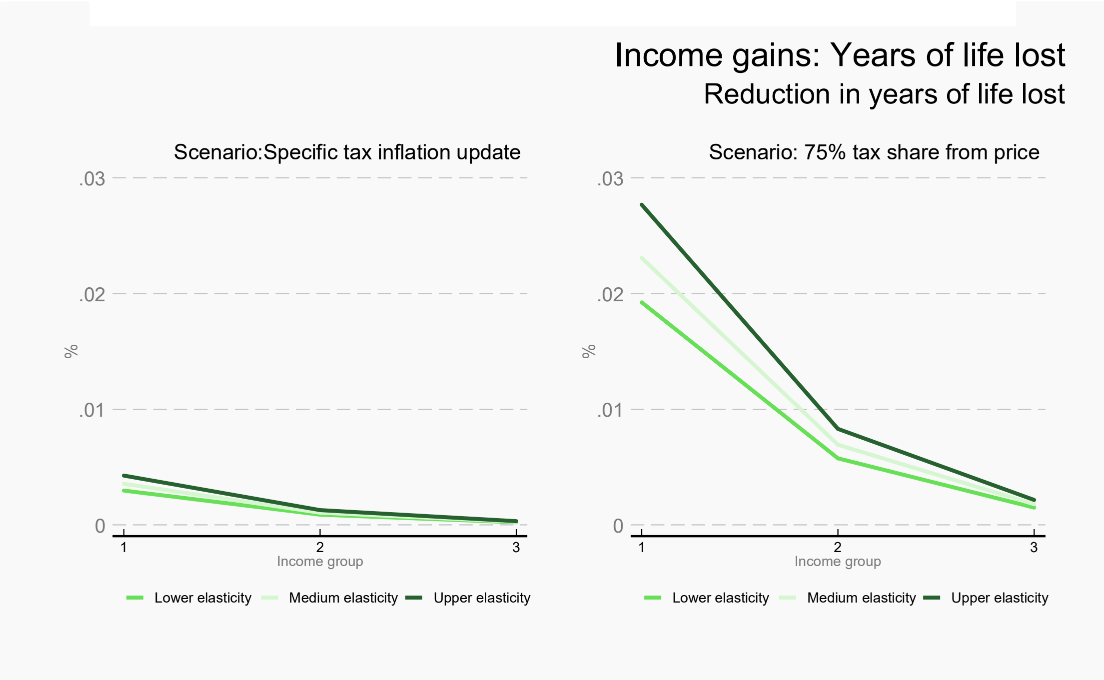


6.5.3 More work life years

The cost of lost work life due to tobacco consumption is estimated using Equation 8 and Table 7. The results shown in Figure 3 show that a reduction in tobacco consumption and the expected reduction in the lost work years have positive effects on welfare and earnings.

Once again, the effects in the second scenario experienced by the low income group are higher than those experienced by the other two groups. In both scenarios, however, the effect seems to be progressive.

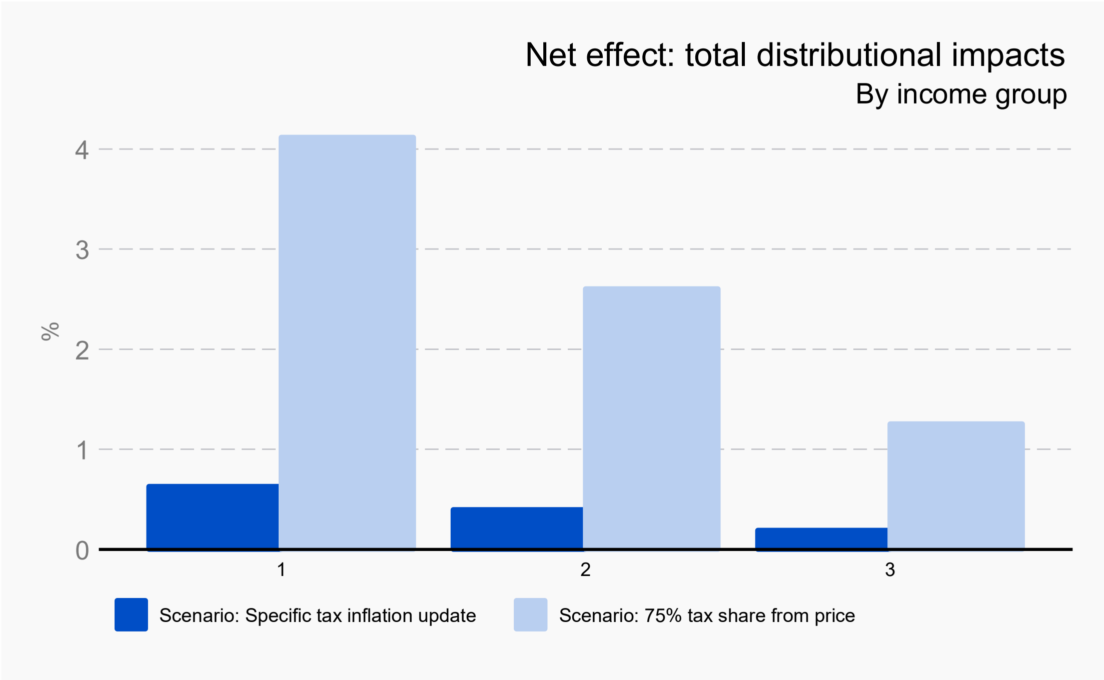
Figure 3 Income gains: Years of life lost



6.5.4 Net effect: Impacts on total distribution

This sub-section adds the previous results of changes in tobacco expenditure, medical expenses, and work life years. Using the middle elasticity limit, Figure 4 shows how the net effect would be better for lower income households. Their income gains would be 3.2 times higher than those experienced by richer households. This means that increasing tobacco prices would be a progressive policy. Indeed, the impacts would be 7 times greater if the price increase was of 58 percent instead of 8 percent, as shown in the simulated scenarios.

Figure 4 Net effect: Total distribution impacts



7. Conclusions

The literature on tobacco has shown that smoking causes a negative effect on health and welfare in general. It has also shown that one of the most effective policies to reduce tobacco consumption is to increase tobacco price and taxes. Tobacco consumption is inelastic, however, which means that an increase in price does not translate 100 percent into a consumption reduction, and thus, the net effects of a tobacco price increase policy are not clear.

This report attempts to shed some light on this problem by analyzing the cost-benefit ratio for two types of tobacco price increase policies. The estimations fully depend on the elasticity used, which will determine how sizeable the impact will be on income as well as the increasing benefits.

Tobacco taxes have two main objectives in mind: One is discouraging tobacco consumption as to improve health and welfare, while the second is collecting more money for the public sector, ideally to cover the externalities produced by consuming tobacco.

On one hand, the results indicate that the increase in tobacco taxes in Mexico accomplished the first objective by reducing cigarette consumption and preventing initiation of new smokers. This can be inferred since there is a decrease in tobacco consumption among low-income households when tobacco price increased by 58 percent. But this is also because there are decreases in medical expenditure across all income groups and elasticity levels.

On the other, tobacco taxes represent a source of income of $47,611 Million MXN. This amount must at least cover the direct costs of tobacco consumption, which account for $79,991 Million MXN. The maximum tax amount, including IEPS and VAT, that the Government would be able to collect from cigarettes is, however, 75 percent of retail price. This means an 82 percent increase in the price of cigarettes over the final price, with which IEPS income would reach a maximum amount of $67,662 Million MXN. At this point, the consumption reduction would be greater than the revenue impacts of the tax increase. This is the reason why it is not possible to obtain a tax rate that covers all direct and indirect costs.

Based on the results obtained for Mexico, it is necessary to increase tobacco prices since this policy is progressive in nature. Although two-thirds of the population would experience increases in tobacco expenses, the benefits are greater in medical expense reduction and productivity gains, which compensate any negative effect resulting from an increase in the tobacco expenditure percentage across all income groups and elasticity levels.

8. Acronyms

EMIM Encuesta Mensual de la Industria Manufacturera

ENCODAT Encuesta Nacional de Consumo de Drogas, Alcohol y Tabaco

ENIGH Encuesta Nacional de Ingresos y Gastos de los Hogares

IECS Instituto de Efectividad Clínica y Sanitaria

IEPS Impuesto Especial a Producción y Servicios

IHME Institute for Health Metrics and Evaluation

INEGI Instituto Nacional de Estadística y Geografía

LIEPS Ley del Impuesto Especial sobre Producción y Servicios

NCD Non communicable disease

SAT Sistema de Administración Tributaria

SHCP Secretaría de Hacienda y Crédito Público

VAT Value Added Tax

WHO World Health Organization

YLD Year Lost Due to Disability

YLL Year Life Los

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Extended cost - benefit analysis of tobacco consumption in Mexico