A Toolkit for Simulating the Tobacco Tax System and Its Impact on Consumption, Sales, and Tax Revenue

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(CIEP)

Introduction

Overall tax revenue among countries in Latin America and the Caribbean (LAC) averaged 21.7 percent of GDP in 2021, while average tax revenue across OECD countries was 34.1 percent of GDP. Similarly, excise tax revenue in LAC countries averaged 1.8 percent of GDP, compared to 2.2 percent in OECD countries (OECD, 2023). Accordingly, and considering the shrinking fiscal space in the region and restrictions in access to finance (ECLAC, 2022), there is a clear need to strengthen sources of public funding.

One way to achieve this is through increasing excise taxes, which fulfill fiscal but also nonfiscal objectives. Imposing these kinds of taxes on products that cause harm to the population and/or the environment—including tobacco, alcoholic beverages, fossil fuels, pesticides, and high-calorie food and drinks—can increase tax revenue. At the same time, raising the prices of these products decreases their consumption and associated health harms.[1] The extent to which consumption is reduced depends on consumer sensitivity to product price (elasticity). Lower-income groups tend to be more responsive to price than those with higher incomes (Powell & Chaloupka, 2023).

Reducing consumption of products that are harmful to health by raising prices is associated with lower rates of disease and premature mortality. In the case of smoking, this also has an effect on child health by reducing rates of low birth weight and infant mortality, among other positive effects on children and families (Powell & Chaloupka, 2023).

[1] The leading types of risk, as measured in disability-adjusted life years (DALYs), are metabolic (high body mass index, high fasting blood sugar levels, high systolic blood pressure), environmental (particles in the environment, household air pollution, unsafe water), and behavioral (alcohol use, smoking, low birth weight) (IHME, 2023).

In response to this need to increase public funding and reduce consumption of harmful products, particularly of tobacco, excise taxes constitute a public policy tool capable of achieving both objectives. To analyze different tobacco tax policy proposals and scenarios, CIEP has developed the Tobacco Tax Simulator, a digital tool providing decision makers, civil society organizations (CSOs), students, academics, and the wider public with accessible, easy-to-interpret estimates under various scenarios to stimulate informed discussion on optimal tobacco tax policy in Mexico.

Purpose of this handbook

This guide aims to help civil society organizations, decision makers, students, academics, specialists, and the wider public in Mexico, other Latin American, and low- and middle-income countries to understand, develop, and integrate into their analysis tobacco tax structures and tax simulators like the one developed by CIEP.

This handbook does not seek to offer discussion on econometric estimation strategies or computational efficiency in programming. Instead, it is intended as a guide to the flow of parameters and calculations used to perform simulations in different environments. This makes tax simulators useful, easy-to-understand tools that support the application of evidence-based public policy.

Who should use this handbook?

No expert knowledge in tobacco taxes, economics, or econometrics is needed to use this handbook, but a basic understanding of Stata codes or programming experience is required to understand the flow diagram and how it can be executed in another language.

How to use this handbook?

The first section describes how excise taxes are applied to tobacco, first in general terms and then specifically in Mexico, detailing the legislation that underpins these taxes and how part of this revenue is transferred from the central government to the states, Mexico being a federal republic. This illustration of the implementation of legislation for subnational transfers can help provide added value for countries that have earmarked these taxes for a particular type of expenditure.

The second section lists the data and inputs required in each country to develop a simulator similar to that found on the CIEP (2019) website and mentions the statistical software used (Stata).

The third section presents the methodology used to develop the CIEP tobacco tax simulator and describes the formulae and parameters used in calculating the effect of the IEPS[2] excise tax on variables like revenue, consumption, and sales. An initial scenario (status quo) is estimated, and then this section explains how the variables are changed to compare them with the initial scenario.

Information is also provided about the estimated distribution of funds among the country's states and cost-benefit calculations in terms of health and productivity. This section also describes the programming used in the simulator.

The fourth section illustrates how the simulator presents the results in infographics on the estimations performed in terms of revenue, sales, price of a pack of cigarettes, distribution of funds among states, and gains/losses in terms of health and income as a result of the change in tobacco tax framework. Importantly, these infographics show the potential that these tools offer for outreach, and how the results of the programming process can be communicated and shared with the public and decision makers.

1. Excise taxes

As previously mentioned, unlike value-added tax (VAT, or IVA in Spanish), excise taxes are levied on certain goods and services with a nonfiscal objective: they attempt to correct the externalities that consumption of these goods and services can cause to oneself or others.

Excise tax structures generally contain two main components. They may include a **specific tax** (an amount charged per unit of the product) or a **price-based tax** (an ad valorem tax imposed in relation to the price of the product) or combine both types of tax. Excise tax may vary according to tax law and can be levied based on different characteristics (price, quantity of the product/tobacco, weight, among others), so before programming any simulator it is crucial to conduct an analysis of the tax law and framework applicable in each country.

[2] Excise tax levied on tobacco in Mexico is known as the excise tax on production and services (*impuesto especial sobre producción y servicios,* or IEPS).

Excise tax on prepared tobacco in Mexico, for example, includes both forms of tax (in Mexico this excise tax is known as the "excise tax on production and services" or *impuesto especial sobre producción y servicios*, IEPS). The ad valorem rate applies to the price of the product exclusive of VAT and prior to retail sale, whereas the specific tax is applied per cigarette stick (both forms of tax are set forth in the Excise Tax on Production and Services Law, LIEPS, and are updated annually for inflation).

1.1 Application in Mexico

The excise tax on production and services (IEPS) was introduced in Mexico in 1980, and after several changes to the legal framework it currently applies to:

- alcohol, denatured alcohol, and molasses;
- calorie-dense non-basic foodstuffs;
- beverages with alcohol content and beer;
- energy and flavored drinks;
- automotive fuels and fossil fuels;
- pesticides;
- **prepared tobacco;**
- telecommunications; and
- games and prize draws.

In the case of prepared tobacco, Article 2, Section I, Subsection A of the Excise Tax on Production and Services Law (LIEPS) imposes an ad valorem tax rate of 160 percent of the wholesaler's price to retailers, or 30.4 percent when cigars or other prepared tobacco products are entirely handmade. The law also levies an additional specific tax of $0.5911 per cigarette[3] sold or imported in 2023, updated to $0.6166 for 2024, and requires that this amount be adjusted annually based on observed inflation in the country.

[3] The IEPS Law (LIEPS) considers a cigarette to weigh 0.75 g, including the weight of other substances mixed with the tobacco. In the case of cigars or other handmade tobacco products, the same specific tax rate is applied, but the weight of the product in grams is divided by 0.75 g.

2. Required data

Various data and parameters are required to develop and program a simulator in Stata. These can be classified into fiscal components, economic components, and microdata.

Fiscal components

- **Rate of value-added tax (VAT) or other sales taxes**

  This is the percentage applied to the final or retail price paid by the end consumer. The simulator uses VAT (in Spanish, IVA), but other countries may apply a different tax to the final sale of products and services as well as different rates depending on the product or link in the production chain.

  In Mexico, the Value-Added Tax Law (*Ley de Impuesto al Valor Agregado*) establishes a rate of 16 percent.

- **Component 1. Specific tax**

  This is a price-independent tax applied to a given quantity of a product or input; in the case of prepared tobacco, this could be a pack of 20 sticks or each individual stick.

  In Mexico, this tax was established by the LIEPS and is set at MXN 0.5911 per stick for 2023.

- **Component 2. Ad valorem tax**

  This is a percentage applied to the price of the product exclusive of VAT (IVA), the specific tax, and the profit margin. This information may change depending on the fiscal scheme applied in each country.

  The tax rate or taxable base amount may vary depending on local law. In Mexico, the rate is set by the IEPS Law at 160 percent.

- **Government revenue from excise tax**

  This is the real (inflation-adjusted) monetary amount collected from tobacco tax. These data are generally published by the treasuries or ministries of finance or economy of central governments.

Economic components

- **Price elasticity of demand for tobacco**

This is the percentage change in the amount demanded/sold for each percentage change in price:

$$\varepsilon = \frac{\Delta\%Q_d}{\Delta\%P}$$

For the CIEP tobacco tax simulator, elasticity had been calculated previously by CIEP (2020) following the methodology of John et al. (2019). Anyone wishing to develop a similar simulator would need to carry out a similar calculation, using the same methodology, or obtain this value from the specialized literature.[4]

In Mexico, elasticity has been estimated at -0.4240, meaning that a 10-percent increase in price results in a 4.24-percent decrease in demand.

- **Retailer's profit margin**

  This is the percentage retailers make in profit on the sale of a product. Generally, it is the percentage difference between the retail price and the acquisition cost of the product.

  This example given for Mexico uses a calculation by Waters et al. (2010), who reported a value of 10.72 percent.

  For other countries, readers are advised to review the available literature and data from surveys or administrative records on industry income and expenditure published by government ministries or departments and national statistics institutions.

- **Growth of GDP from years *t* (present) to *t+1* (next year).**

  Where *t* is the current year and *t+1* is the next year. This is the percentage change in GDP between two years in the time horizon under consideration. For past years, the percentage change in real GDP should be used. For future years, estimates must be used. These data are generally published by national statistics institutions, treasuries or ministries of finance or economy, or central banks.

  The CIEP tobacco tax simulator uses the most recent estimates provided by the Secretariat of Public Finance and Credit (SHCP) and the National Institute of Statistics and Geography (INEGI).

[4] If needed, it is possible to use a regional average or an average of price elasticities in countries with similar incomes to conduct the analysis.

- **Pack price (market price [p])**

  This is the average price of packs of 20 cigarettes sold in the year of simulation.

  For Mexico, these prices were obtained from the National Institute of Statistics and Geography (INEGI) as part of the Consumer Price Index.

  This information is used to track inflation and is made available by institutions responsible for measuring and monitoring inflation, often national statistics institutes.

- **Retail sales of tobacco**

  This is the number of products sold to cigarette distributors, in particular businesses that sell firsthand to consumers.

  For Mexico, this information was obtained from the Monthly Survey of the Manufacturing Industry (EMIM) conducted by INEGI. The data were annualized by adding together each month, then exports were subtracted and imports were added, as reported by the Secretariat of Economy (SE). The result of this calculation is referred to as apparent domestic consumption (ADC).[5]

  $$ADC = production - exports + imports$$

  As with the previous figure, this information can be obtained or requested from national statistics institutes in each country.

- **GDP deflator**

  This measure is usually calculated based on GDP price indices in systems of national accounts published by national statistics agencies.

  Specifically, in Mexico, this is calculated with the GDP implicit price index, published by the National Institute of Statistics and Geography (INEGI) as part of the economic indicators in the System of National Accounts.

Microdata on household income/expenditure

The recommendation is to use microdata on household income and expenditure. Generally, this information is taken from nationally representative surveys by public statistics agencies.

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[5] This estimate assumes that the full amount of product available is consumed; in other words, there is no stock.

This simulator for Mexico uses the National Survey of Household Income and Expenditure (ENIGH), which provides information by household offering data on total expenditure, expenditure on tobacco, and the number of households and household members. All this information can be consulted in the "Concentradohogar" database.

- **Health expenditure as a share of total expenditure**

  This is the average health expenditure of families on smoking-related diseases as a percentage of total (public and private) health expenditure.

  Here, a value of 0.093 (9.3 percent) is used, as estimated in a study by Reynales-Shigematsu et al. (2020).

  For other countries, readers are advised to review the available literature and data from household income and expenditure surveys published by government ministries or departments and by national statistics institutions and reports by central governments on public health expenditure.

- **Loss of income from lost working years**

  This is the monetary value of labor that would have been performed had a person not died due to smoking-related diseases.

  The CIEP tobacco tax simulator uses a value of 0.0019 (0.19 percent), estimated by CIEP (2020) based on the methodology laid out by the Institute for Health Metrics and Evaluation (IHME) (2019).

  It should be noted that IHME (2019) has information available for different countries and may be a useful reference in developing a tobacco tax simulator for another country.

3. Methodology

The primary objective of the CIEP tobacco tax simulator is to identify the impacts in economic and fiscal terms—such as price, consumption, and revenue—of a potential change in tobacco tax policy.

A Mexican framework is used to illustrate the simulation process, but the variables can be replaced with other parameters depending on the legislation applicable wherever the methodology is being replicated. The CIEP tobacco tax simulator allows changes to two variables: specific (lump sum) IEPS per stick and ad valorem tax per pack. Both variables can impact federal revenue from the consumption and sale of cigarettes.

The methodology is divided into two main sections. The first presents the changes in prices, sales, and revenue from cigarettes. This section is further divided into calculations for the status quo and for the alternative scenario. The second part explains how to calculate potential household income gains/losses resulting from the increase or decrease in expenditure on tobacco, medical expenses, and life days. Both sections describe the mathematical calculations in each part of the Stata code, the creation of variables, and the commands used in this process.

The status quo is taken to mean the current economic conditions, which remain unchanged in public policy on tobacco. Status quo calculations are dependent on national legislation and economic theory. In the simulation—also called the alternative scenario—the specific and/or ad valorem tax is modified. This alternative scenario employs the same data processing methodology as the status quo, thus enabling a direct comparison using the different tobacco prices resulting from the increase in specific and ad valorem tax.

The methodology assumes that previously collected data are from the same year. Developers will need to decide whether to operate the simulator with a specific tax, an ad valorem tax, or both, based on their needs and the tax structure of the relevant country.

3.1 Impact of tobacco IEPS on consumption, sales, and revenue

One the most important inputs in this section is the price elasticity of consumption, as previously calculated. One of the most frequently used methods of calculation is that of Deaton (1980), which employs a cluster analysis for more precise data processing. The methodology, explanation, and programming can be found in (John, Chelwa, Vulovic, & Chaloupka, 2023). However, depending on the availability of information for the economy in question, another methodology may be employed to calculate elasticities, or estimates for this parameter may be found in the specialized literature. Calculations are then made for two scenarios: first the status quo and then the alternative scenario.

Status quo

To begin the baseline estimate, it is first necessary to extract the components of the final price: VAT, retailer’s profit, and excise taxes (IEPS). This illustration follows the order in which prices and tax are calculated in the Mexican tax system, but this can be changed to suit each country. If a different legislation provides for more (or fewer) taxes, these should be accounted for in the price decomposition, following the order of application determined by law for bookkeeping purposes.

For example, for cigarettes in Mexico, excise tax is applied to producer prices first, followed by the retailer's profit margin and, lastly, VAT. The status quo price is broken down in the code in the reverse order to that in which each component is added[6]:

1. VAT per pack is one element retailers must account for in determining the final price.

$$VAT\ per\ pack = \frac{Price * VAT\ rate}{1 + VAT\ rate}$$

2. The retailer's profit margin is the percentage of markup added by retailers to the price of a product to obtain the final sales price payable by the consumer. This is an indicator of profit in the sale of tobacco. Readers should note that the retailer's profit margin is a percentage, whereas retailer profit, calculated in the following line, is a monetary amount per pack.

$$Retailer\ profit\ per\ pack\ = \frac{\left(Price - VAT_{per\ pack}\right) * Retailer's\ profit\ margin}{(1 + Retailer's\ profit\ margin)}$$

3. Specific excise tax per pack is obtained by multiplying the specific tax by the number of sticks in each pack of cigarettes. This example is based on a pack of 20 cigarettes.

$$Specific\ tax\ per\ pack = Specific\ tax * Average\ number\ of\ cigarettes\ per\ pack$$

4. The ad valorem tax is multiplied by the price minus VAT per pack, the retailer profit, and the specific tax.

$$Ad\ valorem\ tax\ per\ pack = \frac{\left(Price - VAT_{per\ pack} - Retailer\ profit_{per\ pack} - Specific\ tax_{per\ pack}\right) * Ad\ valorem\ tax}{(1 + Ad\ valorem\ tax)}$$

[6] This price decomposition is based on the Mexican framework. For other countries, please refer to applicable national law.

5. The industry price is obtained by subtracting all taxes applied and the retailer's profit from the market price.

$$Industry\ price = Price - VAT\ per\ pack - Retailer\ profit - Specific\ tax\ per\ pack - Ad\ valorem\ tax\ per\ pack$$

6. Once the price has been broken down into its components, the next step is to calculate the full amount of tax as a share of the pack price.

$$Share\ of\ tax\ in\ price = \frac{VAT\ per\ pack + Specific\ tax\ per\ pack + Ad\ valorem\ tax\ per\ pack}{price} * 100$$

The components calculated above, and the initial parameters will provide estimates of revenue and economic variables in the following part of the code. In some cases, the values will equal those of official sources. Other times, the values obtained will be different, in which case they should be calibrated because any inconsistency with official figures available in each country would introduce bias into the simulation results. This adjustment is made by way of the excise taxes (specific and ad valorem), which are the focus of this simulator. Most commonly, it is information relating to representative samples or surveys not reported by statistical offices—for reasons of confidentiality, competence, or difficulty in census-taking—that will require adjustment. Calibrating the simulator may not be necessary if the results match the sources, which depends on the quality of the data. For the purposes of this handbook, the adjustment process is described in general terms.

7. Retail sales are calculated by multiplying the number of packs sold[7] by the market price.

$$Retail\ sales = Sales * Price$$

8. The next step is to calculate the VAT incurred on the sale of packs of cigarettes.

$$VAT\ revenue = Sales * VAT\ per\ pack$$

[7] Some centers for statistics may report sales of tobacco in kilograms. In this case, a cigarette was considered to weigh 0.75 g, with each pack containing 20 cigarettes. Previous calculations were used.

9. The estimate must take into account the retailer's profit margin in the total sales amount. It is assumed that all sales are retail.

$$Retailer\ profit = Sales * Retailer's\ profit\ margin_{per\ pack}$$

10. The total specific tax from sales is also calculated.

$$Revenue\ from\ specific\ tax = Sales * Specific\ tax\ per\ pack$$

11. Ad valorem tax is calculated following the same procedure.

$$Revenue\ from\ ad\ valorem\ tax = Sales * Ad\ valorem\ tax\ per\ pack$$

Estimated IEPS revenue must then be adjusted to actual observed revenue. To do this:

12. The adjustment must be based on the proportion of observed revenue to the total estimated excise tax from tobacco. This adjustment establishes the differential between the observed and estimated figures. A higher numerator means that the estimation is reporting higher sales than tax office records. More commonly, the numerator is lower because the calculation uses average prices, tobacco sales are determined by the survey, and the retailer profit is a generalized approximation. Only if the result is 1 should no adjustment be made to the variables, as this means that the estimated figures match the observed figures exactly. The calculation is structured this way considering that revenue from specific tax and ad valorem tax are not reported separately. However, if necessary, the adjustment could be made separately, as appropriate.

$$Adjustment = \frac{Revenue\ from\ specific\ tax + Revenue\ from\ ad\ valorem\ tax}{Revenue\ from\ tobacco\ excise\ tax}$$

13. The proportion of observed revenue to calculated excise tax is used to readjust specific tax revenue by dividing specific excise tax from sales of cigarettes by the adjustment. In other words, the result of step 10 over the adjustment.

$$Revenue\ from\ specific\ tax_{adjusted} = Revenue\ from\ specific\ tax / Adjustment$$

14. The same adjustment is made for the ad valorem component.

$$Revenue\ from\ ad\ valorem\ tax_{adjusted} = Revenue\ from\ ad\ valorem\ tax / Adjustment$$

15. Adding together the two components of IEPS yields the observed revenue; this step serves to confirm the adjustment factor that will be used in the simulation. The adjustment factor represents the percentage of revenue over-/under-identified with the simulator estimation.

$$Revenue\ from\ IEPS_{estimated} = Revenue\ from\ ad\ valorem\ tax_{adjusted} + Revenue\ from\ specific\ tax_{adjusted}$$

16. The total industry income is obtained by multiplying sales by the industry price.

$$Industry\ income = Sales * Industry\ price$$

Example of earmarked expenditure in Mexico

In Mexico, this revenue is distributed to subnational governments through a system of fiscal coordination.[8] The aim of this subsection is to illustrate how revenue collected can be earmarked in the simulator. These components should be adapted to local law or otherwise omitted.

17. First, non-earmarked federal transfers (*participaciones*) are calculated as eight percent of total revenue from tobacco.

$$Federal\ transfers_{08} = (Revenue\ from\ specific\ tax_{adjusted} + Revenue\ from\ ad\ valorem\ tax_{adjusted}) * 0.08$$

18. This eight percent is subtracted from revenue, and then 22.39 percent of the remainder is calculated as earmarked taxes further distributed to subnational entities.

[8] This could be an additional complication for Mexico but a non-issue in some other countries.

$$Federal\ transfers_{23} = (Specific\ tax\ per\ pack_{adjusted} + Ad\ valorem\ tax\ per\ pack_{adjusted} - Federal\ transfers_{08}) * 0.22386$$

19. Federal transfers are considered the sum of the partial eight-percent and 23-percent transfers.

$$Federal\ transfers = Federal\ transfers_{08} + Federal\ transfers_{23}$$

Estimation of the alternative scenario

The alternative scenario replicates the status quo calculations but modifies the specific and ad valorem components and inverts the price decomposition process to obtain a new price. Only the industry price, the retailer's profit margin, and the VAT rate remain unchanged. Should these values change, it is suggested that these updates be made in the status quo section. Presented below are the calculations used to identify differences, employing the reverse process to the status quo.

20. The ad valorem tax is calculated based on the industry price previously calculated in the status quo stage. It may be that this price is deflated with respect to the current year if the observations are not recent. This step and the next step assume that ad valorem and specific taxes are both different from the status quo. However, it is possible to change just one of the taxes and study the joint impact in the simulation. Both taxes should be applied within the limits of the legal framework of the relevant country.

$$Ad\ valorem\ tax\ per\ pack_{scenario} = Industry\ price * Ad\ valorem\ tax_{\ modified}$$

21. Similarly, the specific tax is extracted from the industry price. The number of cigarettes should be the same number used in calculating the average price of packs in the status quo section.

$$Specific\ tax\ per\ pack_{scenario} = Specific\ tax_{modified} * Number\ of\ cigarettes\ in\ a\ pack$$

22. The VAT rate can then be applied to the industry price, the two types of excise tax, and the retailer profit. It is assumed that the retailer profit and the VAT rate remain constant with respect to the status quo, to evaluate only the impact of the change in tax.

$$VAT\ per\ pack_{scenario} = (Industry\ price + Specific\ tax\ per\ pack_{scenario} + Ad\ valorem\ tax\ per\ pack_{scenario} + Retailer\ profit) * VAT\ rate$$

23. The difference between the status quo and scenario prices are due to the **specific and ad valorem components**. The amount of VAT paid and the retailer profit also change, since the basis for these calculations includes the components of IEPS.[9]

$$Scenario\ price = VAT\ per\ pack + Retailer\ profit + Specific\ tax\ per\ pack_{scenario} + Ad\ valorem\ tax\ per\ pack_{scenario} + Industry\ price$$

24. To calculate the change in sales, the price elasticity of demand is used to determine the change in consumption due to the increase in prices resulting from the changes to the specific and ad valorem components of excise tax. Sales are considered to be constant with respect to the status quo. The result is an increase/decrease due to the new price.

$$Change\ in\ sales = \left(Sales * \left(\frac{Scenario\ price - Price}{Price}\right) * Elasticity\right) + Sales$$

25. Once the price components have been broken down, it is possible to calculate the share of tax in the scenario price.

$$Share\ of\ tax\ in\ scenario\ price = \frac{VAT\ per\ pack_{scenario} + Specific\ tax\ per\ pack_{scenario} + Ad\ valorem\ tax\ per\ pack_{scenario}}{Scenario\ price} * 100$$

26. The value of retail sales is calculated by multiplying the change in sales by the scenario price. This shows the monetary increase/decrease in sales.

$$Retail\ sales_{scenario} = Change\ in\ sales * Scenario\ price$$

27. VAT incurred on the sale of cigarettes in the scenario is then calculated.

[9] Both amounts are calculated using percentage rates, which remain constant. Therefore, when these rates are applied to a higher base amount (due to the increase in IEPS), the result is higher.

$$Revenue\ from\ VAT_{scenario} = Change\ in\ sales * VAT\ per\ pack_{scenario}$$

28. The estimation should consider the retailer's profit margin in the change in sales. It is assumed that all sales are retail, and the same margin is used as in the status quo.

$$Retailer\ income_{scenario} = Change\ in\ sales * Retailer's\ profit\ margin_{per\ pack}$$

29. Specific tax from sales in the scenario is also calculated.

$$Revenue\ from\ specific\ tax_{scenario} = Change\ in\ sales * Specific\ tax\ per\ pack_{scenario}$$

30. The same procedure is employed for ad valorem tax in the scenario.

$$Revenue\ from\ ad\ valorem\ tax_{scenario} = Change\ in\ sales * Ad\ valorem\ tax\ per\ pack_{scenario}$$

31. The adjustment calculated in step 12 is used to calibrate the simulation. This is applied to revenue from specific tax in the scenario.

$$Revenue\ from\ specific\ tax\ in\ the\ scenario_{adjusted} = Revenue\ from\ specific\ tax_{scenario}/Adjustment$$

32. And then to ad valorem tax in the scenario.

$$Revenue\ from\ ad\ valorem\ tax\ in\ the\ scenario_{adjusted} = Revenue\ from\ ad\ valorem\ tax_{scenario}/\ \text{Adjustment}$$

33. Multiplying the change in sales by the industry price gives the total industry income after the changes to excise tax.

$$Industry\ income_{scenario} = Change\ in\ sales * Industry\ price$$

34. The proportion of change between the scenario price and the status quo price is also calculated.

$$\Delta \mathrm{P} = \left(\frac{Scenario\ price - Price}{Price}\right)$$

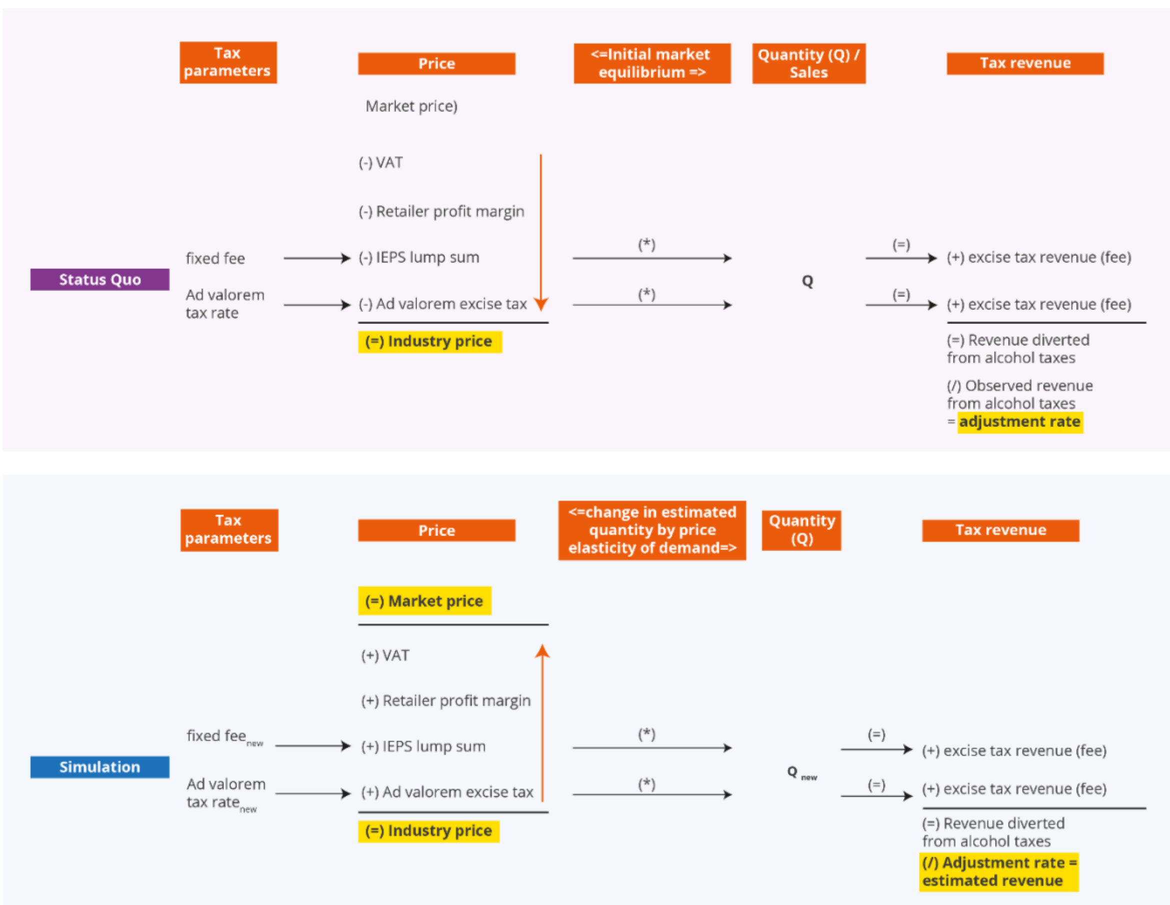
Once the price components and estimated sales have been obtained, the methodology can be repeated from step six to obtain economic and revenue estimates.

Flow diagram

By way of summary, the information in this section has been condensed into the diagram below. Essentially, the idea is to break down the market prices in the status quo so they can be multiplied by observed sales and a virtual revenue amount can be obtained. This revenue is then calibrated using an adjustment factor to arrive at the observed revenue.

For the simulation, the price components can be modified and the market price reconstructed. Based on the elasticity value, a new sales amount can be calculated, and the revenue estimations can be repeated. This diagram provides a general illustration of the data flow of the simulator, but each step can be calibrated based on the information available for each country or different econometric calculation methods.

Figure 1. Diagram of the tobacco tax simulator



Source: Prepared by CIEP based on the tobacco IEPS simulator

Results

After calculating the baseline and alternative scenarios, the following parameters can be considered for display in the simulator in both scenarios:

- specific component,
- ad valorem component,
- IEPS per pack,
- amount of federal transfers to states,
- health expenditure,
- sales,
- change in sales,
- share of tax in price, and
- price.

All of these results can be obtained for the status quo and for the simulated scenario. It is left to the judgment of research teams to determine how to present the most relevant results for the local context.

Cost-benefit

In addition to the impact on government revenue, the effects of public policy on tobacco prices also effect, as a matter of course, tobacco consumption, expenditure associated with smoking-related health conditions, and labor productivity. These impacts reduce the costs associated with tobacco and increase the benefits brought about by the tobacco tax change.

Fuchs et al. (2018) describe two types of economic costs associated with smoking:

- **Direct costs**: Costs[10] associated with medical treatment for the following conditions:
    - heart disease,
    - chronic obstructive pulmonary disease,

[10] These are just some of the costs and are therefore an underestimate, which is better than overestimating and setting unrealistic expectations.

- lung and other cancers,
- strokes, and
- pneumonia/influenza.

- **Indirect costs**: Costs arising from the loss of productivity and lower quality of life.

  Two indicators have been proposed to measure this effect. The first relates to the loss of **years of productivity** due to morbidity (YLD or years lived with disability), or in other words, disability due to smoking-related diseases. The second is the loss of **years of life** due to premature mortality in the population (YLL or years of life lost).

Following the methodology of Fuchs et al. (2018) and CIEP (2019), the cost-benefit of changing the components of tobacco prices can be calculated using the above indicators. The methodology employed to estimate the cost-benefit may vary based on the needs of each research team and local context, but the recommended approach is to take into account direct expenditures on tobacco, health-related costs, and labor productivity.

a. The first step is to measure gains from the change in expenditure on tobacco.

$$\Delta Gain\ Tobacco\ expenditure\ = \Big(\big((1\ +\ \Delta Price)(1\ +\ Price\ elasticity\ *\ \Delta Price)-\ 1\big)*Tobacco\ expenditure\Big)*(-100)$$

b. Then **gains from household medical expenses** are calculated using the following equation.

$$\Delta Gain\ Medical\ expenses\ =\ \big((1\ +\ Price\ elasticity * \Delta Price)-\ 1\big)*\ Health\ expenditure\ )*(-100)$$

c. Similarly, the **gain from days of life lost** is also calculated.

$$\Delta Gain\ Days\ of\ life = \big((1\ +\ Price\ elasticity\ * \Delta Price)-\ 1\big)*\ Days\ of\ life\ lost)*(-100)$$

d. The sum of these three results (a, b, and c) in relation to total expenditure provides a **monetary value** for all the microeconomic gains from the application of tobacco taxes (Fuchs et al., 2018; CIEP, 2019). For Mexico, the three types of gains were converted to pesos and annualized; surveys in Mexico report data by quarter, so the result were multiplied by four.

$$Gain\ in\ pesos\ from\ expenditure_{tobacco\backslash medical\backslash years\ of\ life} = \frac{(\Delta Gain\ from\ expenditure_{tobacco\backslash medical\backslash years\ of\ life} * Total\ expenditure\ )}{100} * (deflator * 4)$$

Results

All of these calculations are presented as outputs in the simulator for display. Also shown is the sum of all gains in income from the three types of costs.

3.2 Programming

The intention of this section is to translate and explain the methodology in a programming language to enable replication. The code was designed in Stata 16, following the procedure outlined in the previous chapter, which is the same order observed in the simulator. Before compiling the code, it is important to collect all of the data listed in the "Required data" chapter. For ease of reference, in this toolkit the Stata commands are shown in green, while the names of variables are indicated in **bold**.

User parameters and updating of databases

The first part of the programming process is to define the fixed variables and the commands that will allow users to update variables subject to deflation. For this, a do-file should be opened where the programming calculations can be made. The full, unannotated code can be consulted in the appendices. Developers are free to name the do-file however they wish and save it in a location of their choosing on their computers.

****Definition of commands that will display outputs for the WEB****

```
global update "update"
```

This creates a global macro called 'update' with the variable "update". Global macros are used to store values that can be used across various places in the code.

```
global output "output"                                  // PRINT OUTPUTS (WEB)
```

Like with the previous command, this creates a global macro called output with the variable "output".

The year of the calculations, or baseline year, is then determined.

local yearvp = Current year

```
. local yearpv = 2023
```

This defines a local macro called 'yearvp' with the value of the current year. Local macros are useful to store values that are used only in a specific part of the code.

Specific tax

This line of code is intended to define the specific tax variable, so one simply adds the number established by law for the country in question. If no such tax exists, this can be omitted and/or included as part of a fiscal policy proposal.

local stax = specific tax rate // PARAMETER 1 Status Quo

```
. local stax    = 0.5911
```

This defines a local macro called stax with the value of the specific tax rate.

local stax_1 = modified specific tax rate // PARAMETER 1 TO BE MODIFIED

```
local stax_1 = 0.5911 + 1
```

This defines a local macro called stax with the value of the modified specific tax rate, which is only useful in the Stata environment. In the example, one (peso) was added to the specific tax rate provided by law.

This line is replaced by the following line when the code is placed on the website.

local stax_1 = {{ieps_pesos}} *// PARAMETER 1 TO BE MODIFIED (WEB)*

This defines a local macro called stax with the value of the specific tax rate, which is only useful in the web programming environment under the source called `ieps_pesos'. This is annotated with an asterisk "" so that it is only used by the web programmer.*

****Ad valorem tax****

The ad valorem tax rate is 160 percent in Mexico, but this figure should be replaced by the established tax rate in the country for which the calculation is being made.

local advala = ad valorem tax rate *// PARAMETER 2 Status Quo*

```
. local advala   = 160/100
```

This defines a local macro called `advala' with a value of 1.6, which represents a parameter associated with the ad valorem *tax.*

local advala_1 = modified ad valorem tax rate *// PARAMETER 2 TO BE MODIFIED*

```
. local advala_1 = 165/100
```

Like in the previous step, this creates a local macro called `advala_1' with the modified ad valorem tax to identify changes in this kind of tax.

This line is replaced by the following line when the code is placed on the website.

**local advala_1 = {{ieps_percentage}}/100* *// PARAMETER 2 TO BE MODIFIED (WEB)*

This indicates that in the web environment, this value is taken from a source called `ieps_percentage'.

VAT (IVA)

VAT in Mexico is 16 percent of the total price of the product.

local vat = Value-added tax rate

```
. local vat = 16/100
```

This defines a local macro called `vat' with a value of 0.16, which represents value-added tax (VAT, or IVA in Spanish), which is 16 percent of the total price of a product in Mexico.

Elasticity: calculated by CIEP (2019)

local elasticity = price elasticity of demand

```
. local elasticity = -0.424
```

This defines a local macro called elasticity with a value of -0.4240, which represents an elasticity parameter. Elasticity measures the extent to which demand for a good changes in response to changes in its price. This parameter can be changed in line with elasticities from other studies or refer to the methodology outlined in John et al. (2019) for the calculation itself.

Retailer margin

This illustration assumes a margin of 10.72 percent of the price exclusive of VAT, based on Waters et al. (2010).

local margin = Retailer margin

```
. local margin = .1072
```

This defines a local macro called `margin' with a value of 0.1072, which represents a retailer margin of 10.72 percent. This calculation has been taken from a different study and can also be found as "reseller margin" in economic censuses. In the absence of this information, this value can be imputed at the programmer's discretion.

Data update

The following commands can be used to take into account and update the household income-expenditure survey databases.

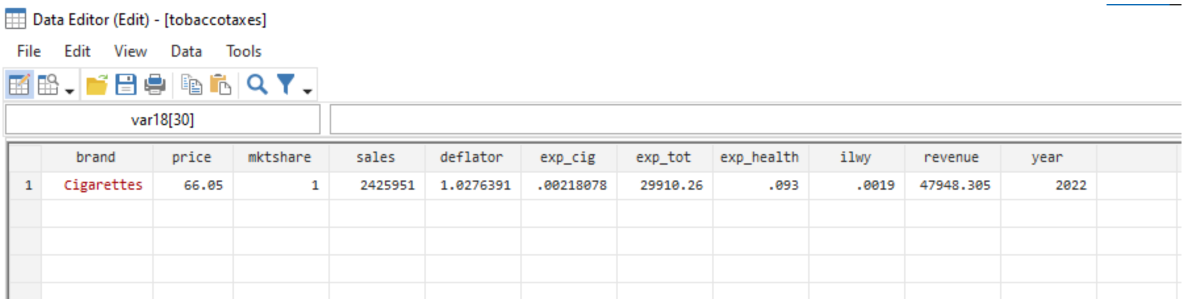
if "$update" != "" {

This checks that the global variable `update' is not empty before updating the data. The sign $ references the global variable.

It is necessary to define the variables that will serve to update the household income-expenditure survey databases. So far, all variables have been saved in locals and/or globals that can be used across the entire code. For the same reason, it is not necessary to save the values in a Stata data file (.dta) or in temporary files. Below, the `use' command is used in Stata to load a data file in DTA format into the current Stata session.

Use "`C:/Tabaco/Nov2022/bases/tobaccotaxes.dta", clear

The `use' command loads data files. Between " " is the full path to the DTA file to be loaded, and *clear* clears the previous database to make sure the new document is loaded without the two mixing. Another database is imported with the *use* command, containing information about the average price of cigarettes called `price', the market share `mktshare', sales `sales', the deflator variable `deflator', and tobacco tax revenue `revenue' for the current year. If revenue from specific and ad valorem tax are reported separately in official statistics, this database should include these differences.



	brand	price	mktshare	sales	deflator	exp_cig	exp_tot	exp_health	ilwy	revenue	year
1	Cigarettes	66.05	1	2425951	1.0276391	.00218078	29910.26	.093	.0019	47948.305	2022

The GDP deflator coefficient has the baseline year of the last National Survey of Household Income and Expenditure. Each of the variables should refer to the year for which it was calculated, which is indicated in the year column. All data should be in current values.

```
tabstat deflator if year == `yearvp', f(%20.5fc) save
```

The tabstat command is used to calculate descriptive statistics in Stata. In this line, it identifies the value of the deflator if (if) the variable `year’ is equal to the previously defined local `yearvp’. The format of the number identified in the .dta database should be that of 20 characters with five decimal places, separated by commas. The save command saves this data temporarily. The command should bring up a table in the results window, with the value of the selected variable.

```
local deflator = r(StatTotal)[1,1]
```

This same variable is saved in a local based on the information selected in the first row and the first column [1,1] of this table.

```
di `deflator'
```

The di command is used to display the value contained in the local macro called `deflator’. The macro variable deflator contains the value obtained previously by selecting the deflator from the table of statistics generated by the tabstat command.

```
.         tabstat deflator if year == 2023, f(%20.5fc) save

    variable |                 mean
-------------+----------------------
    deflator |              1.04463
------------------------------------

.         local deflator = r(StatTotal)[1,1]
.         di `deflator'
1.0446252
```

Annual revenue from IEPS on tobacco

```
local revenue = Tobacco/1000000
```

The information is saved in a local and divided by 1,000,000 to display the figure in millions. If the do-file is to be updated manually on a regular basis, revenue (*recaudación* in Spanish) and the deflator can be replaced with:

```
local revenue = amount of revenue in millions
```

```
local revenues = 146923543456/1000000
```

This means it would no longer be necessary to have a previous DTA; instead, the observations would be imputed. Similarly, revenue from specific and ad valorem tax would also need to be expressed in millions.

Information from ENIGH

This is where the values that will be used from the National Survey of Household Income and Expenditure will be loaded. In this example, the values are quarterly.

```
use "C:/Tabaco/Nov2022/bases/ENIGH 2020/concentrado.dta", clear
```

This document contains total expenditure per household `exp_mon', tobacco expenditure by families that report smoking `tobacco' and the expansion factor for the survey `factor'.

Total household expenditure

mean(exp_mon) [pw=factor]

```
.        mean(exp_mon) [pw=factor]

Mean estimation                    Number of obs   =     90,102

             |       Mean   Std. Err.     [95% Conf. Interval]
-------------+------------------------------------------------
     exp_mon |   39964.81   250.2083      39474.41    40455.22
```

This line is used to obtain the mean monthly expenditure (exp_mon) of all survey participants, smoking and non-smoking. The expansion factor is applied so the calculation can be made representative at a population level.

local exp_tot = r(table)[1,1]

The mean expenditure result is saved in a local under the name `exp_tot'.

di `exp_tot'

The di command shows that the information has been saved.

```
.        local exp_tot = r(table)[1,1]
.        di `exp_tot'
29910.26
```

Share of households that report smoking

The count of families that report tobacco expenditure in the survey through the tobacco column.

tabstat tobacco [fw=factor], stat(count) f(%20.0fc) save

The tabstat command provides descriptive statistics for the `tobacco' variable, considering the expansion factor under the parameter of final weights used in representative surveys. This line counts the number of families that responded to the household income-expenditure survey and their representativity in the population.

local pers_tot= r(StatTotal)[1,1]

The result of the tabstat line is saved in the 'tot_ppl' variable as a local.

di ` tot_ppl'

To check the result, the di (display) command is used to view the information in the results window.

```
.          tabstat tobacco [fw=factor], stat(count) f(%20.0fc) save

    variable |                    N
-------------+---------------------
     tobacco |           35,749,659
-----------------------------------

.          local tot_ppl= r(StatTotal)[1,1]
.          di `tot_ppl'
35749659
```

****Count of people who smoke****

tabstat tobacco if tobacco != 0 [fw=factor], stat(count) f(%20.0fc) save

```
.          tabstat tobacco if tobacco != 0 [fw=factor], stat(count) f(%20.0fc) save

    variable |                    N
-------------+---------------------
     tobacco |            1,667,639
-----------------------------------
```

This line counts the number of households with expenditure on tobacco.

return list

```
.          return list

matrices:
           r(StatTotal) :  1 x 1
```

This command is used to list and access the results generated by previous commands. The results are stored in a special data structure called a "return list". In the example, it identifies a 1 x 1 matrix.

local pers_tob = r(StatTotal)[1,1]

The number of people who smoke is saved in a local variable called `ppl_tob' (marked `pers_tab' in Spanish).

di `ppl_tob'

```
.          local ppl_tob = r(StatTotal)[1,1]
.          di `ppl_tob'
1667639
```

The *di* command can be used to view the saved result again.

local hh_smoke= ` ppl_tob'/`tot_ppl'

The proportion of smoking households in the full set of households in the survey is calculated and saved in the local variable `hh_smoke'.

di `hh_smoke'

The variable can be viewed in the results window using the di command.

```
.          local hh_smoke= `ppl_tob'/`tot_ppl'
.          di `hh_smoke'
.04664769
```

Tobacco expenditure as a share of total expenditure

gen prop_tobacco=tobacco/exp

The gen (generate) command creates new variables, in this case `prop_tobacco’ by calculating the `tobacco’ column, which is the total tobacco expenditure, as a share of the `exp’ (expenditure) variable, which is total household expenditure. This line performs the calculation for each family surveyed.

mean prop_tobacco [pw=factor]

The next step is to obtain the mean for the share of smoking households.

local exp_cig = r(table)[1,1]

This mean value is saved in a local variable called `exp_cig’.

di `exp_cig'

The result can be verified with the di command, which displays the saved information in the results window.

```
.         mean tobacco_share [pw=factor]

Mean estimation                    Number of obs   =     88,902

--------------------------------------------------------------
              |       Mean   Std. Err.     [95% Conf. Interval]
--------------+-----------------------------------------------
tobacco_share |   .0021808   .0000633      .0020568    .0023048
--------------------------------------------------------------

.         local exp_cig = r(table)[1,1]
.         di `exp_cig'
.00218078
```

Health expenditure as a share of total expenditure

This information was obtained from a study by Palacios et al. (2020).

local exp_health = Expenditure on smoking-related diseases/Total expenditure

```
local exp_health = 0.093
```

This represents the percentage of medical expenses attributable to smoking, based on a calculation of health expenditure on smoking-related diseases as a share of total expenditure. This variable was researched previously and is imputed with a local variable called `exp_health'. Users can also make their own calculations, for which they are advised to refer to the study cited above.

Loss of income: percentage of working years

This is taken from a calculation by CIEP (2020).

local ilwy = Loss of income in working years

```
local ilwy = .0019
```

The loss of income in working years (ilwy) was calculated previously and imputed in the local variable `ilwy'. This calculation can be taken from other studies, based on the country, or it can be measured with the help of the methodology proposed by Fuchs et al. (2018).

Average tobacco expenditure of smoking households

tabstat tobacco if tobacco != 0 [fw=factor], stat(mean) f(%20.0fc) save

This step obtains mean expenditure on tobacco by households that report smoking.

local exp_tob_p = r(StatTotal)[1,1]

This mean value is saved in a local variable under the name `exp_tob_p. (p = *promedio*, average).

di `exp_tob_p'

The result can be verified with the display command, which brings up this information in the results window.

```
.        tabstat tobacco if tobacco != 0 [fw=factor], stat(mean) f(%20.0fc) save

    variable |               mean
-------------+--------------------
     tobacco |              1,256
----------------------------------

.        local exp_tob_p = r(StatTotal)[1,1]
.        di `exp_tob_p'
1255.873
```

Tobacco industry data

capture g exp_cig = .

This line of code is used to create a new global variable called `exp_cig' and reset its initial value as a missing value, represented by a period (.).

In Stata, capture is used to prevent the generation of errors if the variable 'exp_cig' already exists. If 'exp_cig' already exists, the command will simply assign a missing value without causing an error. If it does not exist, it will be created with a missing value. The capture command prevents the code from becoming truncated and the variable being substituted despite already existing.

replace exp_cig = `exp_cig'

The variable `exp_cig from the database is substituted with the local variable for the mean expenditure on cigarettes `exp_cig' calculated previously.

capture g exp_tot = .

The same process is carried out for the mean total expenditure of households. First, missing values are generated.

replace exp_tot = `exp_tot'

Then the variable is replaced with the already existing local.

capture g exp_health = .

A missing value is also generated in the health expenditure variable.

replace exp_health = `exp_health'

This uses the imputed value taken from a different study and saved in the local `exp_health'.

capture g ilwy = .

At the same time, loss of income in working years is substituted with a missing value.

replace ilwy = `ilwy'

Then it is substituted with the previously saved local variable.

capture g revenue = .

At the same time, the revenue variable is created with a missing value.

replace revenue = `revenue'

Lastly, it is substituted with the local variable that has already been saved.

```
.          capture g exp_cig = .
.          replace exp_cig = `exp_cig'
(0 real changes made)
.
.          capture g exp_tot = .
.          replace exp_tot = `exp_tot'
(0 real changes made)
.
.          capture g exp_health = .
.          replace exp_health = `exp_health'
(0 real changes made)
.
.          capture g ilwy = .
.          replace ilwy = `ilwy'
(0 real changes made)
.
.          capture g revenues = .
.          replace revenues = `revenues'
(0 real changes made)
.          di `revenues'
```

save " C:/Tabaco/Nov2022/bases/tobaccotaxes.dta", replace

The information is saved in the same do-file with the replaced information.

Status quo calculation

Here again, this section uses the database saved in the update. From this point on, the calculations are the same as in the methodology.

use " C:/Tabaco/Nov2022/bases/tobaccotaxes.dta", clear

****VAT per pack**** **Equation 1**

g vatxpack = price`vat'/(1+`vat')*

VAT per pack is calculated based on the market price `price’ and the VAT rate `vat’, both in local variables.

Retailer margin Equation 2

g retmargin = (price-vatxpack)`margin'/(1+`margin')*

The retailer's margin in pesos is calculated based on the market price minus VAT, and the retailer's margin `retmargin'.

Specific tax per pack Equation 3

*g stxpack = `stax'*20*

The specific tax in pesos is calculated based on the market price.

Ad valorem per pack Equation 4

g avxpack = (price-vatxpack-retmargin-stxpack)`advala'/(1+`advala')*

The ad valorem tax is calculated in the same manner as above, based on the market price.

Industry price Equation 5

g pindustry = price-vatxpack-retmargin-stxpack-avxpack

Lastly, the industry price is calculated based on the market price minus VAT, the retailer's margin, and the specific and ad valorem taxes, which are calculated in pesos.

Change in price Equation 6

g camb_price = vatxpack+retmargin+stxpack+avxpack+pindustry

To confirm there is no discrepancy with the market price, the procedure can be carried out in reverse, by adding together the industry price `pindustry', VAT, the retailer's margin, and the specific and ad valorem taxes.

Share of tax in price Equation 7

*g taxshare = ((vatxpack+stxpack+avxpack)/price)*100*

The total share of tax in the market price is then calculated.

Retail sales Equation 8

*g rsales = sales*price*

This line identifies the total income from retail sales by multiplying sales `sales' in numbers by the market price `price'.

VAT revenue Equation 9

*g vatrev = sales*vatxpack*

Revenue from VAT on tobacco is calculated by multiplying the number of sales `sales' by the VAT charged per pack, as calculated previously.

Retailer profit Equation 10

*g minrev = sales*retmargin*

Total retailer profit is calculated by multiplying the number of sales by the profit margin per pack, in pesos, as calculated previously.

Specific tax revenue Equation 11

*g strev = sales*stxpack*

Similarly, total specific tax revenue is calculated by multiplying sales `sales' by tax per pack in pesos `stxpack'.

label var strev "Specific tax"

In Stata, the command label var is used to assign a label to a variable. In this case, the label "Specific tax" has been assigned to the variable 'strev'. This can be useful to provide a more informative description of the variable and facilitate the interpretation of results or database documentation.

Ad valorem tax revenue Equation 12

*g advrev = (sales*avxpack)*

Ad valorem tax revenue is calculated by multiplying the number of sales by the ad valorem tax in pesos.

```
label var advrev "Ad valorem tax"
```

The "Ad valorem tax" label is added to the total ad valorem tax revenue variable.

Adjustment Equation 13

```
g adjustment = (strev+advrev)/revenue
```

The above calculations are used to obtain the proportion of revenue in relation to total tobacco IEPS from specific and ad valorem tax. This is done with the intention of determining any difference between observations and the calculations performed in the above lines of code.

Adjustment for specific tax Equation 14

```
Replace strev = strev/adjustment in -1
```

The adjustment for specific tax is made by dividing total specific revenue by the last observation in the adjustment variable, also known as the adjustment factor, which is essentially a proportion. The command in -1 is an instruction to consider the last observation in the series.

Adjustment for ad valorem tax Equation 15

```
replace advrev = advrev/adjustment in -1
```

This process is repeated for the ad valorem tax, which is also divided by the last observation in the series `adjustment’, also known as the adjustment factor.

Industry income Equation 16

```
g indusrev = (sales*pindustry)
```

To obtain total industry income, the total number of sales `sales’ is multiplied by the industry price `pindustry’.

8% federal transfers Equation 17

```
g fedtransfers8=(strev+advrev)*0.08
```

In Mexico, specifically, part of this revenue is allocated for expenditure by states and can therefore be considered earmarked expenditure. This step calculates eight percent of total revenue from specific plus ad valorem IEPS. This eight percent is allocated to states.

23% federal transfers Equation 18

*g fedtransfers23=((strev+advrev)-fedtransfers8)*0.2239*

Then, this earmarked expenditure is subtracted from specific and ad valorem IEPS, and the result is multiplied by a rate of 22.39 percent to obtain the other part of the percentage that states receive of the tobacco tax they collect.

Sum of federal transfers Equation 19

g fedtransfers=fedtransfers8+fedtransfers23

The eight percent and 22.39 percent federal transfers are added together to obtain the amount allocated to states.

Scenario calculation

Some of the calculations here are the same as in the previous section because they follow the same procedure but use the new (specific and ad valorem) IEPS components, as modified for the simulation. The simulation can be carried out by changing the rate of the specific IEPS tax, the ad valorem IEPS tax, or both types of tax. The "Display and interactivity" section shows how they can be changed by users. Remember that the reverse engineering process used in the status quo is reversed for the simulation. In other words, the calculations are performed as they are in the real world, starting with the industry price.

Deflate the industry price

local deflator = deflator [-1]

To deflate the database, the `deflator' series is used as a local variable and the last observation is saved for the calculation with the command [-1].

G pindustry_1 = pindustry`deflator'*

This line is intended to update the industry prices calculated in the previous section, by multiplying the price `pindustry' by the deflator coefficient `deflator'. This step can be omitted if all the status quo information has been updated and/or refers to the current year.

Ad valorem tax per pack Equation 20

g avxpack_1 = (pindustry_1)`advala_1'*

Ad valorem tax revenue per pack is calculated by multiplying the updated industry price `pindustry_1' by the ad valorem tax defined in the parameters to be modified, in the "Parameters and updating" section.

Specific tax per pack Equation 21

*g stxpack_1 = `stax_1'*Number of cigarettes in a pack*

Similarly, specific tax per pack is calculated by multiplying the tax defined in the "Parameters and updating" section `stax_1' by the number of cigarettes in a pack.

Retailer profit. Fixed share of wholesale price. Equation 22

g retmargin_1 = retmargin

The simulation uses the same retailer's margin defined in the parameters to be modified. However, to avoid confusing the two, here it is named `retmargin_1'; this parameter can be imputed at the programmer's discretion. If it is different to the status quo value, the results will need to be interpreted differently. For a precise study of the effect of tax changes, this value should be kept constant.

Average VAT per pack Equation 23

g vatxpack_1 = (pindustry_1+stxpack_1+avxpack_1+retmargin_1)`vat'*

In the simulation, VAT per pack is calculated by adding together the simulated industry price `pindustry_1', the simulated specific tax per pack `stxpack_1', the simulated ad valorem tax per pack `avpack_1', and the retailer's profit. This sum is then multiplied by the value-added tax rate `vat'.

Scenario price Equation 24

g price_1 = vatxpack_1+retmargin_1+stxpack_1+avxpack_1+pindustry_1

Lastly, the price is obtained by adding together all the simulation components previously calculated: the value-added tax, the retailer's profit, the specific tax, the ad valorem tax, and simulated industry price. The total is the simulation price `price_1'.

Change in sales -Simulation sales- Equation 25

g sales_1=(sales(((price_1-price)/price)*`elasticity'))+sales*

Simulation sales are determined by calculating the difference between the simulation price `price_1' and the observed price `price'. This difference is multiplied by the `elasticity' value to ensure the calculation is in line with price elasticity of demand values from previous research. This is then multiplied by observed sales to identify the proportion of sales that results from the change in the simulated price. This result may be positive or negative, so actual observed sales are added to determine whether sales decreased or increased due to the change in price.

Share of tax in price Equation 26

*g taxshare_1=((vatxpack_1+stxpack_1+avxpack_1)/price_1)*100*

With the change in price due to the tax changes, one must now calculate the percentage of tax in the simulation price. This is done by adding together all the simulated taxes per pack: the value-added tax `vatxpack_1', the specific tax `stxpack_1', and the ad valorem tax `avxpack_1'. This is then divided by the simulated price `price_1' and the result is multiplied by one hundred to obtain a percentage.

Retail sales Equation 27

*g rsales_1=(sales_1*price_1)*

To obtain total retail sales, the change in sales `sales_1' is multiplied by the simulation price `price_1'.

VAT revenue Equation 28

*g vatrev_1=(sales_1*vatxpack_1)*

Total revenue from value-added tax is calculated by multiplying the new sales in the simulation `sales_1' by the VAT to be collected per pack `vatxpack_1'.

Retailer income Equation 29

*g minrev_1=(sales_1*retmargin_1)*

Retailer income is obtained by multiplying the simulation sales `sales_1' by the retailer's profit `retmargin_1'.

Specific tax revenue Equation 30

*g strev_1=(sales_1*stxpack_1)*

Total revenue from specific tax is obtained by multiplying the simulation sales `sales_1' by the simulated specific tax per pack `stxpack_1'.

Label var strev_1 "Specific tax"

Then the label "Specific tax" is assigned to specific tax revenue `strev_1' using the command label var.

Ad valorem tax revenue Equation 31

*g advrev_1=(sales_1*avxpack_1)*

Total ad valorem tax revenue is obtained by multiplying simulated sales `sales_1' by the simulated ad valorem tax per pack `avxpack_1'.

Label var advrev_1 "Ad valorem tax"

The label "Ad valorem tax" is assigned as above.

Adjustment Equation 32 and 33

*replace strev_1 = strev_1*adjustment in -1*

The adjustment factor calculated in the status quo is used to calibrate the simulation calculation. Here, specific tax revenue `strev_1' is multiplied by the adjustment factor in the last observation in -1 for the variable `adjustment', calculated previously.

*replace advrev_1 = advrev_1*adjustment in -1*

The adjustment factor is also used to simulate ad valorem tax revenue `advrev_1'.

Industry income Equation 34

*g indusrev_1=(sales_1*pindustry)*

Total industry income is obtained by multiplying simulated sales `sales_1' by the industry price obtained in the status quo.

Change in price Equation 35

g deltaprice=(price_1-price)/price

The change in price `deltaprice' is the variation between the simulated price `price_1', as the final value, and the observed price `price', as the initial value.

Local deltaprice

This price change is saved as a local variable so that it can be used later in the code.

As mentioned previously, in Mexico, part of the IEPS revenue from tobacco is transferred to state funds. This analysis can be adapted to accommodate the legal framework of each country or omitted.

This earmarked revenue is subtracted from the sum of simulated specific and ad valorem tax revenue to determine the total possible expenditure on the health sector.

Outputs INFOGRAPHIC 1

The first infographic is displayed using variables based on the *scalar* command, which stores a single value so that it can be used later in the database. A scalar can be used across all parts of the code, unlike locals, which just remain in the part where they were defined. In this case, the locals defined in the first part of the code will only be usable there and cannot be reused in the following infographics or calculations. The process described below saves as scalars the variables that users wish to store for use across the whole code.

Specific component in the alternative scenario

scalar aa_stax_1 = `stax_1'

di aa_stax_1

This scalar saves the simulated specific tax, which had been saved as a local.

```
. scalar aa_stax_1 = `stax_1'

. di aa_stax_1
1.5911
```

****Ad valorem component in the alternative scenario****

*scalar ab_advala_1 = `advala_1'*100*

di ab_advala_1

The ad valorem tax in the simulation is saved as a scalar and converted to a percentage; previously, it was expressed as a ratio of change.

```
. scalar ab_advala_1 = `advala_1'*100

. di ab_advala_1
165
```

****Status quo sales****

scalar da_sales = sales[_N]

di da_sales

The calculation of total sales in the status quo is saved as the scalar `da_sales', taking the last observation.

```
. scalar da_sales = sales[_N]

. di da_sales
2425951
```

****Sales in the alternative scenario****

scalar db_sales = sales_1[_N]

di db_sales

Sales in the simulated scenario, on the other hand, are saved as a scalar called `db_sales'.

```
. scalar da_sales = sales[_N]

. di da_sales
2398.953
```

Change in sales in the alternative scenario

*scalar dc_sales = (sales_1[_N]/sales[_N]-1)*100*

di dc_sales

The percentage change between sales in the status quo and sales in the simulation scenario is saved as the scalar `dc_sales'. This is a calculation of the change between the scalars, given by alternative scenario sales `sales_1' over status quo sales `sales'.

```
. scalar dc_sales = (sales_1[_N]/sales[_N]-1)*100

. di dc_sales
-14.49852
```

Share of tax in the status quo price

scalar ea_taxshare = taxshare[_N]

di ea_taxshare

The full percentage of tax in the status quo price, which has already been calculated, is saved as a scalar called `ea_taxshare'.

```
. scalar ea_taxshare = taxshare[_N]

. di ea_taxshare
68.422505
```

Share of tax in the alternative scenario price

scalar eb_taxshare_1 = taxshare_1[_N]

di eb_taxshare_1

Similarly, the previously calculated percentage of tax in the alternative scenario price is saved as a scalar called `be_taxshare_1'.

```
. scalar eb_taxshare_1 = taxshare_1[_N]

. di eb_taxshare_1
76.983555
```

Status quo price

scalar fa_price = price[_N]

di fa_price

Meanwhile, the total price, including tax, is saved as `fa_price'.

```
. scalar fa_price = price[_N]

. di fa_price
94.793039
```

Alternative scenario price

scalar fb_price_1 = price_1[_N]

di fb_price_1

The price in the alternative scenario, including tax, is saved as a scalar called `price_1'.

```
. scalar fb_price_1 = price_1[_N]

. di fb_price_1
94.793039
```

Saving the information

All of the information calculated so far, from the update to the scenario calculation, is saved in a temporary file for later use.

tempfile info1

The command `tempfile' identifies the name under which calculated information will be saved as a temporary file. The temporary file saves the information from the data sheet in Stata's temporary memory, in this case under the name `info1'.

save `info1'

Lastly, although the file has already been assigned a name, the command `save' saves the information from the file `info1'.

Gains from the increase in excise tax on tobacco

This third part of the code calculates the gains in income from tobacco expenditure, health expenditure, and days of life lost. These equations are taken from the methodology of Fuchs et al. (2018). First, one must retrieve the information saved in the first infographic:

```
use `info1', clear
```

The command `use' calls up the temporary document called `info1' and the auxiliary clear clears the previous dataset so that the database can be entered without any conflict between the two.

The following lines calculate these gains in two formats: in pesos and in percentage differences. In the formats in pesos, each of the gains is multiplied by four to produce an annual value and is deflated with the variable *`deflator'*, which is the deflator coefficient for the calculation year defined at the beginning of the programming process.

****Gains in income: tobacco expenditure - %**** **Equation a**

```
local gi_gt = ((((1+deltaprice[_N])*(1+`elasticity'*deltaprice[_N])-1)*exp_cig)*-100)
```

The first type of gain calculated is gains in income from a decrease in tobacco consumption; the first part generates a proportional coefficient of one percentage point (1) plus the current change in price `deltaprice[_N]'; this is multiplied by a coefficient of 1 plus the product of elasticity and the current change in price `deltaprice[_N]'. Then, 1 is subtracted and the result is multiplied by average family expenditure on cigarettes `exp_cig' so it can be measured in proportion to money spent on cigarettes. Lastly, this is multiplied by -100 to obtain the result as a percentage. If the change in prices, as measured in money spent on cigarettes, is negative, this translates into a gain, and, when multiplied by -100, this figure becomes a positive number that represents this gain resulting from the decrease in consumption. Conversely, if the change in prices, as measured in money spent on cigarettes, is positive, this means cigarette consumption increased, and, when multiplied by -100, this value will produce a negative figure that represents a loss. The result is saved in a local variable under the name `gi_gt'.

Gains in income: tobacco expenditure - $$

local gi_gt_p = ((`gi_gt'*exp_tot)/100)*(4*`deflator')

The percentage from the previous line is multiplied by total family expenditure `exp_tot' and divided by 100 to identify gains in pesos. Then, this is multiplied by four and the deflator coefficient `4*`deflator'' to obtain annual expenditure in real prices.

Gains in income: health expenditure - % **Equation b**

*local gi_gs = (((1+`elasticity'*deltaprice[_N])-1)*(exp_health))*(-100)*

Health expenditure due to changes in prices is determined using a calculation similar to the one above. The first step is to obtain a coefficient of 1 plus the product of elasticity and the current change in price `deltaprice[_N]'. Unlike the previous calculation, this is simply multiplied by the proportion of health expenditure by families `exp_health' to determine the change in health expenditure resulting from the change in prices. Lastly, this is multiplied by -100 to obtain a percentage. If health expenditure is negative, multiplying it by -100 will display a gain, but if health expenditure is positive, the result after multiplication by -100 will be a loss. This variable is saved in a local variable called `gi_gs'.

Gains in income: health expenditure - $$

local gi_gs_p = ((`gi_gs'*exp_tot)/100)*(4*`deflator')

The above percentage is multiplied by total family expenditure `exp_tot' and divided by 100 to obtain gains in pesos. Lastly, this is multiplied by four and the deflator coefficient `4*`deflator'' to obtain annual expenditure in real prices.

Gains in income: days of life lost - % **Equation c**

*local gi_yll = ((((1+`elasticity'*deltaprice[_N])-1)*ilwy)*-100)*

Income from days of life lost is calculated by obtaining the coefficient of 1 plus the product of elasticity and the current change in price `deltaprice[_N]'. This is multiplied by the loss in income in working years (ilwy). Then, this is multiplied by -100 to obtain the result as a percentage.

Gains in income: days of life lost - $$

local gi_yll_p = ((`gi_yll'*exp_tot)/100)*(4*`deflator')

The above result, `gi_yll', is multiplied by total household expenditure to identify the equivalent amount in pesos for the days of life lost. Then, this is divided by 100 so it is no longer expressed as a percentage and multiplied by `4*`deflator'' to obtain real annual gains.

Outputs INFOGRAPHIC 2

The results displayed in the infographic on gains reflect the three calculations above in both formats: in percentage terms and in pesos. Accordingly, all the results are saved as scalar variables in string format.

Gain from tobacco expenditure as a percentage difference

scalar gi_gt = string(`gi_gt',"%10.1f")

di gi_gt

The scalar `gi_gt' for the percentage difference in tobacco expenditure is saved under the same name but in text format to one decimal place.

```
. scalar gi_gt = string(`gi_gt',"%10.1f")

. di      gi_gt
-0.1
```

Gain from health expenditure as a percentage difference

scalar gi_gs = string(`gi_gs',"%10.1f")

di gi_gs

The percentage difference in health expenditure is also saved as the scalar `gi_gs', in string format to one decimal place.

```
. scalar gi_gs = string(`gi_gs',"%10.1f")

. di      gi_gs
5.9
```

Gain from days of life lost as a percentage difference

scalar gi_yll = string(`gi_yll’,”%10.1f”)

di gi_yll

The percentage difference in expenditure in working days lost, as previously calculated, is saved as a scalar in string format `gi_yll’ to one decimal place.

```
. scalar gi_yll = string(`gi_yll',"%10.1f")

. di      gi_yll
0.1
```

Gain from tobacco expenditure in pesos

scalar gi_gt_p = string(`gi_gt_p’,”%10.1f”)

di gi_gt_p

The gain in income from the change in tobacco consumption is saved as a scalar in string format as `gi_gt_p’. This variable is in pesos and is saved to one decimal place.

```
. scalar gi_gt_p = string(`gi_gt_p',"%10.1f")

. di      gi_gt_p
-169.3
```

Gain from health expenditure in pesos

scalar gi_gs_p = string(`gi_gs_p’,”%10.1f”)

di gi_gs_p

Income in pesos resulting from the change in health expenditure is saved as the scalar `gi_gs_p´ in string format to one decimal place.

```
. scalar gi_gs_p = string(`gi_gs_p',"%10.1f")

. di      gi_gs_p
7266.4
```

Gain from days of life lost in pesos

scalar gi_yll_p = string(`gi_yll_p’,”%10.1f”)

di gi_yll_p

The gain in income from days of life lost is obtained as `gi_yll_p' and saved as a scalar under this name, in string format to one decimal place.

```
. scalar gi_yll_p = string(`gi_yll_p',"%10.1f")

. di      gi_yll_p
148.5
```

Sum of total gains Equation d

scalar gi_tot = string(`gi_gt_p'+`gi_gs_p'+`gi_yll_p',"%10.1f")

di gi_tot

The last calculation is the sum of all gains in pesos: gains in family income `gi_gt_p', gains from health expenditure `gi_gs_p', and gains in income from days of life lost `gi_yll_p'. The result is expressed with the scalar `gi_tot' in string format to one decimal place.

```
. scalar gi_tot = string(`gi_gt_p'+`gi_gs_p'+`gi_yll_p',"%10.1f")

. di      gi_tot
7245.5
```

General results for the two infographics

The following lines of code record the results of all the saved scalars in a .txt document.

if "$output" != "" {

This line is a conditional structure that verifies that the *output* macro is not empty. In other words, it checks whether a macro called output has been defined and whether it contains a value. If true, the block of code within the braces will be executed.

noisily di _newline(3) in g "{bf:Tobacco} output"

This line displays a message based on the command `di', which establishes three blank lines with the command `_newline(3)' and then one line in bold with the title "Tobacco" as a message in the results console.

Log the results in the file "output.txt"

quietly log using "output.txt", name(scalar) replace text

In Stata, the command *quietly log using* opens a log file and starts recording results and commands. The word "quietly" is used to instruct Stata not to display an output message indicating that a log file has been opened, allowing the process to be performed silently. The command *using* specifies the name of the log file where the results and commands will be saved. In this case, the file name is "output.txt", which is in .txt file format. The next instruction is to save all scalars, and, if the .txt file already contains data, these data will be replaced.

Display a list of all scalar macros and their current values in the output

noisily scalar list

This line displays a list of all scalar macros and their current values in the results console. The command scalar list lists all scalar macros defined at that moment.

Close the log file that was previously opened to record the scalar macros

quietly log close scalar

This command closes the log file that was opened previously (.txt), quietly is used so as not to display a message in the output indicating that the log file has been closed.

}

```
. if "$output"  != "" {
.         noisily di _newline(3) in g "{bf:Tobacco} output"


Tobacco output
.         quietly log using "`c(sysdir_site)'\output.txt", name(scalar) replace text
.         *quietly log using "output.txt", name(scalar) replace text
.         noisily scalar list
    gi_tot = 7020.9
  gi_yll_p = 143.9
   gi_gs_p = 7044.9
   gi_gt_p = -167.9
    gi_yll = 0.1
     gi_gs = 5.6
     gi_gt = -0.1
```

```
fb_price_1 =  94.793039
  fa_price =  94.793039
eb_taxshare_1 =  76.264777
ea_taxshare =  68.144784
  dc_sales =  -14.50535
  db_sales =  2050.9765
  da_sales =   2398.953
bb_strev_1 =          .
  ba_strev =          .
ab_advala_1 =       165
 aa_stax_1 =     1.5911
.         quietly log close scalar
. }

. timer off 1

. timer list 1
   1:      1.54 /        1 =       1.5390

. noisily di _newline(2) in g _dup(20) ":" "  " in y "TOUCH-DOWN!!!  " round(`=r(t1)/r(nt1)',.1) in g " segs  " _dup(20) ":"


::::::::::::::::::::  TOUCH-DOWN!!!  1.5 segs  ::::::::::::::::::::
```

Interpretation

The results reported in CIEP's simulator for the tobacco IEPS include two parameters, one fiscal outcome, three economic outcomes, and four health-related outcomes. Listed below are the current observations, which are referred to as the "baseline state".

Parameters:

- **Fixed amount:** $0.5911 MXN per stick in 2023.
- **Variable ad valorem rate:** Currently 160 percent of the price.

Fiscal outcomes:

- **Tobacco IEPS revenue:** The Federal Revenue Law (LIF) estimates revenue of MXN 50.114 billion in 2023.

Economic outcomes:

- **Cigarette sales**[11]: In the baseline state, 1.2847 billion packs.
- **Average pack price**: In the baseline state, MXN 62.2.

---

[11] The methodology employed can be found in various documents. Please see www.ciep.mx/5q8J.

- **Price composition of a pack of cigarettes**: In the baseline state, tax (IEPS and VAT[12]) would account for 69 percent of the price.

Public health economic outcomes (considered zero in the baseline state):

- Gains in **income due to lower consumption** of tobacco.
- Gains in **income due to lower medical expenses**.
- Gains in **income due to an increase in healthy days of life**.

Based on these results, shown below are two infographics produced with the tax simulator, which allow users to view the tobacco IEPS outcomes in the baseline state or in the simulations.

[12] Applying a tax like IEPS on a product raises the final price and, as a result, VAT would be charged on a higher base amount.

4. Display and interactivity in a Mexican context

Simulation and impact of IEPS

A simulation was run for illustrative purposes to show how the results are displayed. In this case, the fixed tax parameter was changed to MXN 0.7 per stick and an ad valorem rate of 170 percent was applied.

Based on these new parameters and considering the elasticities and fixed transfers to subnational governments, Infographic 1 shows an estimate of MXN 53.777 billion in revenue (an increase of 3.6625 billion with respect to the baseline state). Ideally, MXN 15.874 billion of this revenue would be distributed to subnational governments and MXN 37.9027 billion would be allocated to the Secretariat of Health. Meanwhile, it is estimated that the price of a pack of cigarettes would increase to MXN 66.4 (an increase of MXN 2.2 with respect to the baseline state), reducing sales by 2.8 percent. Tax (VAT and IEPS) would account for 71 percent of the price.

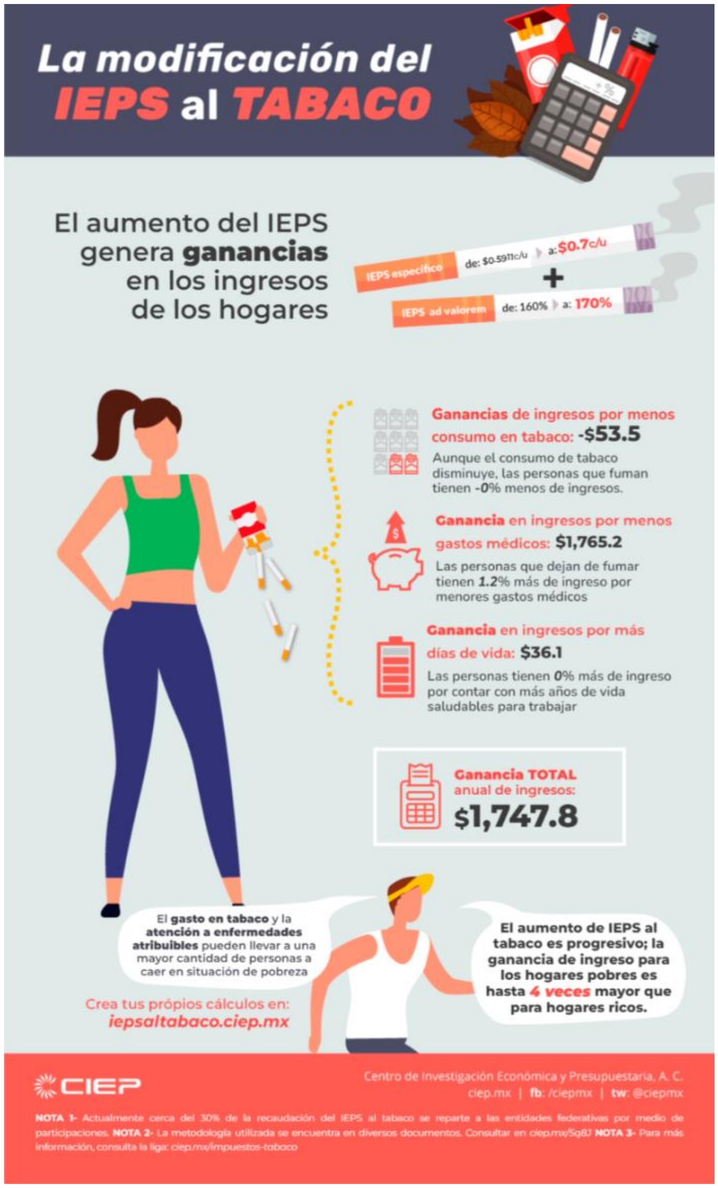
Please note that designing and displaying the simulator results in the infographics developed by CIEP requires programming and additional work, which falls outside the scope of this toolkit.

Infographic 1

Gains in health

Lastly, Infographic 2 presents the health outcomes. It is estimated that following the increase in tax and resulting decrease in tobacco consumption, households would spend on average an additional MXN 53.5, which does not represent a percentage difference in their income. However, potential savings in medical expenses come to an average of MXN 1,765, or 1.2 percent of income. Similarly, a higher number of healthy days of life yields a potential increase in income of MXN 36.1. In total, **households would gain an average of MXN 1,747.8 a year, despite paying higher taxes on cigarettes.**

Infographic 2



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