Tobacco industry in Mexico: a general equilibrium analysis

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ABSTRACT

Objective Effects of tobacco taxation on employment in Mexico are measured by using an applied general equilibrium model.

Methods The study describes the modelling methodology based on a 2013 social accounting matrix for Mexico, built for analysing the impact of tobacco taxation on employment. Unemployment is treated as an endogenous variable.

Results Setting the specific component of the Excise Tax on Production and Services (IEPS) at 1.50 pesos per cigarette would lead to the loss of tobacco-related jobs constituting just 0.1% of all jobs nationally. Revenue from IEPS on tobacco would increase by 49%, while consumption would fall by 26%. This minimal loss of employment can be compensated for if the government invests revenue from IEPS on tobacco in some specific sectors. We show this for the case of the health sector. Far from just reducing cigarette consumption, this tax reform would also create 33,781 jobs with a net gain of 32,285 across different sectors of the economy while only reducing 727 jobs in the tobacco industry in the whole country.

Conclusion Results suggest the existence of a good margin for increasing tobacco tax beyond the 2020 update of 0.49 pesos per stick. In addition, from a public health point of view, if tobacco tax revenue were allocated as a direct healthcare subsidy this would deliver a double dividend by further discouraging consumption and increasing tobacco tax revenue by almost 50%, with little impact on key macroeconomic variables in Mexico, which could be offset in more dynamic sectors while promoting health, employment and development.

INTRODUCTION

In Mexico, smoking remains a health problem that kills around 43,000 people every year. According to the 2015 Global Adult Tobacco Survey, 14.3 million adults aged 15 or over smoked tobacco, that is, a prevalence of 16.4% which implies a serious public health problem since smoking continues to be one of the major risk factors of diseases and death. In 2016, the prevalence of tobacco use was 17.6% among those aged between 12 and 65 years. 2 Not having been implemented some tobacco control policies over this period (such as the introduction of specific excise tax per cigarette and regulations on tobacco warning labels and pictograms), tobacco prevalence would have increased.

Taxing tobacco is the most effective policy to reduce cigarette consumption. There is growing evidence of the effectiveness of taxing tobacco as a way to reduce demand for this product. 3-11 According to a study report of the International Agency for Research on Cancer, a 10% increase in the price of tobacco would result in a reduction in tobacco consumption of between 2% and 5% in high-income countries and an even greater reduction in low-income to middle-income countries. 12 Despite tobacco revenues could be used for a number of other purposes, correcting negative externalities from smoking should be of importance, so that additional revenue from taxing tobacco can be used for prevention programmes as well as for the treatment of health problems related to tobacco consumption.

The WHO has suggested that the total tax burden for tobacco (excise taxes) should represent 70% of the final retail price of a pack of cigarettes. 13 Ideally, and for reasons of efficiency, any excise tax reform for tobacco should focus on the specific component to achieve a greater reduction in consumption. In Mexico, an update of the specific component of the Excise Tax on Production and Services (IEPS) came into effect on 1 January 2020, establishing a specific excise levy of 0.4944 pesos per cigarette and thus increasing the tax burden up to 53.9% of the retail price, a level still not close enough to WHO recommendation.

It is estimated that this reform will increase tobacco tax revenue by 8%. 14,15 Despite this, revenue remains insufficient to cover the financial burden smoking currently poses for the health system, as it reaches up to 58.3% of tobacco illnesses cost. 14 Moreover, tobacco tax revenue is still not earmarked for this purpose.

When discussing possible increases in tobacco taxes, a common and influential argument against a higher tax burden is the impact of any such measure on employment in the tobacco industry. 11,16,17 The argument has indeed been used to oppose tobacco taxes and other so-called health taxes, such as taxes on alcohol and sugar-sweetened beverages. 18 For the tobacco industry in particular, most of the existing estimations of employment effects argue that the sector’s small size and the ease with which taxes can be passed on to consumers result in only a minimal ultimate effect on employment. A couple of estimations for Indonesia and Pakistan suggest that the expected effects would be minor, below 1% of total employment in the economy. 19,20

These estimations, however, fail to account for the potential positive effects on employment in other industries that result from changes in consumer baskets caused by the new tax as well as the effects on employment of extra government spending resulting from additional public revenue. 21-23 Some recent estimates that incorporate these general equilibrium effects in the taxation of alcohol and...
sugar-sweetened beverages in the USA show that the ultimate effects on employment may even be positive, that is, they may result in net job creation.

In this vein, this paper shows for the first time the results of an applied general equilibrium model (AGEM), designed to evaluate the effects of taxing tobacco (cigarettes) on employment in Mexico. The paper describes the modelling methodology and the specific characteristics of the model, which was based on a social accounting matrix (SAM) for Mexico for the year 2013 and was built specifically to analyse the impact of tobacco taxation on employment. As will be explained later, we treat unemployment as an endogenous variable to capture the tax effects on this sector.

Typically, studies have focused on the effects that tobacco tax has on consumption of cigarettes by estimating price elasticities. However, all these estimations rely on partial equilibrium models, which is understandable given the fact that the main impacts of this tax affect consumers directly, and there is little interaction between the tobacco industry and other industries of the economy. Yet when it comes to estimating the effects on employment, one has to consider the effects on the tobacco industry itself, and the effects that arise from changes in consumer baskets and the effects of additional public expenditure, all of which affect employment in other industries. For the best of our knowledge, no publicly available studies estimate the effects of tobacco taxation on employment using a general equilibrium technique, and it is certainly the first AGEM addressing this issue in Mexico.

**The tobacco sector in Mexico**

In 2018, the five largest producers of tobacco worldwide were China, Brazil, India, the USA and Indonesia, together accounting for 68% of global production. The top producers in the Americas are Brazil, the USA, Argentina, Cuba and Guatemala; Mexico comes in at seventh place in the region. The tobacco crop occupies a relatively minor place in Mexico’s agricultural sector. For a decade, the total area devoted to growing tobacco has remained stable at 0.04%, on average, of total farmland.

Like tobacco cultivation, the tobacco sector in Mexico is one of the smallest industries in terms of economic units, value added and employment. According to economic censuses (ECs), establishments in the tobacco industry account for less than 0.1% of economic units both nationally and in the manufacturing sector. Similarly, the tobacco industry represents less than 1% of the total value of domestic production, while as a share of the manufacturing industry, it reached only 1.08% at its peak in 2013. Furthermore, the tobacco sector does not employ a high number of workers and employment in the tobacco sector has exhibited a downward trend overtime (standing at 0.04%, on average, of total farmland).

Insofar as foreign trade of tobacco is concerned, according to our SAM for 2013, 87.2% of total tobacco production at producer prices (without consumer taxes) was consumed on the domestic market and 12.8% was exported. On the import side, the amount registered as total imports for that year represented only 5.9% of the total value of tobacco production at producer prices.

The tobacco sector in Mexico has faced some tax reforms. In 2010, the tobacco tax structure underwent a significant change, for the first time, a specific component of 0.04 pesos per cigarette was introduced. This remained fixed at 0.35 pesos per cigarette from 2011 to 2019. The most recent reform of the specific component of IEPS provided for an adjustment in line with annual inflation over the period, setting the rate at 0.4944 pesos per cigarette and thus increasing the total tax burden (value-added tax (VAT) and IEPS) on tobacco from 67% to 69% (from 0.20% to 0.22% of gross domestic product (GDP)). This remains below the 75% level recommended by the WHO. Revenue from IEPS on tobacco, however, remained constant at 0.20% of GDP from 2010 to 2018.

**METHODOLOGY**

To understand the effects of taxing tobacco in Mexico, we built an AGEM and simulated possible tax reforms. These models have traditionally been used to evaluate tax reforms because, insofar as they incorporate all markets, they make it possible to estimate changes in the industry in question (tobacco) and in other sectors of the economy. Also, these models incorporate the demand side of the economy, which in the case at hand allows us to evaluate the effects on consumption and not just on the production side.

In Mexico, several authors have used the AGEM technique to analyse a range of issues like trade liberalisation, climate change, and redistribution and antipoverty policies, among others. However, tax reform analysis using the AGEM technique has not enjoyed the same attention. Exceptions include Kehoe and Serra-Puche and, more recently, Sobarzo. This is remarkable given that tax reform has been the subject of persistent public debate in Mexico for decades and AGEMs were originally designed to deal precisely with tax reforms. In this context, this analysis of tobacco taxation in Mexico using the AGEM technique is, to our knowledge, the first attempt to analyse various possible tax alternatives.

**Data**

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

\[
V = P \cdot Q
\]

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

\[
V = (1) Q
\]

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

In carrying out a simulation (eg, a tax on one or more goods), prices and quantities change iteratively until a new equilibrium is found, on the basis that in all markets supply should equal demand. Notice that each sector (good) is the aggregate of perhaps hundreds of industries (goods), but in our model, households demand a single good, for example, ‘transport equipment’, which includes the output of many industries but which, in our model, is treated as only one good.

**General characteristics of the model**

The model was solved using GAMS software. It includes 27 production sectors, each sector producing a single commodity...
(principal product criterion), a part of which is intended for the domestic market with the remainder being exported (see table 1). Of these 27 sectors, 21 are tradable while the remaining six sectors produce services mainly for domestic markets, although they also exhibit very low international trade flows.

### Dimensions

There are two factors of production, capital and labour, which are mobile between sectors. Capital is assumed to be fully employed and therefore its price adjusts to equilibrate the market. On the labour market, we assume that the cost of labour (wages) is fixed, and hence employment (endogenous unemployment) adjusts to equilibrate the market. It is assumed that there is one representative consumer and one rest of the world (ROW).

### Production

All production activities combine (composite) intermediate inputs in fixed proportions. Given space limitations, we do not show the equation structure of the model. However, the reader can look at Sobarzo, where the whole equation structure is presented. The difference with our tobacco model is that it is assumed endogenous unemployment whereas in the referred paper it is assumed full employment. Yet composite goods combine with some degree of elasticity of substitution between domestic and foreign goods. Sectors also combine labour and capital by means of a Cobb-Douglas utility function. The same assumption is adopted for government and investment behaviour. The SAM incorporates the full tax system of the Mexican economy: production taxes, the IEPS excise tax, VAT and income tax.

### RESULTS

#### Scenarios

We present two scenarios, both simulating the current 2020 initiative (bill Art 2o IEPS) put forward in 2020 in the Chamber of Deputies by the Health and Treasury Commission, which would increase the specific excise tax on tobacco to 1.50 pesos per cigarette, thus raising the total tax burden to 76%. In scenario A, the resources obtained by the government are assumed to be spent as we model government spending, that is, in a Cobb-Douglas specification and on the same commodities as in our original data. In scenario B, the same reform is simulated, but unlike in the first scenario, we assume that the additional resources obtained are allocated to the public health sector as new funding.

#### Aggregate effects

The aggregate effects of both scenarios are reported in table 2. The effect on key macroeconomic variables is very small; foreign trade flows—total imports and exports in the economy—exhibit a very small percentage change of −0.028% in scenario A and 0.033% in scenario B, which can largely be explained by changes in private household spending. Note that although the effect on aggregate employment is in both cases very small, the change goes from negative (−0.102%) in scenario A to positive (0.119%) in scenario B. The same effect is found with tax revenue.

A price increase of 35% in both scenarios leads to a fall in household demand for cigarettes of 26% (see table 2). If we interpret these numbers as equivalent to partial equilibrium measures the resulting elasticity from dividing per cent change in quantity between per cent change in price would be of −0.74. This estimate is in line with a variety of recent studies reporting a range of elasticities from −0.40 to −0.90 for a wide spectrum of low and middle-income countries such as in Bosnia and Herzegovina, Russia, Bangladesh, India, Indonesia, South Africa, Moldavia, Ukraine and Chile. Also, estimated elasticity in this research is close to current Mexican partial equilibrium elasticities of −0.726. Yet, this is an expected result given that in general equilibrium all variables, sectors and markets adjust, not only the tobacco sector. It is analogous to the short versus long-term effects in microeconomic analysis.

Although the change in employment in the tobacco sector appears to be substantial (−22%), the change observed at a national level is very small at just 1% in both scenarios. The same can be said for tax revenue.

#### Sectoral effects on employment

In scenario A, in which the government’s expenditure pattern remains unchanged, the sectoral impacts are in all cases very low, and with the exception of the tobacco sector, no negative impact greater than 1% is observed. In scenario B, we observe that although the changes in employment remain minimal in all sectors (except the tobacco sector), the total effect becomes positive. Indeed, instead of job losses, we observe job creation in almost all sectors, except construction and the tobacco industry itself, in both taxation reforms (see figure 1).

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**Table 1  Sectoral breakdown of the social accounting matrix (SAM)**

<table>
<thead>
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</tr>
</thead>
<tbody>
<tr>
<td>1. Agriculture</td>
<td>Agriculture</td>
<td>Petroleum</td>
<td>Mining</td>
<td>Electricity</td>
<td>Construction</td>
<td>Food</td>
<td>Beverages</td>
<td>Tobacco</td>
<td>Textiles</td>
<td>Clothing</td>
<td>Leather</td>
<td>Wood and paper</td>
<td>Pharmaceutical products</td>
<td>Chemicals</td>
</tr>
</tbody>
</table>

**Source:** Authors’ own work.

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Final demand and government accounts

There is a single representative consumer that demands goods according to a Cobb-Douglas utility function. The same assumption is adopted for government and investment behaviour. The SAM incorporates the full tax system of the Mexican economy: production taxes, the IEPS excise tax, VAT and income tax.
One factor clearly behind this result is the fact that 93.7% of sales in the tobacco sector are final sales, so there is very little interaction between the tobacco industry and other sectors (just 6.3% are intermediate sales).

With households spending 37.4% less on tobacco, consumers (and the government) direct this money towards other services with greater impact and sectoral interconnections, such as education, health, pharmaceuticals, clothing and transport. Our results show a net gain of 32,285 jobs with respect to the employment figures provided by the 2018 Mexican ECs. Figure 2 shows the distribution of jobs created across sectors and that other services and commerce account for 23.1% and 44.6% of new jobs, respectively.

**DISCUSSION**

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

**Table 2** Aggregate impacts of tobacco tax in Mexico and specific effects on the sector (percentage changes)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Scenario A (percentage change)</th>
<th>Scenario B (percentage change)</th>
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<tbody>
<tr>
<td><strong>Impact across all sectors</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Exports</td>
<td>−0.028</td>
<td>0.033</td>
</tr>
<tr>
<td>Imports*</td>
<td>−0.019</td>
<td>0.02</td>
</tr>
<tr>
<td>Employment</td>
<td>−0.102</td>
<td>0.119</td>
</tr>
<tr>
<td>Price in wages</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Price in capital</td>
<td>−0.002</td>
<td>−0.001</td>
</tr>
<tr>
<td>Government income</td>
<td>0.084</td>
<td>−1.509</td>
</tr>
<tr>
<td><strong>Impact in the tobacco industry</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Final consumption of tobacco</td>
<td>−26.0</td>
<td>−25.9</td>
</tr>
<tr>
<td>Final consumer price</td>
<td>35.0</td>
<td>35.0</td>
</tr>
<tr>
<td>Employment in tobacco sector</td>
<td>−22.6</td>
<td>−22.3</td>
</tr>
<tr>
<td>Tax revenue associated with the tobacco industry</td>
<td>49.3</td>
<td>49.3</td>
</tr>
</tbody>
</table>

Source: Authors’ own work.

*With no substitution effect (assuming tobacco imports are taxed in the same way as domestic tobacco).

Through an AGEM, we have shown four important aspects of tobacco taxation in Mexico. First, a higher tax burden would not have important macroeconomic effects. Our results suggest, instead, that the impacts on the main macroeconomic variables are minimal. Second, taxing tobacco more heavily has important effects on household tobacco consumption, thus reducing the health risks associated with tobacco consumption. Third, to the extent that tobacco, like other commodities such as alcohol and sugary beverages, typically reacts to taxes as these products decline its consumption as demand is inelastic, then revenue gains associated with higher taxes are potentially substantial. Finally, we have shown that, under certain circumstances, depending on whether the government and households spend the extra resources, the effects on employment can be reversed. This brings to the forefront of the discussion the issue of earmarking.

Despite that tobacco growers face obstacles to move to another activity, our estimates show that jobs in the agriculture sector would remain stable in our tax scenarios. Indeed, private consumption could increase by 6.9%. The government must tackle this issue by accelerating new ways to increase mobility in the search of new job opportunities, and to ease productive alternative crops, as it is well known how the tobacco industry employs these communities as part of their interference strategies to block tax increases itself.

Other modelling strategies like input-output models, for instance, do not incorporate the demand side as an active part of the price determination system. Another potential approach is to rely on expenditure systems. However, they fail to incorporate general equilibrium effects. The approach followed does however have some limitations, the most important of which is perhaps that we do not know how sensitive the results are to the specification of the expenditure system. This remains pending for future work.

**CONCLUSIONS**

Smoking is an ongoing problem in Mexico and the tobacco industry poses an ever-present threat to the health of the Mexican people. The WHO has reported that an excise tax on tobacco is the most effective way to reduce consumption while providing a substantial source of revenue for governments.

An increase in the specific component of the IEPS to 1.50 pesos would bring tobacco tax revenue up to 0.39 GDP points (far beyond what was achieved by the current reform, which increased revenue only from 0.20% to 0.22% of GDP).

Promoting this initiative would exceed the WHO recommendation and alleviate the burden on the health sector by providing funding for tobacco-related diseases, while creating jobs across a range of sectors of the economy, such as in commerce and healthcare. This would all be made possible through a 49% increase in current tobacco revenue levels. This research leaves an open door to pursue further research on this topic by changing the specification of the expenditure system to obtain a more robust sensitivity analysis.
This is the first applied general equilibrium model built to analyse the effects of tobacco taxation on employment and is also the first to be applied in the industry in Mexico based on tobacco tax reforms currently proposed and implemented in the country.

By incorporating general equilibrium effects, we are able to estimate the effects on employment on the tobacco sector and across all sectors of the Mexican economy. Previous research is based on partial equilibrium analysis, thus ignoring general equilibrium effects and how these effects are felt across the rest of the economy.

While opponents of tobacco taxation regularly argue that taxing tobacco generates unemployment, the model shows that under certain circumstances, taxing tobacco does not necessarily cause job losses but can instead create jobs.

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