

Effects of fiscal policy on the poor after changes in fiscal policy on tobacco products in Mexico: ex-post evaluation

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Key messages

- In 2011, Mexico introduced a specific component into its tobacco tax structure that caused prices to increase. Notably, this new specific tax was not indexed for inflation, and its effect diminished steadily over time.
- In 2019, the Mexican government agreed to implement annual indexation for inflation in the specific tax, and it was made retroactive to 2011. As expected, this reform caused prices to rise.
- The tax reforms, both in 2011 and 2019, were effective in reducing tobacco consumption and increasing revenue.
- Following the 2011 and 2019 tax reforms, the number of households with tobacco expenditures fell by 6.8 percent and 4.9 percent, respectively.
- The 2011 reform reduced tobacco consumption by 32.7 percent, while the 2019 reform achieved a 1.9 percent decrease.
- The 2011 and 2019 tax reforms increased tobacco tax revenue by 9.1 percent and 6.5 percent, respectively.
- Tobacco tax reforms have reduced poverty in smoking households by 4.4 percent (2011 reform) and 2.6 percent (2019 reform).

Effect of tobacco tax reforms in Mexico

| Reform | Prevalence* | Tobacco expenditure | Consumption | Revenue | Poverty |
|--------|-------------|---------------------|-------------|---------|---------|
| 2011 | ↓ - 6.8% | ↓ -5.5% | ↓ -32.7% | ↑ 9.1% | ↓ -4.4% |
| 2019 | ↓ -4.9% | ↑ 6.5% | ↓ -1.9% | ↑ 6.5% | ↓ -2.6% |

*Calculated as the percentage of households with positive tobacco expenditure.

Notes: Decrease: ↓ Moderate decrease: ↓ Increase: ↑ Moderate increase: ↑

⇒ **Increasing tobacco tax levels above inflation would reduce consumption, provide more tax revenue, and mitigate harm to health, with no impact on poverty.**

Background

Increasing excise taxes on tobacco products is widely proven to be the most effective and cost-effective measure to reduce smoking (WHO, 2013; Chaloupka et al., 2019). Mexico has a more than four-decade history of excise taxes on cigarettes. An excise tax on production and services (IEPS) was introduced on tobacco products in Mexico in 1981. For decades, this tax was charged solely on an ad valorem basis, with filtered cigarettes subject to a higher rate than unfiltered ones. Following ratification of the WHO Framework Convention on Tobacco Control (FCTC) by Mexico in 2004, excise tax reforms have been gradually introduced. In 2005, the ad valorem rate was standardized at 110 percent for both filtered and unfiltered cigarettes. This rate was then gradually raised to 160 percent in 2010.

One of the most significant changes was the introduction of a specific component in 2010, resulting in a mixed excise tax structure on cigarettes that persists to this day. Initially, it was stipulated that the specific component per stick was to be raised in increments, from 0.04 pesos in 2010 to 0.06 pesos in 2011, and then 0.08 pesos in 2012, up to 0.10 pesos (DOF, 2009).

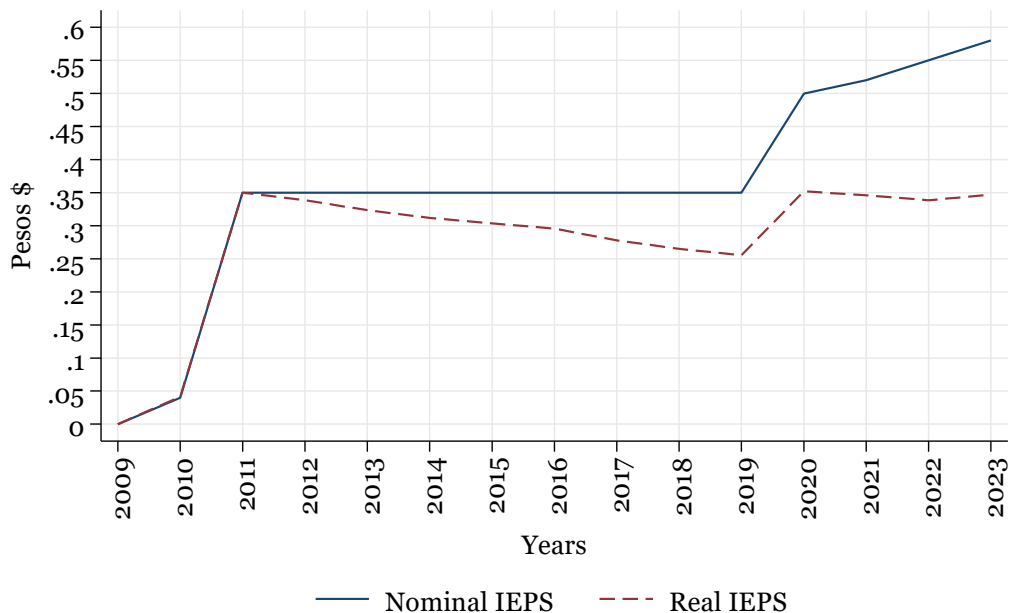
While official guidelines to Article 6 of the FCTC and a large body of empirical studies (WHO, 2013; Chaloupka et al., 2019) all recommend including a specific component that is larger than the ad valorem component to achieve the optimal tobacco tax structure, the amount levied by this reform in Mexico was very low: just 0.80 pesos per pack of 20 cigarettes in 2010, resulting in a total tax burden of 62.7 percent of the final retail price (Reynales-Shigematsu et al., 2019) which is lower than minimum of 75% tax share recommended by the WHO. In 2010, a bill was introduced to increase the specific tax to 0.40 pesos per stick with an annual adjustment for inflation, but it was rejected.

The following year (in 2011), a new provision came into force, establishing a fixed (specific) tax of 0.35 pesos per stick (DOF, 2010), equivalent to a 775-percent increase in the specific component. Following this reform, the excise tax represented 68.8 percent of the final retail price (7.00 pesos per pack) (Reynales-Shigematsu et al., 2019). Despite this considerable progress, the reform failed to include an adjustment of the specific tax for inflation. Over time, this major oversight led to a weakening of the impact of this tax as its value fell in real terms. While a high ad valorem tax does increase retail prices substantially, the introduction of a specific component narrows price gaps, reducing the likelihood that smokers will simply switch to cheaper brands. Crucially, however, the specific tax should be adjusted for inflation to prevent these products from becoming more affordable over time.

The World Bank has reported that Mexico’s tax policy from 2007 to 2011, combined with other tobacco control measures, was associated with a 16.6-percent drop in consumption. In fact, smoking prevalence fell from 22.9 percent in 2008 to 19.1 percent in 2011 (World Bank Group, 2019). However, prevalence increased in 2016-2017 to 20.1 percent, demonstrating that the effect of the tax erodes quickly with no adjustment (ENCODAT, 2017). The Global Adult Tobacco Survey (Instituto Nacional de Salud Pública, 2023) reported no significant change in the prevalence of daily smokers between 2009 and 2023 (15.9 and 15.3 percent, respectively), while a significant drop was observed in the number of cigarettes smoked per day, which fell from 9.4 to 7.7 over the same period (World Bank Group, 2019).

Subsequent reform proposals to raise the specific tax, in 2013 and 2016, were unsuccessful (Saldaña & Melgoza, 2020), so the effect of the specific component was eroded with inflation. Indeed, it was not until 2020 that a reform was implemented to bring the specific tax in line with inflation since the 2011 reform, raising it from 0.35 to 0.4944 pesos per stick (9.98 pesos per pack), and establishing a permanent annual adjustment for inflation.

Graph 1. Specific tax per stick: nominal vs. real, 2011-2013 (2011=100)



Source: Authors’ calculations with data from SHCP and INEGI for the corresponding years.

Graph 1 illustrates the low rate of specific excise tax (IEPS) when it was introduced in 2010, at just over 0.041 real pesos, before it was promptly adjusted to 0.35 pesos. This rate was maintained from 2011 to 2019, with no

fiscal policy change to correct for the fall in value in real terms. Similarly, the graph shows how the adjustment for inflation applied from 2020 to 2023 only barely offset the decrease observed in real terms over the nine years during which the nominal rate of the specific IEPS remained unchanged. This calls for a new proposal for a fiscal reform to bring about an adequate increase in the specific tax rate.

Against this backdrop, this study analyzes the two tobacco tax reforms – that of 2011 and the more recent 2019 reform – to pursue two key objectives. First, the research aims to show the overall impacts in terms of expenditure, consumption, government revenue, and well-being finding its distributional impacts of the increase in specific tax from 0.04 to 0.35 pesos per stick in 2011. Similarly, the second objective is to examine the same insights of the adjustment for inflation of the specific component of tobacco excise tax in 2019. To this end, we compute the impact of these tax reforms on these indicators and smoker well-being in terms of changes in poverty levels as well.

Thus, this paper sets out to examine the consequences of policymakers failing to strengthen the specific excise tax on cigarettes. Over time, as a result, this would cause a stagnation of tax policy, since simply adjusting tax rates for inflation has proven inadequate in the long term. This study is structured as follows. The first section describes evidence showing the substantial benefits provided by tobacco tax increases, both internationally and in Mexico. The second section presents the methodology, data, and analytical techniques employed in this research. The third section shows the empirical application of the results for each objective, in terms of expenditure on tobacco, cigarette consumption, tax revenue, and poverty levels. This is followed by a discussion of the findings, and lastly, some policy recommendations and conclusions.

Literature review

The empirical evidence indicates that raising tobacco taxes reduces consumption. On this basis, scholars have explored hypothetical reform scenarios, using price elasticities of demand to estimate the possible decline in consumption. For example, Goodchild et al. (2016) investigated, based on data from 181 countries, the potential effect of a hypothetical reform in 2014 that would have increased the price of a pack of cigarettes by USD 1.00 in different countries, as part of efforts toward the 2030 Agenda for Sustainable Development. They used price elasticities of demand by country income group (low, lower middle, upper middle, and high) and found that the prevalence of (adult) daily smokers would fall by 9 percent (from 14.1 to 12.9 percent), while tobacco revenue would see a 47-percent increase in this scenario.

In the Philippines, Austria and Pagaduan (2019) use pre- and post-reform survey data (from 2009 and 2015, respectively) and the difference-in-differences technique to analyze the impact on cigarette consumption of the Sin Tax Reform Act, which took effect in the country in 2012. The results found that the reform was effective in reducing consumption (in particular, the quantity purchased by smokers) and in making demand more responsive to price increases.

In Argentina, González-Rozada (2020) explored the impact of a 2016 increase in the internal tax rate for tobacco on demand, price elasticity, consumption, and tobacco revenue, based on an error correction model. The tax reform led to an increase in price elasticity and revenue (on the order of 40 percent), along with a decrease in consumption.

Hong et al. (2023) examined the impact of two tobacco excise tax reforms in China (in 2009 and 2015). Based on panel data from 294 Chinese cities between 2007 and 2018 and a continuous difference-in-differences model, they found that the 2015 reform brought about a considerable decline in tobacco consumption, while the 2009 reform did not. They further noted a differential effect by smoker age, cigarette price, and city size.

Ngo et al. (2022) utilized the Tobacconomics Cigarette Tax Scorecard, which scores national governments on the key components of successful excise taxation: structure, absolute price, change in affordability over time, and tax share of price. They find that for the 2014-2020 period, each unit increase in the overall cigarette tax scores—a 0 to 5 index—reduces per capita consumption of cigarettes by as much as 9 percent. This decline is more pronounced in low and middle-income countries.

In India, work by Rout and Parhi (2020) offers an ex-ante and ex-post analysis of cigarette affordability around a 2017 reform that introduced a goods and services tax (GST) on cigarettes in an attempt to achieve a uniform tax system. They found that while affordability was reduced in the first two years of the reform, subsequently it remained unchanged. Notably, the reform had failed to simplify the tax structure, instead leaving loopholes that allowed manufacturers to produce various low-tax brands. As a result, large price discrepancies between tobacco brands have continued to persist creating opportunities for smokers to substitute to a cheaper brand when prices increase.

López-Nicolás et al. (2013) compared changes in smoking prevalence arising from the introduction of a minimum tax regime on tobacco products in Spain.

They employed a difference-in-differences approach, using price series before and after the reform with data from surveys, and found only a slight decline in prevalence among women and no effect on men. Somewhat similar to India, they speculate that these results were likely caused by the continued availability of low-cost tobacco products, which is further evidence that an aggressive specific tax that shrinks price variation is a strongly preferred policy.

In Mexico, research by Zavala-Arciniega et al. (2020) examines changes in (daily and occasional) smoker prevalence over different periods. The authors pooled data from the National Addiction Survey (ENA), reviewed the periods 2002, 2011, and 2016 (before the FCTC came into force; when the reform that raised the specific component to 0.35 pesos per stick came into force; and well after the reform, respectively), and used the GATS to review the periods 2009 and 2015 (prior to the reform introducing the specific component and post-reform period). They found an overall decrease in prevalence of 11 percent over the full period studied (from 2002 to 2016). For the most part, this decline was observed between 2002 and 2009, while the 2009-2016 period saw a slight increase (from 16.5 to 19 percent). Daily smoker prevalence was nearly halved, falling from 13 percent in 2002 to 7 percent in 2016. However, occasional smoker prevalence rose by 35 percent, from 8.8 percent in 2009 to 11.9 percent in 2016.

Studies have consistently shown that reforms that raise tobacco taxes have succeeded in reducing consumption and increasing revenue. However, introducing any excise tax reform has varying effects, and this depends considerably on how it is implemented and what is implemented. Prevalence decreases to different extents depending on the population subgroup, and the complex nature of tax structures may even open the door to alternative strategies by manufacturers as they attempt to counter the fall in demand.

Methodology and data sources

An ex-ante and ex-post evaluation of the distributional impact of the increase in tobacco tax during reform periods was carried out using microdata from the National Survey of Household Income and Expenditure (ENIGH) for the years 2010, 2012, 2018, and 2020. The surveys follow the same nationally representative two-stage cluster probability sampling design, based on primary sampling units.

Data

The instrument used to collect data on tobacco expenditure remained unchanged in the surveys. ENIGH surveys report tobacco expenditure at the household level, and the quantity consumed per week in kilograms. The number of cigarettes consumed was determined based on a cigarette weight of 1.25 grams. This conversion factor has been adopted elsewhere in the literature (Jiménez-Ruiz et al., 2008). Monetary values were deflated, with 2020 as the base year. Given that the ENIGH surveys do not report information about cigarette prices, the unit value was calculated by dividing monthly expenditure on cigarettes by the monthly quantity reported by households.

Table 1. Smoking households in Mexico according to ENIGH, 2010-2020

| Year | Reform period | Sample | Households |
|------|---------------|--------|------------|
| 2010 | ex-ante | 1,583 | 1,993,845 |
| 2012 | ex-post | 529 | 2,207,886 |
| 2018 | ex-ante | 3,571 | 1,680,289 |
| 2020 | ex-post | 4,112 | 1,586,914 |

Note: The figure given is the number of smoking households that report positive tobacco expenditure.

Source: Authors' work based on the 2010, 2012, 2018, and 2020 ENIGH surveys.

Table 2 presents the prevalence of tobacco expenditure by quintile for each year, before and after the changes to tobacco tax policy. Low-income quintiles exhibit lower levels of tobacco consumption, with an average of 2.4 percent over the whole period, while prevalence increases with each quintile up to an average of 10.2 percent for the highest income quintile.

Table 2. Prevalence of tobacco consumption in Mexico, 2010, 2012, 2018, and 2020. (95% confidence intervals)

| Year/Quintile | 1 | 2 | 3 | 4 | 5 | Year average |
|---------------|-------------|-------------|-------------|-------------|---------------|--------------|
| 2010 | 3.57 | 4.86 | 6.01 | 9.46 | 12.7 | 7.32 |
| CI | 3.55 - 3.58 | 4.84 - 4.88 | 5.99 - 6.03 | 9.43 - 9.48 | 12.66 - 12.72 | 7.30 - 7.34 |
| 2012 | 2.15 | 5.10 | 7.28 | 7.51 | 12.09 | 6.82 |
| CI | 2.14 - 2.16 | 5.09 - 5.12 | 7.26 - 7.30 | 7.49 - 7.53 | 12.06 - 12.11 | 6.80 - 6.84 |
| 2018 | 1.99 | 3.25 | 4.29 | 5.30 | 8.45 | 4.66 |

| | | | | | | |
|------------------|-------------|-------------|-------------|-------------|---------------|-------------|
| CI | 1.98 - 2.00 | 3.24 - 3.26 | 4.28 - 4.31 | 5.29 - 5.32 | 8.43 - 8.47 | 4.64 - 4.68 |
| 2020 | 2.04 | 3.43 | 3.93 | 5.26 | 7.49 | 4.43 |
| CI | 2.03 - 2.05 | 3.42 - 3.44 | 3.91 - 3.94 | 5.24 - 5.27 | 7.47 - 7.51 | 4.41 - 4.45 |
| Quintile average | 2.44 | 4.16 | 5.38 | 6.88 | 10.18 | 5.81 |
| CI | 2.42 - 2.46 | 4.14 - 4.17 | 5.36 - 5.40 | 6.85 - 6.91 | 10.16 - 10.20 | 5.79 - 5.83 |

Note: Figures show the percentage of households that smoke and report positive tobacco expenditure.

Source: Authors' work based on the 2010, 2012, 2018, and 2020 ENIGH surveys.

The econometric models are explained below. First, quantile tobacco consumption functions were estimated by taking the poorest 20 percent, the second 20 percent, and so on, up to the richest 20 percent. We compared 2012 vs. 2010 and 2020 vs. 2018 to achieve our two specific objectives. Lastly, we computed semi-parametric quintiles regression analysis where the models have been estimated with a 5-percent cut-off for outlier control at the upper end of the distribution in each year to achieve a smoother estimation and remove extreme upper values. With these equations, the impact of the tobacco reform on poverty is assessed, by using the log difference in the unit price as an independent variable, among other relevant covariates explained below.

Econometric analysis

For the first research question, the econometric model follows a quantile semi-parametric specification of a tobacco consumption function, which was estimated by taking the poorest 20 percent as the first quantile, those in the middle levels as the 2nd, 3rd, and 4th quantiles, and the top 20 percent as the 5th quantile. Models are employed both before and after the tax reform in the two periods (between 2011 and 2019), using ENIGH databases for 2010-2012 in the case of the first reform and 2018-2020 databases for the second reform. The first dependent variable $\log c_{ti}^\theta$ is the log of per capita tobacco expenditure, with as covariates the log of per capita expenditure $\log(ex)_i^\theta$; the unit value for cigarettes ($\log(uv)_i^\theta$); dsex, which takes the value of one for males; age group, with individuals in k-groups for 13-19, 20-29, 30-39, 40-49, 50-59, and 60+ years of age; urban-rural locality ($drural_i^\theta$); and level of education attained (S_i^θ) with four categories: no education, primary education, high school, and college or professional education. We write the consumption for any household i and quantile θ in terms of the vector of exogenous variables in a semiparametric log linear equation as follows:

$$\log c_{ti}^\theta = \alpha_0 + \alpha_1 \log(ex)_i^\theta + \alpha_2 \log(uv)_i^\theta + \alpha_3 dsex_i^\theta + \alpha_{4k} \sum_{k=1}^6 age_i^\theta + \alpha_5 drural_i^\theta + \alpha_{6k} \sum_{k=1}^4 S_i^\theta + u_i^\theta \quad [1]$$

Likewise, we replicate this equation to estimate the impact on quantities of cigarettes smoked ($\log Q_{ti}^\theta$) and the level of excise revenue ($\log R_{ti}^\theta$). Revenues were

calculated as the simple sum of taxes collected in the microdata, applying the fiscal rules to obtain excise tax (IEPS). Equations (2) and (3) express their respective specifications:

$$\log Q_{ti}^{\theta} = \alpha_0 + \alpha_1 \log(ex)_i^{\theta} + \alpha_2 \log(uv)_i^{\theta} + \alpha_3 dsex_i^{\theta} + \alpha_{4k} \sum_{k=1}^6 age_i^{\theta} + \alpha_5 drural_i^{\theta} + \alpha_{6k} \sum_{k=1}^4 S_i^{\theta} + u_i^{\theta} \quad [2]$$

$$\log R_{ti}^{\theta} = \alpha_0 + \alpha_1 \log(ex)_i^{\theta} + \alpha_2 \log(uv)_i^{\theta} + \alpha_3 dsex_i^{\theta} + \alpha_{4k} \sum_{k=1}^6 age_i^{\theta} + \alpha_5 drural_i^{\theta} + \alpha_{6k} \sum_{k=1}^4 S_i^{\theta} + u_i^{\theta} \quad [3]$$

To fulfill our first specific objective, we analyzed headcount poverty indices (with a dummy to combine the poor population – based on official CONEVAL poverty lines – with the ENIGH database) before and after both tax reforms, considering all smoking households (regardless of poverty status), pooling their per capita expenditure on both health and tobacco to calculate the “forgone income” (John et al., 2019). The same process was employed to determine the impact on the poverty gap to check for any decline or increase before and after the fiscal shock.

We tested the hypothesis that poverty among smoking households in 2012 was at least equal to or lower than 2010, and in 2020 with respect to 2018. Given that we expect any response to be observable in the short term, this process offers insight into the corresponding fiscal impacts. The 2010 ENIGH was conducted just before the first tobacco excise reform was introduced in 2011, and the 2012 survey gathered data one year after the tax increase. The same applies to the 2019 reform, for which we used the 2018 and 2020 ENIGH surveys.

To test this hypothesis, we followed the methodology set forth in the toolkit developed by John et al. (2019) to obtain expenditure on health and tobacco products and infer how much this represents in the total per capita expenditure of the distributions for each year, and then calculate forgone income for the poor. In sum:

1. We applied consumption functions based solely on tobacco expenditure in the pool to determine if there is a change in 2012 compared to 2010, based on attributes corresponding to the level of per capita expenditure, considering age, employment in the informal sector, receipt of cash transfers from government, area of residence, poverty).
2. We observed the tax burden in a regression for 2010 and 2012, and this was replicated for 2018 and 2020. The tax burden equations are specified in an identical manner to the consumption functions to make sure they are analogous and fully comparable.

3. To calculate the poverty impact in smoking households for the first reform (from 2010 to 2012) and then in the second reform (from 2018 to 2020), we included a dichotomous measure of poverty, by merging the poor estimated from figures by the National Council for the Evaluation of Social Development Policy (CONEVAL), and we identified the share of tobacco users in poverty and estimated the corresponding forgone income, controlling for other factors such as decreases in real income and expenditures incurred on tobacco and health. We calculated how many were close to the poverty line in order to detect the “new poor,” if such were the case, and this allowed us to determine if poverty would increase due to forgone income and the increase in tobacco prices for each year. To the best of our knowledge, these analyses have not been performed previously.
4. A simple seemingly unrelated regression (SUR) specification was carried out to model the impact on poverty for each reform and test and determine the significance of the effect of the change in unit value as a proxy for the price of cigarettes as a relevant covariate (Greene, 2008, pp. 252-256).

This generalized econometric model technique is useful as there may be other factors, beyond the tobacco tax reforms and resulting price increases, that have had an impact on poverty in both periods, such as decreases/increases in real income within the quintiles, unemployment or the number of household members, and rising food prices and health costs, among others. This research employs official poverty estimates, using the distribution in the ENIGH as a dependent variable in Equation (4) and the first income quintile to isolate the endogeneity in the SUR system. We ran the two seemingly unrelated equations simultaneously to capture the poverty impacts of the variables and primarily, the price of cigarettes, using the following specification:

$$y_{it} = X_{it}\beta_{it} + \varepsilon_{it}, \quad i = 1, \dots, M. \quad [4]$$

where $M = 2$ for the 1st quintile and income-poor respectively, and disturbances ε_{it} are correlated across the M equations. The explanatory variables included in X_i are the same in both equations, namely the unit value, the log of per capita health expenditure, a dummy that takes the value of $d=1$ which comprises the south of the country, the number of household members, the log of the working population, and another dummy to capture rural areas. The subscripts i, t correspond to the same covariates in the system for the income-poor and the 1st quintile respectively, and t stands for each period to capture the corresponding reform by running first $t = 2010-2012$ and then $t = 2018-2020$. Regardless of poverty levels, the aim is to test the hypothesis that the tobacco reform and change in tobacco prices, specifically, did not have any effect on poverty in the post-reform year.

Lastly, because with the ENIGH it is possible to depict the distribution of disposable income and expenditure, we analyzed the ENIGH data as it already captures the effect of tax prior to the reform (ex-ante) and afterwards (ex-post).

Then, we proceeded to calculate the unit value (a proxy of prices) based on each survey, by considering the primary sampling units (PSUs) within each cluster of households and assigning an average unit value by Mexican state to capture price variation and correct for non-response bias. The remaining tobacco consumption is computed to detect if households became impoverished in 2012 and in 2020 after the reforms (ex-post situation), and thus capture the impacts of the reforms in terms of poverty and possible forgone income. Otherwise, this was captured as out-of-pocket health expenditure or other expenditure associated with an increase in the cost of food or other goods.

Results

Presented below are the results for the three basic indicators in the analysis: 1. Change in tobacco expenditure; 2. Change in quantities consumed; and 3. Tax revenue as the tax paid by each household. Note that all these values are expressed in constant 2020 prices over the same third quarter where the survey was taken up. Table 3 shows that for the lowest income quintiles, the 2011 reform had a greater impact, with a sharper fall in cigarette consumption and increases in tobacco expenditure in contrast to the 2019 reform, which only resulted in an increase in revenue and slight increases in expenditures. Following the 2011 reform, all quintiles exhibited an increase in revenues paid, as would be expected, but the decline in consumption of cigarettes and tobacco expenditure is not homogeneous. A similar situation was observed in the 2019 tobacco reform. These trends were then analyzed in greater detail.

A more pronounced decline can be clearly observed across the three indicators in the first period (2010-2012) following the introduction of the more impactful first tobacco tax reform. The second reform (2018-2020), on the other hand, achieved a decrease in these indicators to a lesser extent. For this second period studied, the IEPS reform to adjust for inflation was undermined by two factors. First, there is evidence of increased smoking prevalence in 2020 during the COVID-19 pandemic (ENSANUT, 2021), and second, a mere adjustment for inflation was insufficient to bring about a more pronounced impact on tobacco consumption, or any significant change in tax revenue. Table 3 and Table A1 in the Appendix present these trends.

The changes are shown as shares of totals within the quintiles according to each fiscal reform and it is easy to see that as the quintiles increase, the expenditures on tobacco become positive because of an increasing pattern of consumption in the wealthier households. With the exceptions of quintile 4 in 2010-2012, the change was positive and statistically significant as shown in the estimated C.I. and for the fifth quintile. On the other hand, in the second reform for 2018-2020 the reverse was found, as updating only for inflation was insufficient in reducing expenditures among the poorer households. The pattern for cigarettes consumed followed a similar trend among the poorest consumers and quintiles but increased among the wealthier ones.

The totals for each figure are displayed in the bottom of Table 3. These results show that the fiscal impact was stronger in the former than in the latter, as consumption declined to a greater extent (-27.6% and -1.1% respectively) and both years displayed positive value in expenditures (1.4% and 2.4%).

Table 3. Relative share of tobacco expenditure, consumption of cigarettes, and tax revenue, and differences by population quintile in Mexico, 2010-2020

| | 2010 | 2012 | Diff. | 95% CI | | 2018 | 2020 | Diff. | 95% CI | |
|--------------------------------|-------|-------|-------|---------|--------|------|-------|-------|--------|--------|
| | | | | Lower | Upper | | | | Lower | Upper |
| Quintile 1 | | | | | | | | | | |
| Tobacco expenditure | 5.41 | 1.52 | -3.89 | [-4.49 | -3.29] | 2.46 | 2.72 | 0.26 | [-0.34 | 0.86] |
| Cigarettes consumed | 9.88 | 3.25 | -6.63 | [-7.15 | -6.11] | 5.4 | 5.39 | -0.01 | [-0.53 | 0.51] |
| Tax revenue | 8.86 | 2.87 | -5.99 | [-6.42 | -5.56] | 3.98 | 4.35 | 0.38 | [-0.05 | 0.81] |
| Quintile 2 | | | | | | | | | | |
| Tobacco expenditure | 7.7 | 5.59 | -2.10 | [-2.73 | -1.47] | 5.01 | 8.27 | 3.26 | [2.63 | 3.89] |
| Cigarettes consumed | 13.54 | 22.32 | 8.79 | [7.89 | 9.69] | 9.15 | 13.55 | 4.40 | [3.50 | 5.3] |
| Tax revenue | 11.39 | 8.62 | -2.77 | [-3.21 | -2.33] | 8.05 | 12.45 | 4.39 | [3.95 | 4.83] |
| Quintile 3 | | | | | | | | | | |
| Tobacco expenditure | 10.32 | 11.52 | 1.20 | [0.60 | 1.80] | 9.3 | 12.3 | 3.00 | [2.40 | 3.6] |
| Cigarettes consumed | 13.56 | 16.00 | 2.45 | [1.85 | 3.05] | 15.7 | 17.32 | 1.66 | [1.06 | 2.26] |
| Tax revenue | 14.23 | 17.79 | 3.56 | [2.96 | 4.16] | 14.3 | 16.35 | 2.03 | [1.43 | 2.63] |
| Quintile 4 | | | | | | | | | | |
| Tobacco expenditure | 24.75 | 15.81 | -8.93 | [-9.56 | -8.30] | 19.5 | 20.61 | 1.16 | [0.53 | 1.79] |
| Cigarettes consumed | 25.76 | 17.9 | -7.86 | [-8.76 | -6.96] | 24.3 | 24.56 | 0.29 | [-0.61 | 1.19] |
| Tax revenue | 25.01 | 20.58 | -4.43 | [-4.87 | -3.99] | 23.5 | 24.05 | 0.59 | [0.15 | 1.03] |
| Quintile 5 | | | | | | | | | | |
| Tobacco expenditure | 51.83 | 65.56 | 13.73 | [13.13 | 14.33] | 63.8 | 56.1 | -7.68 | [-8.28 | -7.08] |
| Cigarettes consumed | 37.26 | 40.52 | 3.26 | [2.74 | 3.78] | 45.5 | 39.17 | -6.34 | [-6.86 | -5.82] |
| Tax revenue | 40.51 | 50.14 | 9.63 | [9.20 | 10.06] | 50.2 | 42.79 | -7.39 | [-7.82 | -6.96] |
| Totals | | | | | | | | | | |
| Per capita tobacco expenditure | 21.4 | 22.8 | 1.4 | [1.29 | 1.51] | 19.8 | 22.2 | 2.4 | [2.27 | 2.49] |
| Cigarettes consumed | 67.0 | 39.4 | -27.6 | [-27.73 | 27.51] | 40.1 | 39.0 | -1.1 | [-1.21 | -0.99] |
| Tax revenue | 55.1 | 58.0 | 2.9 | [2.79 | 3.01] | 49.9 | 56.4 | 6.5 | [6.41 | 6.63] |

Source: Authors' estimations using the 2010, 2012, 2018, and 2020 ENIGH surveys.

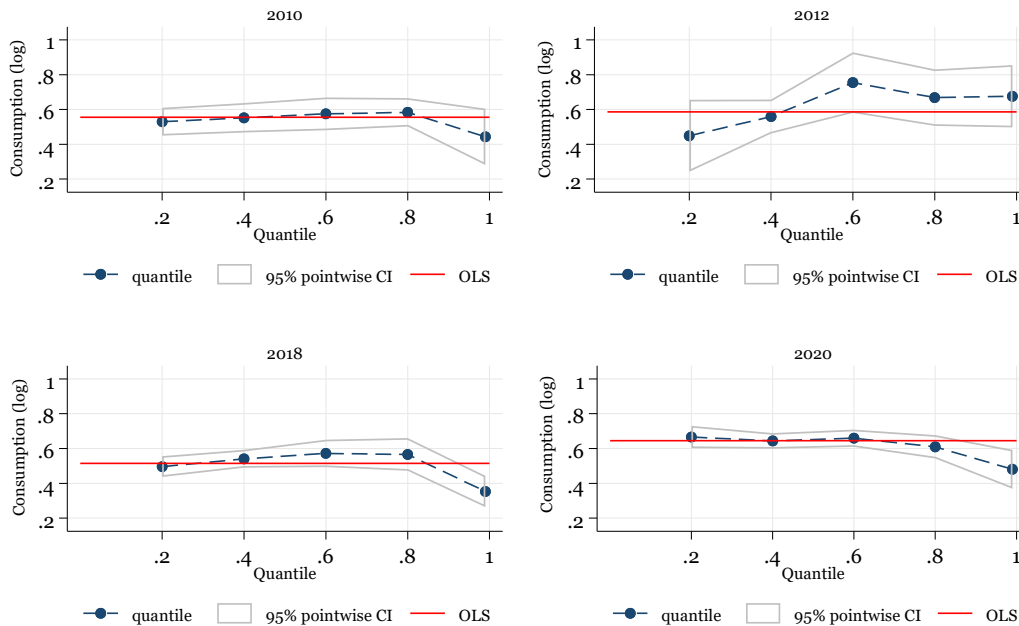
Also of note is the fact that expenditure and quantity consumed experience a sharper decline after the 2011 reform, with the quantity of cigarettes consumed by the poorest quintile dropping from 168 to 133 sticks per month (see Table 4 next section). In the 2019 reform, however, cigarette consumption by the poorest quintile remained virtually unaffected, at 123 sticks, while for the wealthiest quintile, this indicator fell from 656 to 622. Meanwhile, revenue data reported by the ENIGH show an increase from 404 to 611.8 million pesos a month, as expected, equivalent to a 12.4-percent increase (Table A1 in the Appendix).

Econometric results

Impact on expenditure

The trend in the first reform of 2011 showed a greater decrease in consumption in the poorest quintile, as its value (in logs) was on average lower in 2012 than 2010. However, the 2020 tobacco tax reform had a neutral effect, with more heterogeneous values across the other quintiles, as can be noted in Graph 2 by comparing the pre- and post-reform years. Despite this, expenditure decreased, and particularly remarkable is the fact that the expenditure functions are above the mean effect estimated by ordinary least squares (OLS) for quintiles 3, 4, and 5 in post-reform 2012, and for quintiles 2, 3, and 4 in pre-reform 2018. In 2020 the most recent reform declined mainly the highest quintile in the distribution of tobacco consumption. More insights can be seen in Table A2 included in the Appendix. From these models and calculating the marginal effects of increases in the unit values for the whole population (difference of $\log(uv)$ coefficients in last rows in Table A2 for each period), we found that the prevalence of households with positive expenditures in tobacco products reduced 6.8% after the 2011 fiscal reform and 4.9% after the 2019 reform.

Graph 2. Tobacco consumption by quintile in Mexico (2011 & 2019 reforms)



Source: Authors' calculations with data from SHCP and INEGI for the corresponding years.

A joint test of equality across all models with their coefficients and for the quantiles considered yields a rejection at a 5-percent level of significance. This indicates that in Mexico, expenditure on cigarettes as a result of the tax reforms in this period of analysis follows a distinct pattern, regardless of socioeconomic stratum ($F(19, 3607) = 10.14$, Prob. > F = 0.0000).

Impact on quantity demanded

Shown below, are the impacts of the reforms on quantities consumed by households with tobacco expenditure. By employing equation (2) and considering only the first and fifth quintiles, we estimated the number of cigarettes consumed per month and confidence intervals. Table 4 presents the number of cigarettes consumed per month (obtained from equation 2), confirming that the 2011 tax reform achieved a greater impact than the 2019 reform. Consumption in the poorest quintile fell by almost 21 percent, while the wealthiest quintile saw a much less pronounced decline of 4.5 percent. In contrast, after the second reform, the poorest quintile reduced their consumption by only 1 percent, while a decline of 5.2 percent was observed in the top quintile. Some differences are found not to be significant, such as the case in the former reform over the first reform at the fifth quintile and in the latter reform at the third quintile. From the models displayed in Table A3 (included in the Appendix), we calculate that the expenditure in tobacco decreased 32.7% after the fiscal reform of 2011, while a moderate reduction of 1.9% was estimated after the fiscal reform of 2019.

Table 4. Impacts of 2011 and 2019 tobacco tax reforms on per capita cigarette consumption (sticks consumed per month)

Difference Confidence interval

| Quintile | Quantity of cigarettes | | 2012-2010 | Lower | Upper |
|----------|------------------------|-------|-----------|-----------|-------|
| | 2010 | 2012 | | 2012-2010 | |
| 1 | 95 | 82 | -13 | [-17 | -8] |
| 2 | 168 | 133 | -35 | [-38 | -30] |
| 3 | 291 | 248 | -43 | [-57 | -26] |
| 4 | 442 | 411 | -30 | [-45 | -14] |
| 5 | 792 | 757 | -35 | [-73 | 12] |
| total | 357.6 | 326.2 | -31.4 | -46 | -13.2 |
| Quintile | Quantity of cigarettes | | 2020-2018 | Lower | Upper |
| | 2018 | 2020 | | 2020-2018 | |
| 1 | 80 | 74 | -6 | [-9 | -3] |
| 2 | 124 | 123 | -1 | [-5 | 3] |
| 3 | 220 | 219 | -1 | [0 | -2] |
| 4 | 362 | 359 | -3 | [-1 | -5] |
| 5 | 656 | 622 | -34 | [-32 | -36] |
| total | 288.4 | 279.4 | -9 | -9.4 | -8.8 |

Source: Authors' estimations using the 2010, 2012, 2018, and 2020 ENIGH surveys.

Impact on revenue and tax burden

Table 5 presents the effective mean tax burden and the percentage of this tax burden in expenditure by smoking households, by quintile. The first tax reform resulted in greater fiscal pressure on smoking households in the middle and upper quintiles, with a decrease in tax burden observed only in the first quintile. This decrease in the first quintile is less pronounced in the second reform, illustrating how simply adjusting tax for inflation was insufficient in reducing the tax burden as a proportion of household expenditure. This gap becomes wider for higher quintiles. Table A4 shows the main coefficients of the model and its impacts on revenues in the Appendix. From these, we calculated that revenue increased 9.1% and 6.5% after the 2011 and 2019 fiscal reforms, respectively.

Table 5. Average burden of tobacco taxes before and after fiscal reforms in Mexico.

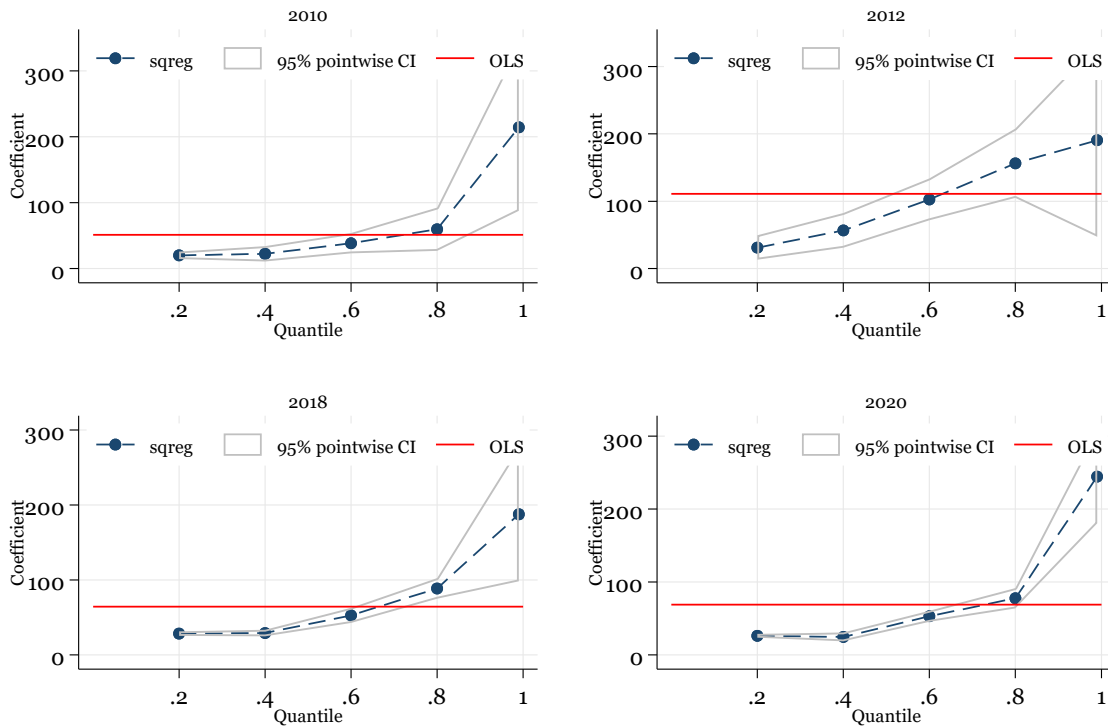
| Quintiles | 2010 | 2012 | Diff. | 95% CI | | 2018 | 2020 | Diff. | 95% CI | |
|-----------|------|------|-------|--------|-------|------|------|-------|--------|-------|
| | | | | Lower | Upper | | | | Lower | Upper |

| | | | | | | | | | | |
|------------------|------|------|-------|--------|--------|------|------|-------|--------|--------|
| 1 | | | | | | | | | | |
| Tax burden | 1.70 | 1.30 | -0.40 | [-0.43 | -0.37] | 1.00 | 0.90 | -0.10 | [-0.14 | -0.06] |
| % of expenditure | 5.65 | 3.46 | -2.19 | [-2.22 | -2.16] | 2.52 | 2.51 | -0.01 | [-0.05 | 0.03] |
| 2 | | | | | | | | | | |
| Tax burden | 1.60 | 1.60 | 0.00 | [-0.03 | 0.03] | 1.20 | 1.40 | 0.20 | [0.17 | 0.23] |
| % of expenditure | 4.37 | 4.02 | -0.34 | [-0.37 | -0.31] | 3.33 | 4.37 | 1.04 | [1.005 | 1.07] |
| 3 | | | | | | | | | | |
| Tax burden | 1.60 | 2.60 | 1.00 | [0.97 | 1.025] | 1.30 | 1.50 | 0.20 | [0.16 | 0.24] |
| % of expenditure | 3.86 | 6.81 | 2.95 | [2.92 | 2.97] | 3.85 | 4.88 | 1.03 | [0.99 | 1.06] |
| 4 | | | | | | | | | | |
| Tax burden | 2.60 | 2.90 | 0.30 | [0.27 | 0.33] | 1.50 | 1.60 | 0.10 | [0.07 | 0.13] |
| % of expenditure | 5.69 | 7.93 | 2.24 | [2.21 | 2.26] | 4.95 | 5.19 | 0.24 | [0.22 | 0.27] |
| 5 | | | | | | | | | | |
| Tax burden | 2.50 | 3.10 | 0.60 | [0.57 | 0.63] | 1.80 | 2.10 | 0.30 | [0.27 | 0.33] |
| % of expenditure | 5.00 | 9.47 | 4.47 | [4.45 | 4.49] | 5.95 | 6.23 | 0.28 | [0.25 | 0.31] |
| Total | | | | | | | | | | |
| Tax burden | 1.90 | 2.30 | 0.40 | [0.36 | 0.43] | 1.40 | 1.50 | 0.10 | [0.07 | 0.13] |
| % of expenditure | 4.72 | 5.94 | 1.22 | [1.18 | 1.26] | 3.91 | 4.49 | 0.58 | [0.55 | 0.62] |

Source: Authors' estimations using the 2010, 2012, 2018, and 2020 ENIGH surveys.

The results of the econometric model by quantile demonstrate that the upper quintiles account for most of the revenue (and hence tax burden) arising from the reforms. The revenue results show a greater fiscal pressure from the third quintile, with a larger impact on smokers from the wealthiest 20 percent of households. However, there are still some quintiles with insignificant differences, such as those where the lower limit is negative like in the first quintile in the 2018-2020 tobacco tax reform.

Graph 3. Tobacco excise revenue in Mexico by quintile, 2011 and 2019 reforms (millions of pesos per month)



However, the bottom panel of Graph 3 shows, once again, how the 2019 reform did not result in any major increase in revenue (except for the wealthiest quintile). This can be explained by the fact the tax increase was very slight in nominal terms. To achieve any substantial increase in revenue, a policy is needed that will raise tax in real terms.

Impact on poverty and forgone income

The effects of these tobacco tax reforms on poverty are shown in tables 6 and 7 and graphs 4 and 5. In the first reform, based on per capita income, poverty and poverty intensity fell to the same extent (1.7 percentage points), while an analysis based on forgone income due to tobacco showed a slight increase in poverty that was just significant at 1 percentage point. In comparison, poverty intensity fell by 1.3 percentage points. Despite the fall in income associated with tobacco expenditure, poverty decreased with the first reform (Graph 4).

Table 6. Poverty levels before and after tobacco tax reforms in Mexico, 2011 and 2019. (Figures in percentages and 95% confidence intervals)

| | Per capita income | | Forgone income due to tobacco | |
|--------------------|-------------------|------------|-------------------------------|------------|
| | Poverty | Intensity* | Poverty | Intensity* |
| Before 2011 reform | 39.8 | 14.1 | 40.7 | 14.5 |

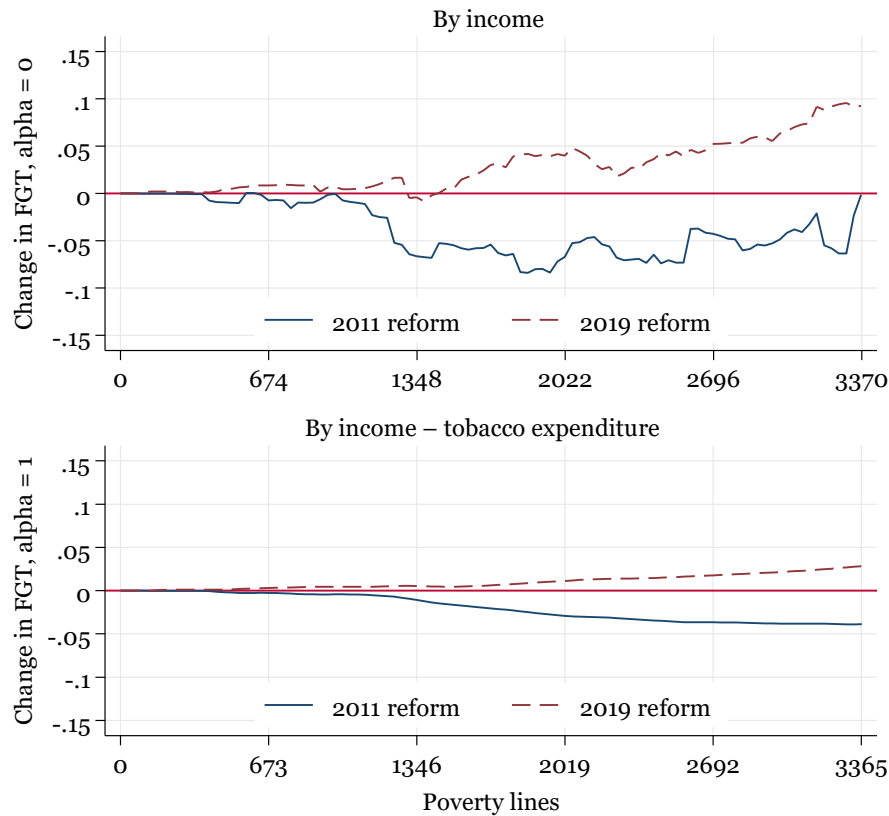
| | | | | |
|--------------------|-------------|-------------|-------------|-------------|
| CI | [39.6 39.9] | [10.1 18.2] | [36.0 45.4] | [10.4 18.5] |
| After 2011 reform | 38.0 | 12.4 | 41.7 | 13.2 |
| CI | [37.9 38.1] | [8.7 16.0] | [41.3 42.1] | [9.5 16.9] |
| Difference | -1.8 | -1.7 | 1.0 | -1.3 |
| CI | [-1.7 -1.8] | [-1.4 -2.2] | [5.3 -3.3] | [-0.9 -1.6] |
| Before 2019 reform | 36.1 | 11.9 | 38.0 | 12.5 |
| CI | [36.0 36.1] | [9.3 14.6] | [37.9 38.1] | [9.8 15.2] |
| After 2019 reform | 41.3 | 13.5 | 43.0 | 14.5 |
| CI | [41.3 41.4] | [11.8 15.3] | [42.9 43.1] | [12.6 16.3] |
| Difference | 5.2 | 1.6 | 5.0 | 1.96 |
| CI | [5.0 5.4] | [0.7 2.5] | [4.6 5.4] | [1.1 2.8] |

* Intensity is measured as the amount of income needed by the poor to move out of poverty, measured as the normalized mean distance of per capita income from the poverty line or threshold for each family. CI in brackets.

Source: Authors' estimations using the 2010, 2012, 2018, and 2020 ENIGH surveys.

In the second reform, Table 6 shows increases in poverty among households with tobacco expenditure, on the order of around 5 percentage points in each income scenario. However, the significant effect of the COVID-19 pandemic—which other research shows exacerbated poverty—must also be considered. Poverty is also affected by other factors that fall outside the scope of this estimation, and which may be introducing bias into the result. Indeed, this increase is not solely a consequence of the 2019 tax reform; the poverty intensity indicator confirms that both tax reforms barely widened the gap in smoker income, by just -1.7 and 1.6 percentage points in 2011 and 2019, respectively. Other impacts were observed in 2020 from both the tax reform and the COVID-19 pandemic, and these effects are explained later. Even so, the additional excise tax levied on the unit price of cigarettes reduced smoker poverty, as shown in later sections and Table 8.

Graph 4. Changes in poverty due to the 2011 and 2019 tax reforms in Mexico



Source: Authors' estimations using the 2010, 2012, 2018, and 2020 ENIGH surveys.

Changes in poverty considering health expenditure

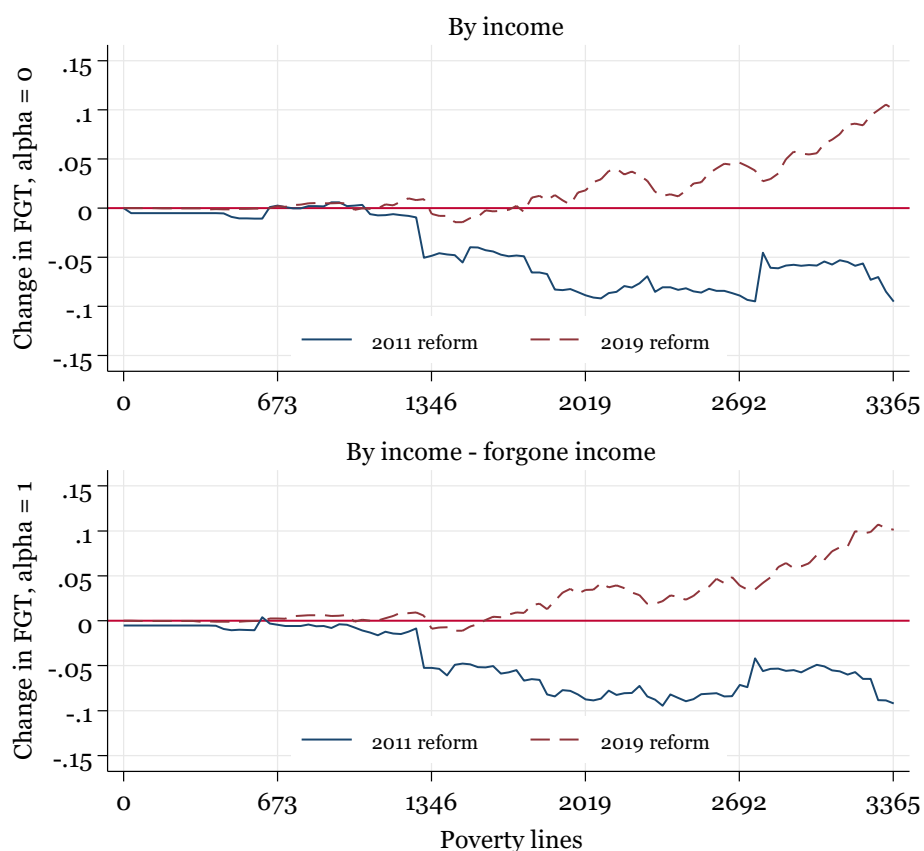
Table 7 and Graph 5 show the impacts when accounting for both forgone income due to tobacco expenditure and expenditure by smoking households on health care. A similar pattern is observed, with the 2011 reform barely increasing poverty by 1.5 points. Although the 2019 reform was implemented in the context of increasing poverty, a comparison with Table 6 shows no significant change when considering smoking households' expenditure on health care (medicine, hospital stays, and other related aspects) in addition to tobacco expenditure. Similarly, the bottom panel of Graph 4 shows that the change in poverty intensity was barely positive in the 2019 tax reform.

Table 7. Poverty levels before and after tobacco tax reforms in Mexico, considering health care expenditure, 2011 and 2019

| | Per capita income | | Forgone income from tobacco and health care | |
|--------------------|-------------------|-----------|---|-----------|
| | Poverty | Intensity | Poverty | Intensity |
| Before 2011 reform | 39.8 | 14.1 | 43.5 | 16.5 |
| After 2011 reform | 38.0 | 12.4 | 45.0 | 15.5 |
| Difference | -1.7 | -1.7 | 1.5 | -1.0 |
| Before 2019 reform | 36.1 | 11.9 | 41.3 | 14.6 |
| After 2019 reform | 41.3 | 13.2 | 46.4 | 16.7 |
| Difference | 5.3 | 1.3 | 5.1 | 2.1 |

Source: Authors' estimations using the 2010, 2012, 2018, and 2020 ENIGH surveys.

Graph 5. Changes in poverty due to the 2011 and 2019 tax reforms in Mexico

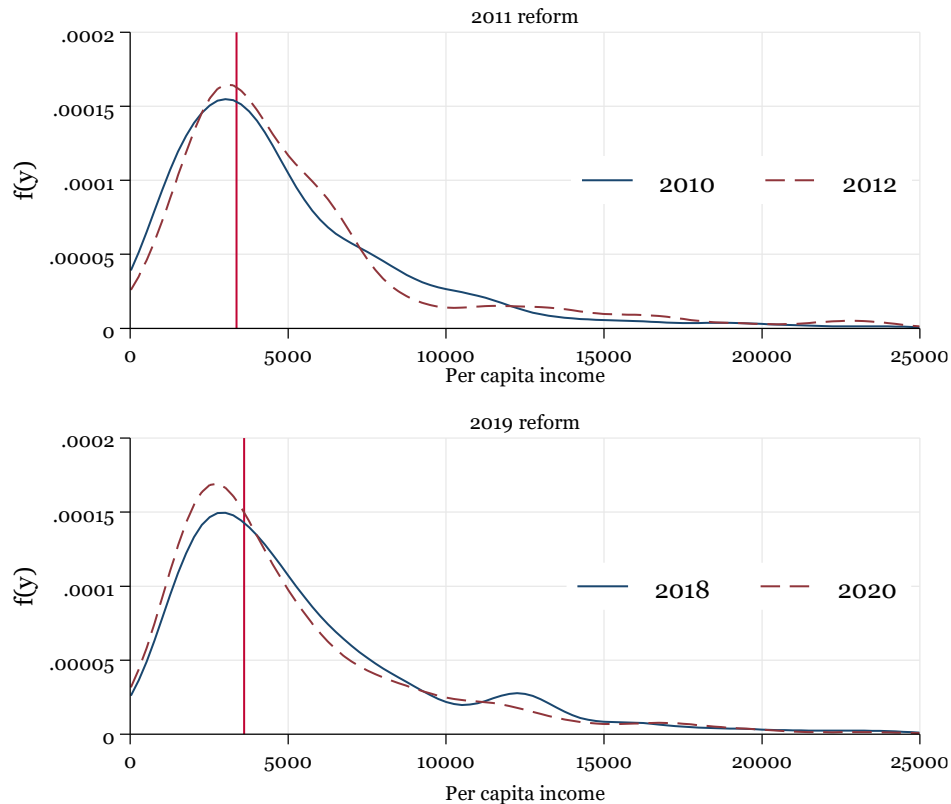


Source: Authors' estimations using the 2010, 2012, 2018, and 2020 ENIGH surveys.

To confirm the reforms did not have a significant negative impact on poverty, the results of the estimation of the system of equations in Equation (4) are shown in Table 8. Even considering the increase in poverty due to the pandemic in smoking households, only small increases are observed around the poverty

threshold. This means that, particularly for the 2019 reform, only households close to the threshold would be affected by this measure (with income above 2,500 pesos), while there would be no impact on smokers beyond this point in the distribution, as shown in Graph 6.

Graph 6. Income density of smokers and the 2011 and 2019 tobacco tax reforms in Mexico/*



/* Considering forgone income from health expenditure.

Source: Authors' estimation using the 2010, 2012, 2018, and 2020 ENIGH surveys.

Post-reform tobacco prices did not increase poverty. On the contrary, poverty levels in tobacco household consumers show negative signs with statistically significant coefficients in both periods of tobacco reforms. The first reform in 2011 resulted in a reduction in poverty, exhibiting a change of -4.4 and -2.7 points (non-significant difference test with a Prob error of $\chi^2 = 0.2671$), while the 2019 reform, even with the COVID-19 pandemic, reduced poverty from -4.3 to -2.5 points (significant difference test with a Prob error of $\chi^2 = 0.0807$), implying that the coefficients of tobacco unit prices do not differ from one another and the ex-post econometric measurement did not result in an increase in poverty.

The covariates that did have a positive effect on poverty, meaning an increase in poverty, were: residing in the south of the country (states of Oaxaca, Guerrero, or Chiapas), living in a large or overcrowded household, and living in a rural household.

Table 8. Poverty impacts in the 2011 and 2019 tobacco reform periods in Mexico

| Dependent variable Quintile 1 = poverty | Model 1 (2011 reform) | | Model 2 (2019 reform) | |
|--|-----------------------|-----------|-----------------------|------------|
| | Quintile 1 | Poor | Quintile 1 | Poor |
| Unit value (price) | -0.0443*** | -0.0271* | -0.0429*** | -0.0255** |
| Health expenditure | -0.123*** | -0.114*** | -0.112*** | -0.0915*** |
| South region | 0.0303 | 0.0899 | 0.136*** | 0.219*** |
| Members | 0.0692*** | 0.0969*** | 0.0739*** | 0.107*** |
| Working individuals | -0.134*** | -0.229*** | -0.132*** | -0.235*** |
| Rural | 0.188*** | 0.022 | 0.124*** | -0.0353*** |
| Constant | 0.718*** | 0.704*** | 0.621*** | 0.553*** |
| R ² | | 0.2982 | | 0.2565 |
| N | | 1976 | | 7032 |

* p<0.05, ** p<0.01, *** p<0.001

Source: Authors' estimation using the 2010, 2012, 2018, and 2020 ENIGH surveys.

Discussion

The results show that both tobacco tax reforms achieved an impact, with a reduction in expenditure and a reduction in consumption that varied by socioeconomic group, with no uptick in poverty in smoking households. The decrease in both prevalence and consumption was more substantial in poor households than in those with higher income levels. One limitation of this study is the change in the national minimum wage, which saw a cumulative increase of over 40 percent in 2019 and 2020, making tobacco more affordable. This change in base income and expenditure among the poor may have counteracted, in part, the effect of the reforms, but measuring this effect falls outside the scope of this analysis. Even with this new wage legislation, it was found that both tobacco tax reforms led to decreases in cigarette consumption and were progressive. Following the reforms, smoking households allocated a lower proportion of income to expenditure on cigarettes, and this was confirmed for each reform.

Another no less important aspect is tax revenue paid, which increases with higher socioeconomic groups. This analysis shows that each quintile contributes tax revenue in a manner that is highly progressive, with total annual government revenue approaching 7 billion pesos in 2020. Although surveys of this kind tend to underreport income, and hence revenue obtained, the trend remains relevant.

One strength of this study is that poverty levels were estimated using two different approaches: by disposable income per capita and by deducting out-of-pocket expenditure by smokers on health care and tobacco. Both approaches

found small changes in poverty, no greater than 2 percent, in smoking households on the cusp of the poverty line following both tax reforms.

The results appear to validate the hypothesis set forth by Verguet et al. (2020), who assert that in the face of relatively high elasticities of demand, increases in cigarette prices of 50 percent or more may be progressive. This suggests that the impact of higher tobacco taxes on revenue is an empirical issue, and they may be progressive in their effects, contrary to common belief about the impact of excise tax on consumers' wallets. **This study has confirmed that a tax increase in Mexico is progressive**, with a higher share of the increased tax burden falling on higher income groups while a decrease in consumption is observed across the whole population.

After controlling for other factors, our analysis shows a reduction in poverty levels, with a decrease of around 4 percentage points in 2011 and 2019 in the poorest quintile associated with the changes in unit values after the reforms. An additional strength of this analysis is that our estimation establishes that the observed, uncontrolled, or crude increase in poverty is due to other factors, with up to 5 percentage points associated with rural areas and large, overcrowded smoking households (household size). Further, the poor consuming tobacco are not a substantial subgroup in the national poverty level, so poverty remains unchanged at the country level.

Conclusion and policy recommendations

Both the 2011 and 2019 tax reforms were effective in reducing tobacco consumption and bringing about a shift in consumer spending, and they did not result in an increase in poverty levels. The 2011 reform was more effective, producing more significant changes in the relevant indicators studied than the reform introduced in 2019. Indeed, the significance of the 2011 reform is well known, as it was the first time a significant adjustment was made to the specific component of the tax, which had been introduced just one year earlier and rose by 600 percent under the reform. This is one of the key reasons why the changes observed in the indicators were more pronounced.

The 2019 reform, on the other hand, resulted in more modest changes in these indicators, given that the adjustment for inflation was insufficient to reverse the increasing trend in smoking prevalence that began in 2017 and was exacerbated by the COVID-19 pandemic, during which it reached 19.1 percent. It is important to recall then, how important it is to implement stronger fiscal measures that reduce affordability and therefore allow for a greater reduction in tobacco consumption and its prevalence among the population.

Prevalence as measured by the share of households that purchase tobacco decreased over the entire period covered by the two tax reforms. The highest prevalence rate was recorded in 2010, at 7.3 percent, and this figure dropped consistently over the period, reaching 4.2 percent in 2020. An analysis by

quintile showed the same pattern, with low levels of prevalence recorded in lower socioeconomic groups and greater prevalence among wealthier quintiles. However, gradual declines were observed across all quintiles over time.

Consumption fell across groups but more so among lower income households. It decreased by nearly 21 percent among the poorest 20 percent of smokers. In contrast, the decline in consumption stood at just 4.5 percent in the richest quintile.

Tobacco expenditure also fell to a greater extent among lower income groups. For every peso previously spent by smokers, after the reforms, the lower quintiles now spent 50 cents, while richer households spent 80 cents.

Tax revenue collection varied among quintiles but was generally greater in higher income quintiles. In the first quintile, revenue fell by 51 percent, but increases in revenue were observed from the second quintile onwards, on the order of 14 percent, 88 percent, 24 percent, and 87 percent, respectively, in the 2011 reform. In contrast, the 2019 reform yielded only a 16.7-percent increase in revenue from the highest quintile.

Lastly, broadly speaking, the tax reforms reduced poverty. It was found that the change in cigarette prices had impacts on poverty levels, the greatest of which was a 4.4-point reduction in the poorest quintile in 2011. The change in cigarette prices following the 2019 reform also reduced poverty by 4.3 points, notably against the backdrop of the COVID-19 pandemic. Observed, uncontrolled increases in poverty more broadly in these years cannot, therefore, be attributed directly to the tobacco tax reforms because of the confounding effect of the pandemic and other variables such as household size.

This study has shown, based on appropriate information from surveys of household income and expenditure in the years before and after the introduction of these tax measures, that tax reforms are highly effective in reducing consumption and help to improve the overall wellbeing of the population given the economic and health benefits of lowered consumption. Furthermore, they lead to a potential increase in government tax revenue and reduce the share of household expenditure allocated to tobacco by Mexican families. The results from this study also highlight a need to push for steeper increases to the specific tax on tobacco beyond a mere adjustment for inflation. While inflation indexation is a necessary first step to help maintain current progress, it is insufficient to produce substantial positive effects in terms of raising government revenue or reducing consumption. In the long run, there will be no effect on these indicators without a larger tax increase in Mexico.

References

- Austria, M. S., & Pagaduan, J. A. (2019). Are Filipino smokers more sensitive to cigarette prices due to the Sin Tax Reform Law? A difference-in-difference analysis. *DLSU Business and Economics Review*, 28(2), 10-25.
- Chaloupka, F. J., Yurekli, A., & Fong, G. T. (2012). Tobacco taxes as a tobacco control strategy. *Tobacco Control*, 21(2), 172-180. doi:10.1136/tobaccocontrol-2011-050417
- Chaloupka, F. J., Powell, L. M., & Warner, K. E. (2019). The use of excise taxes to reduce tobacco, alcohol, and sugary beverage consumption. *Annual Review of Public Health*, 40, 187-201. <https://doi.org/10.1146/annurev-publhealth-040218-043816>
- DOF (2009). Decreto por el que se reforman y adicionan diversas disposiciones de la Ley del Impuesto Especial sobre Producción y Servicios [Decree reforming and adding various provisions in the Excise Tax on Production and Services Law]. Published on November 27, 2009, in the Official Gazette of the Federation (DOF).
- DOF (2010). Decreto por el que se reforma el artículo 2o. de la Ley del Impuesto Especial sobre Producción y Servicios [Decree reforming Article 2 of the Excise Tax on Production and Services Law]. Published on November 19, 2010, in the Official Gazette of the Federation (DOF).
- DOF (2019). Acuerdo por el que se actualizan las cuotas que se especifican en materia del impuesto especial sobre producción y servicios [Decision updating the specified amounts of excise tax on production and services]. Published on December 24, 2019, in the Official Gazette of the Federation (DOF).
- ENCODAT (2017). Encuesta Nacional de Consumo de Drogas, Alcohol y Tabaco 2016-2017 [2016-2017 National Survey on Drug, Alcohol, and Tobacco Consumption]. https://www.gob.mx/cms/uploads/attachment/file/246059/fact_transversal_final_01_0417_V6.pdf.
- Franco-Churrugarin F., & Gonzalez-Rozada M. (2021). The impact of cigarette price increases on the prevalence of daily smoking and initiation in Mexico. A Tobacconomics Research Report. Chicago, IL: Tobacconomics, Health Policy Center, Institute for Health Research and Policy, University of Illinois Chicago.
- Goodchild, M., Perucic, A. M., & Nargis, N. (2016). Modelling the impact of raising tobacco taxes on public health and finance. *Bulletin of the World Health Organization*, 94(4), 250.
- González-Rozada, M. (2020). Impact of a recent tobacco tax reform in Argentina. *Tobacco Control*, 29(Suppl 5), s300-s303.
- González-Rozada, M., & Montamat, G. (2019). How increasing tobacco prices affects the decision to start and quit smoking: Evidence from Argentina. *International Journal of Environmental Research and Public Health*, 16(19), 3622. <https://doi.org/10.3390/ijerph16193622>

- Greene, W. H. (2008). *Econometric Analysis* (6th ed.). Pearson, Prentice Hall, USA.
- Huesca, L., Araar, A., Llamas, L., & Lacroix, G. (2021). The impact of tobacco tax reforms on poverty in Mexico. *SN Business & Economics*, 1(10), 142. <https://doi.org/10.1007/s43546-021-00141-x>
- Huesca, L., Llamas, L., Vargas Téllez, C. O., & Rodríguez Iglesias, G. (2022). The distributional effects of a tobacco tax reform in Mexico: Social welfare improvements from fiscal reforms. (Tobacconomics Working Paper No. 22/12/3). CIAD. <https://tobacconomics.org/research/the-distributional-effects-of-a-tobacco-tax-reform-in-mexico-social-welfare-improvements-from-fiscal-reforms-working-paper-series/>
- Huesca, L., Araar, A., Llamas, L., & Calderón, C. (2019). *Acelerando la fiscalidad efectiva al tabaco en México: Impuestos especiales, consumo, desigualdad y pobreza [Accelerating effective tobacco taxation in Mexico: Excise taxes, consumption, inequality, and poverty]*. Series of background papers for the Tobacco Taxes in Latin America project. Country study No.7/2019. Red Sudamericana de Economía Aplicada Red Sur/Institute for Health Research and Policy.
- Hong, Q., Su, J., & Hong, P. (2023). Tobacco excise tax reform: From the perspective of “tax to control tobacco” policy in China. *Health Economics*, 32(10), 2260-2277. <https://doi.org/10.1002/hec.4728>
- Instituto Nacional de Salud Pública (2023). *Encuesta Global de Tabaquismo en Adultos [Global Adult Tobacco Survey]*. https://www.gob.mx/cms/uploads/attachment/file/895921/REPORTE_COMPLETO_GATS_2023.pdf
- Jiménez-Ruiz, J. A., Sáenz-De-Miera, B., Reynales-Shigematsu, L. M., Waters, H. R., & Hernández-Ávila, M. (2008). The impact of taxation on tobacco consumption in Mexico. *Tobacco Control*, 17(2), 105-110.
- John R., Chelwa G., Vulovic V., & Chaloupka F. (2019). *Using Household Expenditure Surveys for Research in the Economics of Tobacco Control. A Tobacconomics Toolkit*. Chicago, IL: Tobacconomics, Health Policy Center, Institute for Health Research and Policy, University of Illinois at Chicago, 2019. www.tobacconomics.org
- López-Nicolás, Á., Badillo-Amador, L., & Cobacho-Tornel, M. B. (2013). Will the European Union’s new tobacco tax legislation lead to reductions in smoking prevalence? Evidence from a quasi-experiment in Spain. *Nicotine & Tobacco Research*, 15(12), 1963-1970.
- Ngo, A., Drope, J., Guerrero-López, C. M., Siu, E., & Chaloupka, F. J. (2022). As countries improve their cigarette tax policy, cigarette consumption declines. *Tobacco Control*, 33(e1). doi:10.1136/tobaccocontrol-2022-057486
- Powell, L. M., & Chaloupka, F. J. (2023). Protecting and promoting health through taxation: Evidence and gaps. In J. A. Lauer, F. Sassi, A. Soucat,

- & A. Vigo, Health Taxes (pp. 57–86). World Scientific.
https://doi.org/10.1142/9781800612396_0003
- Reynales-Shigematsu, L. M., Wipfli, H., Samet, J., Regalado-Pineda, J., & Hernández-Ávila, M. (2019). Tobacco control in Mexico: A decade of progress and challenges. *Salud Pública de México*, 61(3, May-Jun), 292-302. <https://doi.org/10.21149/9360>
- Rout, S. K., & Parhi, A. (2020). Has tax reforms in India been effective in tobacco control: Evidences on affordability of cigarette after introduction of Goods and Service Tax. *Journal of Family Medicine and Primary Care*. 9(12), 5927–5932. https://doi.org/10.4103/jfmpe.jfmpe_1169_20
- Saenz de Miera, B., Wu, D. C., Essue, B. M., Maldonado, N., Jha, P., & Reynales-Shigematsu, L. M. (2022) The distributional effects of tobacco tax increases across regions in Mexico: An extended cost-effectiveness analysis. *International Journal for Equity in Health*, 21, 8.
- Saldaña, N., & Melgoza, A. (2020). Así ha sido la ‘jugada maestra’ de las tabacaleras [How tobacco companies have pulled off a masterstroke]. *Ethos Laboratorio de Políticas Públicas*.
https://www.ethos.org.mx/finanzas-publicas/reportajes/asi_ha_sido_la_jugada_maestra_de_las_tabacaleras
- WHO (2003). Convenio Marco de la OMS para el Control del Tabaco [WHO Framework Convention on Tobacco Control]. World Health Organization. WHO Document Production Services, Geneva, Switzerland.
- WHO (2013). Directrices para la aplicación del artículo 6 [Guidelines for implementation of Article 6]. WHO Framework Convention on Tobacco Control, Geneva, Switzerland.
- World Bank Group (2019). Mexico: Overview of Tobacco Use, Tobacco Control Legislation, and Taxation (English). WBG Global Tobacco Control Program. Washington D.C.: World Bank Group.
- Zavala-Arciniega, L., Reynales-Shigematsu, L. M., Levy, D. T., Lau, Y. K., Meza, R., Gutiérrez-Torres, D. S., Arillo-Santillán, E., Fleischer, N. L., & Thrasher, J. (2020). Smoking trends in Mexico, 2002–2016: Before and after the ratification of the WHO’s Framework Convention on Tobacco Control. *Tobacco Control*, 29(6), 687-691.
<https://doi.org/10.1136/tobaccocontrol-2019-055153>

Appendix

Table A1. Total tobacco expenditure, consumption of sticks, and revenue by population quintile in Mexico, 2010-2020

(Expenditure and revenue in pesos; quantities in number of sticks)

| Quintile 1 | 2010 | 2012 | % | 2018 | 2020 | % |
|--------------------------------|-------------|-------------|-------|-------------|-------------|-------|
| Per capita tobacco expenditure | 18,488,369 | 7,192,398 | -61.1 | 7,451,264 | 7,871,162 | 5.6 |
| Quantity of cigarettes | 37,810,160 | 14,805,933 | -60.8 | 14,788,230 | 13,169,462 | -10.9 |
| Government revenue | 35,849,083 | 17,533,401 | -51.1 | 14,536,439 | 15,983,643 | 10.0 |
| Quintile 2 | | | | | | |
| Per capita tobacco expenditure | 26,306,156 | 26,484,725 | 0.7 | 15,192,454 | 23,919,629 | 57.4 |
| Quantity of cigarettes | 51,797,050 | 101,809,690 | 96.6 | 25,067,254 | 33,104,758 | 32.1 |
| Government revenue | 46,097,562 | 52,754,203 | 14.4 | 29,437,770 | 45,713,234 | 55.3 |
| Quintile 3 | | | | | | |
| Per capita tobacco expenditure | 35,248,205 | 54,519,138 | 54.7 | 28,195,444 | 35,583,097 | 26.2 |
| Quantity of cigarettes | 51,883,891 | 72,990,752 | 40.7 | 42,912,122 | 42,309,677 | -1.4 |
| Government revenue | 57,615,375 | 108,845,729 | 88.9 | 52,356,748 | 60,069,637 | 14.7 |
| Quintile 4 | | | | | | |
| Per capita tobacco expenditure | 84,557,929 | 74,850,096 | -11.5 | 58,987,883 | 59,635,438 | 1.1 |
| Quantity of cigarettes | 98,557,517 | 81,641,338 | -17.2 | 66,478,634 | 59,990,976 | -9.8 |
| Government revenue | 101,253,419 | 125,921,851 | 24.4 | 85,766,260 | 88,348,196 | 3.0 |
| Quintile 5 | | | | | | |
| Per capita tobacco expenditure | 177,109,643 | 310,360,915 | 75.2 | 193,322,902 | 162,274,875 | -16.1 |
| Quantity of cigarettes | 142,587,123 | 184,809,047 | 29.6 | 124,639,162 | 95,661,190 | -23.2 |
| Government revenue | 163,983,885 | 306,825,367 | 87.1 | 157,174,838 | 183,446,887 | 16.7 |
| Year total | | | | | | |
| Per capita tobacco expenditure | 341,710,302 | 473,407,272 | 38.5 | 303,149,948 | 289,284,201 | -4.6 |
| Quantity of cigarettes | 382,635,741 | 456,056,759 | 19.2 | 273,885,402 | 244,236,064 | -10.8 |
| Government revenue | 404,799,324 | 611,880,550 | 51.2 | 365,544,104 | 367,289,548 | 0.5 |

Source: Authors' estimations using the 2010, 2012, 2018, and 2020 ENIGH surveys.

**Table A2. Quantile regressions of tobacco consumption in Mexico
(2011 & 2019 reforms) / 1**

| | (2010) | (2012) | (2018) | (2022) |
|---------------------|---------|----------|----------|----------|
| Q1 | | | | |
| $\log(ex)_i^\theta$ | 0.417* | 0.341* | 0.611* | 0.508* |
| $\log(uv)_i^\theta$ | 0.0413 | -0.332* | -0.0637 | 0.0272 |
| _cons | 0.990 | 1.372+ | -1.982* | -0.773 |
| Q2 | | | | |
| $\log(ex)_i^\theta$ | 0.501* | 0.417* | 0.617* | 0.548* |
| $\log(uv)_i^\theta$ | 0.0328 | -0.373* | -0.0576 | -0.0477 |
| _cons | 0.196 | 0.970 | -1.421* | -0.129 |
| Q3 | | | | |
| $\log(ex)_i^\theta$ | 0.505* | 0.521* | 0.624* | 0.571* |
| $\log(uv)_i^\theta$ | 0.0521 | -0.233 | -0.0281 | 0.00407 |
| _cons | 0.628 | 0.345 | -1.421* | 0.0957 |
| Q4 | | | | |
| $\log(ex)_i^\theta$ | 0.544* | 0.554* | 0.613* | 0.583* |
| $\log(uv)_i^\theta$ | -0.124+ | -0.113+ | -0.0597 | -0.0263 |
| _cons | 0.506 | 0.395 | -0.559 | 0.115 |
| Q5 | | | | |
| $\log(ex)_i^\theta$ | 0.457* | 0.676* | 0.397* | 0.467* |
| $\log(uv)_i^\theta$ | -0.450 | -0.126 | -0.245* | -0.328 |
| _cons | 1.614 | -0.165 | 3.305* | 1.111 |
| N | 1315 | 317 | 3415 | 3626 |
| OLS | | | | |
| $\log(ex)_i$ | 0.514* | 0.646* | 0.555* | 0.586* |
| $\log(uv)_i$ | -0.016 | -0.0844* | -0.0486* | -0.0895* |
| _cons | -0.118 | -1.983* | -0.176 | -1.301* |
| N | 1466 | 417 | 3105 | 3988 |

/1 Full model results available upon request.

+ $p < 0.10$, * $p < 0.05$

Source: Authors' estimations using the 2010, 2012, 2018, and 2020 ENIGH surveys.

**Table A3. Quantile regressions for demand of cigarettes in Mexico
(2011 & 2019 reforms) / 1**

| | (1) 2010 | (2) 2012 | (3) 2018 | (4) 2020 |
|---------------------|-------------|-------------|-------------|-------------|
| Q1 | | | | |
| $\log(ex)_i^\theta$ | 0.2669 | 0.224* | 0.187* | 0.168* |
| $\log(uv)_i^\theta$ | -0.69* | -0.79* | -0.47* | -0.72* |
| _cons | 5.244* | 3.740* | 3.859* | 4.003* |
| Q2 | | | | |
| $\log(ex)_i^\theta$ | 0.200 | 0.250* | 0.156* | 0.1430 |
| $\log(uv)_i^\theta$ | -0.66* | -0.57* | -0.44* | -0.74* |
| _cons | 5.965* | 4.020* | 4.579* | 5.483* |
| Q3 | | | | |
| $\log(ex)_i^\theta$ | 0.0706+ | 0.126+ | 0.139 | 0.1496* |
| $\log(uv)_i^\theta$ | -0.45* | -0.49* | -0.46* | -0.58* |
| _cons | 7.118* | 5.633* | 6.093* | 7.007* |
| Q4 | | | | |
| $\log(ex)_i^\theta$ | 0.149 | 0.180+ | 0.132 | 0.0915* |
| $\log(uv)_i^\theta$ | -0.43* | -0.47* | -0.45* | -0.460* |
| _cons | 7.132* | 5.817* | 6.764* | 7.238* |
| Q5 | | | | |
| $\log(ex)_i^\theta$ | 0.102+ | 0.0767 | 0.1649 | 0.1622 |
| $\log(uv)_i^\theta$ | -0.37* | -0.394 | -0.321* | -0.37* |
| _cons | 9.579* | 8.083* | 9.688* | 8.496* |
| N | 1583 | 529 | 3571 | 4112 |
| OLS | | | | |
| lexp | 0.462 | 0.135 | 0.0771 | 0.0580 |
| lnnp | -0.78 | -0.795 | -0.621 | -0.679 |
| _cons | 6.731* | 5.742* | 6.035* | 6.476* |
| N | 1583 | 529 | 3571 | 4112 |

1/ Full model results available upon request.

+ p < 0.10, * p < 0.05

Source: Authors' estimations using the 2010, 2012, 2018, and 2020 ENIGH surveys.

Table A4. Tobacco excise revenue in Mexico by quantile, 2011 and 2019 reforms

| | (Millions of pesos per month) / 1 | | | |
|---------------------|--|---------|---------|---------|
| | (1) | (2) | (3) | (4) |
| | 2010 | 2012 | 2018 | 2020 |
| Q1 | | | | |
| $\log(ex)_i^\theta$ | 20.47* | 32.02* | 29.11* | 28.36* |
| $\log(uv)_i^\theta$ | -2.535 | -5.172 | -15.95* | -13.71* |
| _cons | 112.9* | 321.6* | 223.1* | 216.9* |
| Q2 | | | | |
| $\log(ex)_i^\theta$ | 24.04* | 60.14* | 30.85* | 26.18* |
| $\log(uv)_i^\theta$ | -4.314 | -7.908 | -16.17* | -13.89* |
| _cons | 114.4* | 590.6* | 215.8* | 145.2* |
| Q3 | | | | |
| $\log(ex)_i^\theta$ | 38.01* | 102.7* | 51.29* | 51.53* |
| $\log(uv)_i^\theta$ | -7.804 | -1.318 | -25.32* | -19.56* |
| _cons | 199.1* | 861.6* | 353.0* | 313.8* |
| Q4 | | | | |
| $\log(ex)_i^\theta$ | 59.63* | 164.3* | 85.14* | 80.60* |
| $\log(uv)_i^\theta$ | 17.71 | -28.95 | -33.23* | -28.72* |
| _cons | 381.0* | 1338.2* | 679.0* | 486.5* |
| Q5 | | | | |
| $\log(ex)_i^\theta$ | 186.5* | 201.0* | 181.1* | 246.3* |
| $\log(uv)_i^\theta$ | 54.48 | -182.7 | 92.97 | 43.69 |
| _cons | 1160.0+ | 1708.2* | 1250.2* | 1693.8* |
| N | 1581 | 529 | 3571 | 4112 |
| OLS | | | | |
| ly | 50.72* | 111.4* | 64.91* | 69.32* |
| lnnp | 7.304 | -5.162 | -12.52+ | -11.36 |
| _cons | -362.2* | -982.2* | -463.3* | -500.7* |
| Prediction | | | | |
| Millions pesos | 24,500 | 26,730 | 25,400 | 27,051 |
| Variation (%) | | 9.1% | | 6.5% |
| N | 1581 | 529 | 3571 | 4112 |

1/ Full model results available upon request.

+ $p < 0.10$, * $p < 0.05$

Source: Authors' estimations using the 2010, 2012, 2018, and 2020 ENIGH surveys.