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An Optimal Tobacco Tax

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ABSTRACT

The tobacco industry in Mexico, as a whole, takes away more from society than what it contributes to the economy. This is because some of its externalities, such as tobacco-attributable diseases and the consequent losses in productivity – adding up to some $52,000.0 million MXN – far outweigh the industry's value added to the economy, including taxes, totaling to approx. $39,413.3 million MXN. So, for every $1 MXN that comes from the tobacco industry, another $1.32 MXN is lost, indirectly, to the industry itself. Also, for every employee of the industry, there are between 5 to 15 consumer deaths each year from tobacco-related diseases.

The main objective of this work is to find the optimal *specific* tobacco tax that will at least cover the amount that the society (including the government) spends in correcting the externalities of the industry in question. Estimations say that such tax should be $22 MXN on each cigarette pack (leaving unchanged the current ad valorem rate of 160 percent). The eventual benefits of a given reduction in the number of smokers were also estimated. The cost-benefit analyses, to be found at the end of this report, indicate that taxes have a better ratio in reducing the number of smokers compared to any other hypothetical anti-smoking policy with a similar aim. This is mainly because an ex-smoker, even after 10 years of quitting, is still at a relatively high risk of getting ill, compared to a non-smoker. Moreover, the benefits of anti-smoking policies are heavily concentrated in the future, making them seem smaller by any discount rate. Therefore, providing disincentives is a better policy than trying to get smokers to quit.

ACRONYMS

Acronym	Meaning	Translation (if needed)
AMI	Acute Myocardial Infarction	
CECAS	Consejos Estatales contra las Adicciones	State Councils Against Addictions
CLP	Chilean Peso	
COI	Cost of Illness	
CONADIC	Consejo Nacional contra las Adicciones	National Council Against Addictions
COPD	Chronic obstructive pulmonary disease	
ENA	Encuesta Nacional de Adicciones	National Addiction Survey
ENSA	Encuesta Nacional de Salud	National Survey of Health
ENSANUT	Encuesta Nacional de Salud y Nutrición	National Survey of Health and Nutrition
FCTC	Framework Convention on Tobacco Control	
GDP	Gross Domestic Product	
GYTS	Global Youth Tobacco Survey	
IEPS	Impuesto Especial sobre Productos y Servicios	Special Tax on Products and Services
IMSS	Instituto Mexicano del Seguro Social	Mexican Social Security Institute
INEGI	Instituto Nacional de Estadística y Geografía	National Institute of Statistic and Geography
INSP	Instituto Nacional de Salud Pública	National Institute of Public Health
ISISVEA	Informe del Sistema de Vigilancia Epidemiológica de las Adicciones	Epidemiological Surveillance System of Addictions Report
ISSSTE	Instituto de Seguridad y Servicios Sociales de los Trabajadores del Estado	State's Employees' Social Security and Social Services Institute
LC	Lung cancer	
LGCT	Ley General para el Control del Tabaco	General Law on Tobacco Control
MOH	Ministry of Health	
MXN	Mexican (New) Pesos	
OR	Odds Ratio	
PAF	Population Attributable Fraction	
PEMEX	Petróleos Mexicanos	Mexican Petroleum
SAF	Smoking-Attributable Fraction	
SEDENA	Secretaría de la Defensa Nacional	Ministry of National Defense
SEMAR	Secretaría de Marina	Ministry of Navy
SHCP	Secretaría de Hacienda y Crédito Público	Ministry of Finance
TAC	Tobacco-Attributable Costs	
TCD	Total Cost of all Diseases	
VBD	Vascular Brain Disease	
WHO	World Health Organization	

1. THE TOBACCO PROBLEM

Let us start by stating two simple facts that some policymakers may not always be fully aware of. First, for every $1 MXN spent by the government, its equivalent ($1 MXN) must be recovered by way of taxes sooner or later. Else, no matter what the policy, project, or program, none of them could get implemented – unless it is by getting the country into debt or cutting down on public expenditure elsewhere. Second, the connection between the economic welfare created by a market (by way of employment opportunities, production, investments, taxes, etc.) and the social costs thereof must be addressed by any industry running in an economy. This means that the cost of the damages done by the industry – if any – by its very presence (to the ecosystem, consumers, non-consumers, natural resources, etc.) must not outweigh its benefits. Else, there would be no justification for its presence in an economic sense.

However, regardless of the apparent simplicity of the above statements, the tobacco industry (at least in Mexico) behaves differently. To summarize, six statistics (in annual terms, in MXN of 2010) are used: *one*, the industry's value-added figure[1] at basic prices is $12,488.0 million MXN (INEGI 2012); *two*, smoking causes the government to spend up to $45,000.0 million MXN each year on treatment of tobacco-attributable diseases (CMCT 2010; Quintana *et al.* 2010); *three*, these diseases lead to annual losses amounting to some $7,000.0 million MXN in labor productivity (CFMR 2012); *four*, excise tax collected on tobacco amounted to $26,925.3 million MXN in 2010 (SHCP 2012); *five*, the industry employs some 4,400 people nationwide (INEGI 2009); and *six*, its products cause between 25,000 to 65,000 deaths each year (Waters *et al.* 2010). So, in economic terms, for every $1 MXN created by the industry (value added plus taxes),[2] another $1.32 MXN is disbursed by the society (including the government) towards correcting the market's externalities[3] (tobacco-attributable health expenditures plus losses in productivity). Also, for every person employed by the industry, there are between 5 to 15 consumer deaths each year.

Along with the above figures, the WHO (2011) has estimated that tobacco kills nearly half of its users, causing economic damage to the tune of hundreds of billions of dollars worldwide each year. Jha *et al.* (2006) and Mackay & Eriksen (2002) have found that half of the tobacco-related deaths take place between the ages of 35 and 69, resulting in the loss of about 20 to 25 years of life, if compared against the life expectancy of non-smokers. Moreover – though information in the form of solid statistics is limited – a sick family member can compromise a household's income drastically and thus create secondary problems such as discontinuation of children's education. In 2008, when the last available

[1] Defined as the net production balance – of an industry, establishment, or an economic unit – that results after subtracting (from the total production), all intermediate consumption (INEGI 2012).

[2] The gross production of an industry is composed of its value added at basic prices and the net taxes collected from its products (INEGI 2012).

[3] *Disclaimer*: It is not our intention to account for human deaths, diseases, or illnesses as mere market externalities nor can these be measured in simple monetary terms. We recognize that it is a multi-dimensional problem in which human, social, political, economic, and even religious factors are involved.

addiction survey was done, 13.9 million smokers[4] in the country were between the ages of 12 to 65 years (INSP 2008). Unfortunately, this figure has not been updated since then.[5]

So, given these statistics, the question is: what has the Mexican government done so far? In the past decade, as the first Latin American country to ratify WHO's Framework Convention on Tobacco Control (FCTC), it has implemented several anti-smoking policies. For instance, taxes were raised (from 100 percent in 2000 to 247 percent[6] in 2012); health-warnings were issued and anti-smoking campaigns were launched (health information and pictographs on all cigarette packs); access restrictions for youth and smoke-free space laws were strengthened nationwide. Broadly speaking, taxation has had better results worldwide, but prevention is preferred because ex-smokers are at a relatively higher risk of getting ill, even after 10 years of quitting, compared to non-smokers (Olivera Chavéz *et al.* 2010; Reynales Shigematsu *et al.* 2006). Given the huge burden of social costs that the industry places on the nation (as has been known since the 1950s), it seemed – till until very recently – like a relatively unregulated market compared to, for example, many pharmaceutical companies "whose products treat or even cure, rather than cause, serious health problems" (Hanson & Logue 1998).

Nonetheless, the government still has the responsibility of bridging the gap of around $12,586.7 million MXN between the social costs and the economic welfare created by the tobacco industry (i.e. $52,000.0 million MXN of tobacco-attributable health expenditures and losses in productivity, and $39,413.3 million MXN of industry's gross production, respectively). Two main approaches can be considered: an increase in the tax and/or a reduction in the public healthcare costs. In the first case, excise tax on tobacco could be raised. In the latter approach, the smokers could either be offered an incentive to quit (not necessarily in monetary terms; it could just be the prospect of getting healthier) or tobacco manufacturers could be held liable for all the harm caused through the use of their products (i.e. by not reducing healthcare costs in general, but just the *public* healthcare costs). No matter what shape a policy may take, justifications for having cross-subsidies in the public budget for this particular purpose (i.e. non-smokers paying taxes for the treatment of smokers' illnesses) are weak (Smith & Bopp 1999; Ross & Chaloupka 2006).

So, on the claim that (a) smokers, when going in for the next pack of cigarettes, either underestimate the long-term risks of smoking or do not give much thought to it, and (b) that they could potentially not internalize the harms, but instead externalize them to their private or public insurances (Hanson & Logue 1998), this policy simulation will try to close the gap between short- and long-term benefits and costs in the tobacco market. While an optimum tax will be estimated to ensure the financing of all tobacco-attributable health expenditures – including losses in productivity due to premature deaths and incapacities – on the other hand, estimations of public benefits in the long run (i.e. reduction in healthcare expenditure) will be computed, under scenarios where varying proportions of smokers quit the habit. Efficiencies of both these methods will be considered to find out which method is more likely to ensure that the industry's contribution to the economy is at least equal to the amount that it takes away in the form of externalities (i.e. through higher taxes and,

[4] Mexico had 112,336,538 inhabitants according to the last Census of 2010.
[5] At the time when this article was written, the new addiction survey of 2011 was not yet public.
[6] A combination of a 160 percent ad valorem tax and a specific quota per 20-cigarette pack of $7 MXN.

therefore, higher revenues; and/or by reducing the number smokers and, thus, reducing tobacco-attributable expenditures).

Unfortunately, given the wide range of anti-tobacco programs – from advertisements to cash transfers – our focus is only going to be on how effective a specific percentage of smokers quitting their habit would be, in the long run, in terms of savings to the public healthcare sector (i.e. without considering the actual costs of the particular anti-smoking policy). Thus, the number of ex-smokers it would take to balance the industry's economic welfare and social costs 10 years[7] hence would be estimated.

After a brief literature review (section 2), this study will first estimate the optimal tax (section 3) that would theoretically collect the same amount as all tobacco-attributable expenditures that the industry burdens the society, and the government with. It will then simulate the long-term benefits to health, given a hypothetical demand reduction (section 4). Thereafter, a cost-benefit analysis will be carried out for the two approaches (i.e. by increasing government's revenues through an optimal tax or by decreasing government's need of public expenditure through anti-smoking campaigns) to determine which is a lesser burden to society in terms of costs (section 5). Finally, an incidence analysis will be conducted to find out who will be more, or less, affected in case of a tax increase, given their specific patterns of consumption (section 6). Concluding remarks are to be found at the end of the report (section 7).

2. LITERATURE REVIEW

In recent years, many anti-smoking policies have been implemented in Latin America. Among them we can find excise taxes, smoke-free space laws, advertising bans, and packaging and selling regulations. All these measures are aimed at discouraging consumption, thereby reducing the incidence of tobacco-attributable health issues; none of them – to the best of our knowledge – *explicitly* addresses the relationship between tobacco's tax revenues (or any other type of income) and tobacco-attributable health expenditures. The idea is not just to increase tax collection or discourage consumption, it is to ensure that the government will have all the necessary resources to fulfill its short- and long-term obligations in countering the ill effects of tobacco. Specifically, the problem resides in reaching a fair point between not having a tax so high that it could potentially encourage smuggling, nor having it so low that it may just not be enough to fulfill its goal. This *gray area* is the central discussion point between most economists and policymakers. This section will review justifications, outcomes, and/or procedures seen in some countries for effecting a tobacco excise tax or for implementing some of their anti-smoking policies.

2.1 Tobacco Taxation in Latin America

In Chile, there have been discussions about changing the country's current tobacco tax scheme[8] to one that is based on the number of cigarettes or packages sold, adjusted by

[7] See Section 4 for more information about the 10-year period considered here.
[8] Cigarettes have an ad valorem tax plus a specific quota. Other tobacco products have only an ad valorem tax.

their weight and size instead of their selling price. This is because tobacco's externalities are directly related to the number of cigarettes consumed per unit time and to the accumulated consumption during one's lifetime. Chile currently levies a tax of 0.0000675 UTMs[9] per cigarette, plus an ad valorem rate of 62.3 percent – a scheme that seems to be concerned *only* with collecting more revenues, according to Yáñez Henríquez (2012) (i.e. the tax is not linked with any objective of reducing consumption, delaying the starting point, nor of monetarily fulfilling tobacco's externalities). This country had three environmental sanitation objectives for the decade 2000-2010, set by its Ministry of Health, from which it could only fulfill two (Table 2.1); according to Valenzuela Schmidt (2010), this was because anti-smoking policies were not properly aligned with each other.

Table 2.1: Chile's environmental sanitation objectives 2000- 2010

Objective	Observed (prevalence)	Accomplishment
Reduce tobacco consumption in the general population by 25% (from 40% to 30%)	2000: 42.7% 2008: 41.2%	Unfulfilled
Reduce tobacco consumption in 8th grade students by 26% (from 27% to 20%)	2001: 26.1% 2003: 24.0% 2005: 26.0% 2007: 20.4%	Fulfilled
Reduce tobacco consumption in women of childbearing age by 11% (from 45% to 41.7%)	2006: 45.0% 2008: 41.7%	Fulfilled

Source: Valenzuela Schmidt (2010).

Argentina is among the Latin American countries with the lowest tobacco prices, making it easier for teenagers to not only start consumption but also to continue with the habit.

All cigarette sales are taxed, regardless of whether the cigarettes are imported or nationally produced, with no less than 75 percent of the price of the most sold brand (Law No. 24,674) or with 60 percent over the final price (whichever is higher). According to Comité de Derechos Económicos, Sociales y Culturales (CDESC 2011), in 2004, a price-elasticity evaluation for Argentina was conducted; results showed that the price of cigarettes can be raised by a 100 percent and tax revenues will still not get reduced, and that the government's direct expenditures on providing medical aid to treat tobacco-related diseases are twice as much as the tobacco tax collected. In fact, Argentina is the only country in South America that has not ratified the WHO's FCTC.

In El Salvador, the tobacco tax law was imposed taking into consideration the following four points:[10] First, it is the duty of the State to ensure the well-being of its population (as per the first article of the Constitution of the Republic of El Salvador). Second, taxes on tobacco products should primarily be aimed at discouraging consumption, given the potentially damaging effect of these products on the health of the users. Third, it is imperative to put in place additional resources to cover the medical expenditures that may arise from the consumption of these products; thus, it becomes necessary to establish, in addition to the

[9] Unidad Tributaria Mensual. It is a unit used in the Chilean fiscal system that is adjusted monthly by inflation. For August 2012, each unit represented $39.570 CLP (SII 2012).
[10] Decree No. 539, El Salvador

ad valorem tax, a tax specifically aimed at raising funds to correct the externalities of the tobacco industry. Fourth, going by the above, it was necessary to effect a new law to guarantee access to additional revenues as may be required for the implementation of tobacco-related health projects. So, taxes were set in two ways: a specific tax and an ad valorem tax on production and importation of tobacco products. The specific tax was set at $0.0225 USD for each cigarette, cigar or any other tobacco product; in case of loose tobacco, the tax will apply per gram. The ad valorem tax was settled at a rate of 39 percent over the MSRP,[11] excluding tax services and the specific tax. In case of cigars, the ad valorem tax rate is 100 percent over the final price.

In Colombia, according to the Ministry of Health and Social Protection, tobacco taxes should not be considered as a fiscal or financing measure to the health system, but as a mere public health instrument targeted at reducing consumption as well as exposure to a toxic and non-essential product. Therefore, the success of the tax should not be measured in terms of the amount of revenue collected, but in reduction in the prevalence of the habit among the young, and reduction in tobacco-related death rates and diseases. The tax on consumption is 34 percent over the final price of a 20-cigarette pack.

2.2 Anti-Smoking Policies in Mexico

Barrientos Gutiérrez *et al.* (2008) conducted a field research in three types of public establishments in Mexico[12] – health, education, and the public administration – to check if the smoke-free space law was being properly observed. They used three different methods for this: environmental monitoring, direct inspection, and reports from workers. Although 70 percent of such establishments considered themselves to be a smoke-free space, nicotine was detected in the air in each one of them – with the exception of the research institute. People were seen smoking inside the establishments, and at least 25 percent of the workers had reported the presence of environmental tobacco smoke. Unfortunately, this study is relatively old and there is no new evidence to reinforce or dilute these figures.

Before the graphic warnings were introduced in Mexico, an experiment was conducted to try to predict the impact of such measures on smokers. Primarily, Trasher *et al.* (2006) tried to find the most *shocking*[13] warnings within the categories of lung cancer, long-term and fatal outcomes of smoking, cigarette components, risks to pregnant women, and short-term diseases (both written and graphic). Written warnings, it was found, could be as effective as some images. It was finally concluded that such measures could help create awareness among smokers about the side-effects of tobacco use and the possible consequences of continuing with the habit. It is unfortunate, however, that there are such few studies on the effectiveness of this policy as against the prevalence of smoking in the country.

Taxes have been proven to be the most effective measure to reduce smoking worldwide – Mexico being no exception (Valdés Salgado *et al.* 2007). International studies have shown that despite the addictive nature of tobacco, smokers do adjust their consumption patterns

[11] Manufacturer's Suggested Retail Price (MSRP)

[12] Two hospitals, one medical clinic, four universities, one high school facility, one research institute, and one office building.

[13] Participants appraised images ranging from least to most shocking.

with changes in price. According to Olivera Chavéz *et al.* (2010), two main studies were done for Mexico using household expenditure surveys, which computed the elasticity of price. The first found a price-demand elasticity of -0.62 and the second, without some of the limitations presented in the former, found an elasticity of -0.52. Nonetheless, Olivera Chavéz *et al.* conducted a third research using aggregate data and found an elasticity of -0.25. Other studies for Latin America have calculated elasticities between -0.26 and -0.55: specifically, for Argentina it was found to be -0.26; for Brazil, -0.42; for Chile, -0.45 and for Uruguay it was -0.55. As expected, elasticities tend to be greater for the long term than for short term; also, youth and the poor seemed to be more sensitive to price changes (Olivera Chavéz *et al.* 2010). Therefore, taxes can help in two ways: by reducing consumption (and tobacco-attributable diseases) and by increasing government revenue.

3. OPTIMAL TAX

In this section, an optimal tax will be estimated with the objective function of collecting – solely by way of taxes on tobacco products – the amount required to fund the fraction of the public health expenditure attributable to tobacco consumption, i.e. around $52,000.0 million MXN (see section 1). For this purpose, we will need to state some assumptions. We will also need to use different figures, databases, and studies – given the complexity of the problem and the lack of quality data – to build, for instance, a more robust methodology, such as a CGE, a demand system, etc. Nonetheless, each step will be kept as explicit and clear as possible, so the reader could know why each assumption was chosen or how each particular issue of the procedure was considered.

So, what we need to do first is to get to know the tobacco market in Mexico. This means we need to have access to information on cigarette prices (or an average price), production, and tobacco's excise tax scheme. This will help us figure out how much the government could – or should – collect by way of taxes on this product. Equipped with this information, we will then do the math with different scenarios, until in theory the tax collection equals the expenditures on tobacco-attributable health issues. It is worth mentioning that a price-elasticity will be needed to enable us to compute estimations with greater accuracy.

3.1 Production: volume and prices

From the year 2003 to 2010, the tobacco industry had a real growth of 11.30 percent in its production at basic prices.[14] This figure constituted a 13.57 percent increase in its intermediate consumption and another 10.00 percent increase in its value added (INEGI 2012). At the end of the period, the industry's production was $19,888.2 million MXN, its intermediate consumption $7,400.2 million MXN, and its value added was $12,488.0 million MXN (Figure 3.1). These numbers include the harvesting of tobacco as well.[15] Particularly,

[14] Basic prices: defined as the amount receivable by the producer from the purchaser for a unit of goods or services, less any tax payable and plus any subsidy receivable as a result of its production or sale. This excludes any transport charges invoiced separately by the producer.

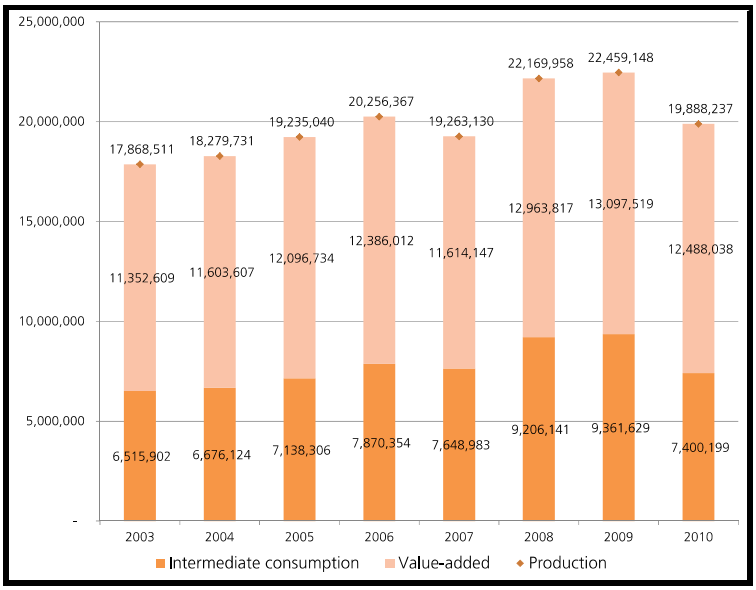
[15] In the last two decades, the harvest of tobacco leaves has decreased considerably in Mexico; currently 0.05 percent of all agriculture areas are cropped. For instance, its national production has decreased from 59,570 tons in 1994 to 11,142 tons in 2008. The employment figures have also gone down, from 19,997 in 1993, to

the tobacco industry represents between 0.28 percent (as in 2010) and 0.39 percent (as in 2004) of the total production of the manufacturing industry. The market is a duopoly with British American Tobacco (BAT) and Phillip Morris (PM) controlling over 95 percent of it (Waters *et al.* 2010).

The production of tobacco has been very erratic, at least since 2003. Between the years 2007 and 2010, the industry, on an average manufactured around 2,257.7 million cigarette packs each year. However, in 2011 the production went down to 1,760.1 million cigarette packs (Figure 3.2).

Now, if we take tobacco production at basic values (before taxes) of 2010, which was $19,888,237,000 MXN (Figure 3.1), and divide it by the number of cigarette packs produced in the same year, i.e. 2,178,165,000 packs (Figure 3.2), we will get an average price of $9.13 MXN per cigarette pack. This will be the base number to use in the next steps. Here, we assume that: one, all packs have 20 cigarettes; two, that there is no wastage in production; three, none of these packs will end up in the black market; and four, ceteris paribus.

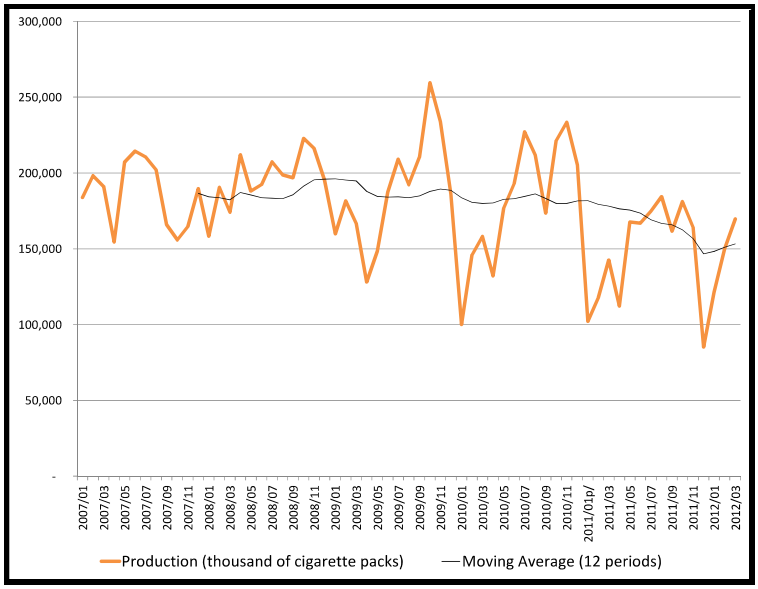
Figure 3.1: Tobacco industry's production
At basic prices. Thousand MXN of 2010.



Source: INEGI 2012

some 3,830 and 6,077 employees in 2007. In contrast, tobacco leaves imports have increased considerably, from 7,728 tons in 1994 to 28,239 tons in 2008 (Waters *et al.* 2010).

Figure 3.2: Tobacco industry's production
Thousand of cigarette packs.



Source: INEGI 2012

3.2 Tobacco Taxation

From the 1980s, tobacco products in Mexico have carried an excise tax in addition to the tobacco companies' income tax and the *semi-general*[16] value-added tax (VAT). This is called the Special Tax on Products and Services (IEPS),[17] first introduced in 1981 with an ad valorem rate of 139.3 percent on filtered cigarettes. Unfiltered cigarettes were treated differently with the political justification that they were largely consumed by the poorest. It was not until the year 2000 that a 20.6 percent tax was imposed on these – a rate that was gradually increased until it touched 110 percent in 2005. Afterwards, the special treatment disappeared, with both filtered and unfiltered cigarettes coming under the same ad valorem tax rate. Nonetheless, handmade cigarettes are still treated differently and have a lower tax rate of 30.6 percent, given the labor-intensive nature of these companies and the argument that the livelihoods of those employed here need to be protected. Finally, if cigarettes are imported from other countries without a commercial agreement, they will carry a tariff of 67 percent.

For the year 2011, the IEPS scheme consisted of an ad valorem rate of 160 percent and a specific quota of $7.00 MXN (for a 20-cigarette pack). For 2010, such quota was only $0.80 MXN and before that it did not exist. Even though this scheme means extra revenues to the government, unless it is indexed to inflation – which it is not at present – the effect will slowly decrease in real terms as time goes by. Table 3.1 shows how IEPS has evolved since 2000. It is important to mention here that the Mexican VAT, which has had an ad valorem rate of 16 percent over the final price since 2010, must consider all previous taxes, rights, quotas, interests, overprices, etc. (Art. 12, Ley del Impuesto al Valor Agregado). This means that any increase in the IEPS tax has an indirect effect on VAT collection.

[16] For instance, food, medicines, education, housing, and transportation get special treatment.
[17] It also taxes other specific products or services such as beers, alcohol, gasoline, diesel, and gambling.

Table 3.1: Evolution of IEPS

Year	Ad valorem	Specific Quota	IEPS as % of Price	IEPS + IVA as % of Price
2000	100%		39.27%	52.31%
2001	100%		39.27%	52.31%
2002	105%		40.23%	53.27%
2003	107%		40.60%	53.64%
2004	110%		41.14%	54.18%
2005	110%		41.14%	54.18%
2006	110%		41.14%	54.18%
2007	140%		45.81%	58.86%
2008	150%		47.12%	60.17%
2009	160%		48.33%	61.37%
2010	160%	$0.80	49.35%	62.39%
2011	160%	$7.00	55.38%	68.43%

Source: Computed by the authors. Note: Average price used for estimations was $9.13 MXN per 20-unit cigarette pack

Table 3.2 illustrates how an average cigarette pack price goes up from the producer's selling price to the final price paid by the consumer, in accordance with the law effective in the year 2010 and considering an average price of $9.13 MXN per pack (see section 3.1). The year 2010 was chosen as our baseline because it had no data limitations. As a result, cigarette packs in Mexico are overpriced by 62.36 percent on an average, taking into consideration VAT and IEPS taxes. This figure is lower compared to Uruguay and Chile, where packs are overpriced by 68 percent and 76 percent, respectively (Waters *et al.* 2010). A correlation can also be seen between IEPS and VAT (where the former affects the latter, indirectly).

With this information, we could have a first estimation of our tax collection from the IEPS. If we assume that the 2011 production is a good proxy for the 2010 sales (conceding some adjustment rigidities in production), the government should theoretically collect $27,122.3 million MXN [= ($14.61 + $0.80) $*$ 1, 760, 143, 000 cigarette packs]. Close to this, the SHCP (2012) reported that tobacco's excise tax was $26,925.3 million MXN in 2010, with a real growth of 61.19 percent from 2003 (Figure 3.3). If such an assumption is not conceded (using the production figure of 2010), the results will have an overestimation of 28.7 percent, ending in $33,563.7 million MXN. This difference could be due to the lack of information about the package sizes produced by the industry, given that INEGI (2012) only reports the total production amount without providing any specifications.[18]

[18] It is worth noting that the 14-cigarette packs have had huge success in Mexico.

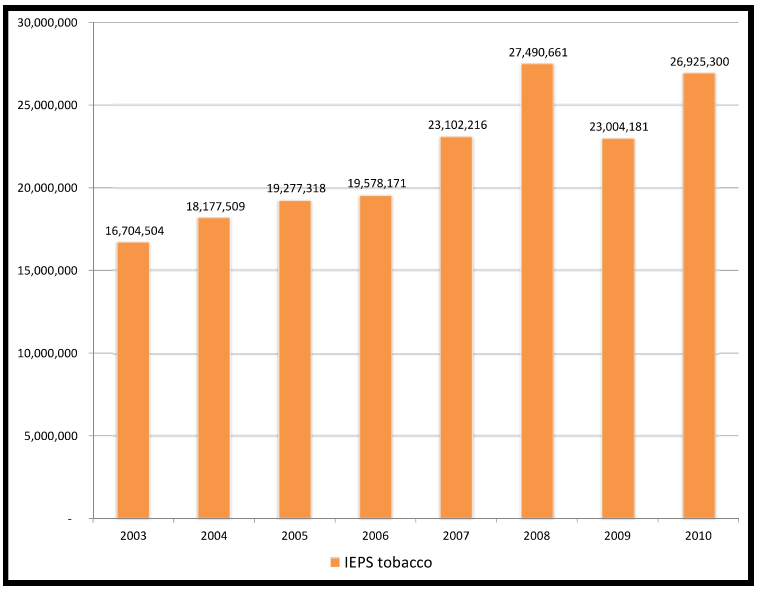
Table 3.2: IEPS in cigarettes for 2010

Average Price	$9.13
+160% (IEPS)	$14.61
+ Specific Tax	$0.80
= Retailer's price	$24.54
+ Retailer's margin (10.72%)	$2.63
= Price before VAT	$27.17
+ 16% (VAT)	$4.08
= Final Price	$31.25
Overprice IEPS	49.32%
Overprice IEPS + VAT	62.36%

Source: Computed by the authors, using information from Waters *et al.* (2010).

Figure 3.3: Tobacco's excise tax collection

Thousand MXN of 2010



Source: SHCP 2012.

3.3 Final Estimation

In Mexico, several studies have been conducted to estimate how much of the public health expenditure is attributable to tobacco consumption (Reynales Shigematsu *et al.* 2006; CMCT 2010; Quintana *et al.* 2010), as well as the extent of losses in productivity due to tobacco-related premature deaths and incapacities among workers (CFMR 2012). Results provide figures between $43,000.00 to $75,200 million MXN in the case of the former (Waters *et al.* 2010), and some $7,000.00 million MXN for the latter (CFMR 2012). For this research, we will consider a public expenditure of $45,000.0 million MXN (Quintana *et al.* 2010; CMCT 2010) and a labor productivity loss of $7,000.00 million MXN (CFMR 2012), both adding up to a total tobacco-attributable expenditure of around $52,000.0 million MXN.

Waters *et al.* (2010) gathered different price-elasticity estimations for cigarette consumption worldwide. For Mexico, specifically, the numbers showed a decline from -0.25 to -0.70. According to their own estimations, the average price-elasticity for Mexico is -0.52. This figure will also be the one used in this section, and it will be assumed that it is an arc elasticity between the range of prices studied here.

After getting this information and optimizing the specific quota of IEPS needed to collect $52,000.0 million MXN [=$43,000.0 million MXN + $7,000.00 million MXN (Quintana *et al.* 2010; CMCT 2010; CFMR 2012)], results go as in Table 3.3, with their corresponding math (previous results of the optimization are not shown). There is one consideration to be borne in mind: given that the IEPS has an indirect effect on the VAT, all changes seen in the latter will be attributed to the former (because, without the IEPS, VAT will be much lower).

Table 3.3: Optimal tax estimation

MXN of 2010

Consumption 2010 (cigarette packs)	1,760,143,000
(x) Optimal IEPS ($14.61 MXN + **$22.00 MXN**)	$36.61
(=) Linear Tax Collection	$64,437,371,424
(+) VAT Change ($8.46 - $1.6175*)	$11,410,856,601
(x) Final Consumption (1 - 0.52 x 60.3%**)	68.6%
(=) Estimated Tax Collection	$52,056,301,125

(*): Using the same procedure as in Table 3.2, if IEPS does not exist, VAT will go down to $1.6175 MXN per 20-cigarette pack. (**): This figure is computed using the midpoint increase between the original and the final price. Source: Computed by authors.

So, to have a tax collection that will, at least, fund tobacco-attributable expenditures plus productivity losses, the specific tax per 20-cigarette pack should go up to $22.00 MXN, leaving unchanged the ad valorem rate of 160 percent and the VAT scheme. Such an increase would represent a 31.37 percent reduction in consumption, using Waters *et al.* (2010) average elasticity for Mexico. However, this does not necessarily represent the number of people who become ex-smokers; it can just be a plain reduction in consumption.

The procedure in this section assumes that: one, price elasticity is constant along the demand curve and has not changed since its estimation; two, the economic condition of the households remained constant from 2010; three, production costs do not increase; and four, ceteris paribus.

4. REDUCING THE NUMBER OF SMOKERS: BENEFITS IN THE LONG RUN

The gross production of the tobacco industry (i.e. the amount that it contributes to the economy) is estimated to be $38,556.9 million MXN of 2010 (INEGI 2012; SHCP 2012). As mentioned earlier, the government spends some $45,000.0 million MXN on tobacco-attributable diseases each year (CMCT 2010; Quintana *et al.* 2010), with labor productivity losses of $7,000.0 million MXN (CFMR 2012). So, given that there are 13.9 million smokers in the country (INSP 2008), each one of them represents some $2,777.18 MXN of production/consumption to the economy and about $3,745.46 MXN in health expenditure

to the government (or to the society as a whole), per year. Nonetheless, even when having an extra ex-smoker would immediately indicate an economic loss of $2,777.18 MXN (less consumption), it would not mean a social gain of $3,745.46 MXN; the gain would be much lower. This is because ex-smokers would still be at a relatively higher risk of getting ill as compared to non-smokers, even after 10 years of quitting (Reynales Shigematsu *et al.* 2006; Olivera Chavéz *et al.* 2010).

This section will estimate the magnitude of such benefits in the long run, working with the treatment costs of four major tobacco-attributable diseases – AMI (acute myocardial infarction), COPD (chronic obstructive pulmonary disease), VBD (vascular brain disease), LC (lung cancer) – and the population sample (smokers, ex-smokers, and non-smokers), as well as the odds ratios (OR) used in and carried out by Reynales Shigematsu *et al.* (2006). The expected present value of benefits (with a 5 percent discount rate) is calculated using the same methodology as that described in sub-section 4.1. Once we have a theoretical Tobacco-Attributable Cost (TAC) for some proposed scenarios (such as a 1 percent, 10 percent, 20 percent, and 30 percent reduction in the number of smokers), the difference between this and the original TAC will be computed; thus we will have our benefit estimation. Similarly, as in section 3, some assumptions will have to be made. An attempt will nonetheless be made to keep each step as precise and clear as possible.

4.1 Estimation

Reynales Shigematsu *et al.* (2006) carried out a cost of illness (COI) analysis from the perspective of the health provider – in this case, the IMSS. A random sample of clinical files (1,596 patients) were reviewed to estimate the frequency at which services and facilities were used from June 2001 to 2004 and – according to the patients' smoking habits adjusted against other socio-demographic variables – the authors determined how many of these were directly attributable to tobacco. Here we will explain the procedure.

The first step to calculate the TAC is to apply the epidemiological concept of population attributable fraction (PAF) to a factor of causal risk (i.e. tobacco consumption). The PAF is most frequently defined as "the proportional reduction in average disease risk over a specified time interval that would be achieved by eliminating the exposure(s) of interest from the population while distributions of other risk factors in the population remain unchanged" (Rockhill *et al.* 1998). Therefore, the smoking-attributable fraction (SAF) can be interpreted as the proportion of cases (in AMI, COPD, VBD and LC) that would have been prevented over a specific period of time if patients had not smoked. The formula used in this study corresponds to the case of multi-category exposures (non-smokers, smokers, ex-smokers), an extension of the formula derived by Walter (1976) in [Kleinbaum *et al.* (1982); Rockhill *et al.* (1998)]. The expression of the SAF for each disease can be written as:

$$SAF_l = \frac{\sum_{i_l=0}^{k}(p_{i_l})(OR_{i_l}-1)}{1+\sum_{i_l=0}^{k}(p_{i_l})(OR_{i_l}-1)}$$

Where subscript *l* refers to the *l*th disease, *i* to the *i*th exposure level, *p* to the proportion of population exposed to the risk factor of smoking, and *OR* to the odds ratio. Table 4.1 displays information from Reynales Shigematsu et al. (2006). The last row represents the

SAF for each tobacco-attributable disease. Estimations reveal that 70.7 percent of all AMI; 33.7 percent of all VBD; 80.5 percent of all COPD; and 79.2 percent of all LC[19] cases are due to smoking.

The following step computes the total cost of all diseases (TCD) considered in this study and the SAF. Table 4.2 displays the tobacco-attributable costs that IMSS incurred in the year 2004, expressed in MXN of 2010, which account for $9,266.2 million MXN. We will expand these results by proportionately distributing tobacco-attributable costs estimated by Quintana *et al.* (2010) (i.e. $45,000 million MXN). This procedure assumes that, on an average, diseases are distributed in the same proportion in all the other health institutions and that they also have the same average cost per case.

Table 4.1: SAF estimations

Abbreviation	Variable	AMI	VBD	COPD	LC
C	Cases	425	402	411	358
NS	Non-smoker	107	167	103	68
S	Smoker	251	133	223	247
Ex	Ex-smoker	67	102	85	43
$P_0 = NS/C$	Prevalence of non-smokers	0.252	0.415	0.251	0.190
$P_1 = S/C$	Prevalence of smokers	0.591	0.331	0.543	0.690
$P_2 = Ex/C$	Prevalence of ex-smokers	0.158	0.254	0.207	0.120
OR_0	Non-smoker's odds ratio	1.000	1.000	1.000	1.000
OR_1	Smoker's odds ratio	5.030	2.030	8.090	6.470
OR_2	Ex-smoker's odds ratio	1.210	1.660	2.360	1.370
X	$P_0 * (OR_0 - 1)$	0.000	0.000	0.000	0.000
Y	$P_1 * (OR_1 - 1)$	2.382	0.341	3.850	3.774
Z	$P_2 * (OR_2 - 1)$	0.033	0.168	0.282	0.044
Num	$X + Y + Z$	2.413	0.508	4.128	3.818
$Denom$	$Num + 1$	3.413	1.508	5.128	4.818
SAF	$Num/Denom$	0.707	0.337	0.805	0.792

Source: Adapted by authors using information from Reynales Shigematsu *et al.* (2006).

Table 4.2: Tobacco-attributable costs of IMSS

MXN of 2010

Abbreviation	Variable	AMI	VBD	COPD	LC
AC	Average cost	$178,266	$162,561	$99,669	$148,837
C	Cases	39,906	21,061	14,742	685
SAF (Table 4.1)	SAF	0.707	0.337	0.805	0.792
$= SAF * C * AC$	TAC IMSS	$6,258.4	$1,435.5	$1,471.8	$100.5
(Expanded)	TAC National	$30,392.9	$6,971.5	$7,147.4	$488.2

Note: TAC IMSS and TAC National are in million MXN of 2010. Source: Adapted by authors using information from Reynales Shigematsu *et al.* (2006).

[19] It is very important to note that the Reynales Shigematsu *et al.* (2006) final results are slightly different from those presented here, although we applied exactly the same procedure as they did, theoretically.

Now, once we know the methodology to estimate the TACs (with the odds ratio for non-smokers, smokers and ex-smokers), we will adapt it for our purposes and add a new level of exposure: ex-smokers in transition. When a person stops smoking, the relative risk does not reduce immediately. So, because we only have OR for ex-smokers, considered as those who stopped smoking at least 10 years earlier, we need to assume a linear[20] decrease between ORs of smokers and ex-smokers, going from year 0 (when they quit) to year 10 (when they are considered as ex-smokers and, therefore, can share the same ORs). In other words, from year 0 to year 10, the ORs of the ex-*smokers in transition* begin with those of *smokers* and end with those of *ex-smokers*. Given that each year the risk theoretically gets lower, benefits become larger as time goes by. We run 10 TACs, one for each year of transition, and then we add all the benefits estimated.

We will estimate the 10-years cumulated benefits that the government will have (reduction of TAC) under scenarios where a fraction of smokers quit, given a hypothetical public policy. However, to do this kind of estimation, it is important to consider the complexity of the assumptions used: one, no population growth is taken; two, there is no confounding of exposure-disease association (Rockhill et al. 1998); three, there are no new smokers, therefore, only at year 1, there is a reduction in the number of smokers and an equal increase in the number of ex-smokers in transition (with their own ORs); four, the prevalence of each exposure level is constant; five, the OR of an individual in the process of becoming an ex-smoker has a linear and constant diminishing behavior, subjected to the 10-year time period; six, the average annual cost of each disease is constant; and seven, ceteris paribus.

As already mentioned, the starting point of any tobacco control policy proposed here is to determine whether there are any benefits in reducing TAC, through bringing about a reduction in the number of smokers. Results suggest – considering the assumptions mentioned earlier – that a decrement of 1 percent in the number of smokers represents a 10-year cumulative benefit of $1,188.6 million MXN (see Table 4.3), at present value.

Table 4.3: 10-years cumulated benefits

Decline of Smokers	Benefits (Million MXN)	Benefits / 10-year TAC	Benefits / Smokers
1.0%	$1,188.58	0.34%	$86.48
5.0%	$5,966.60	1.72%	$452.38
10.0%	$11,996.01	3.45%	$960.06
10.4%	**$12,481.3**	**3.59%**	**$1,012.39**
20.0%	$24,270.37	6.98%	$2,185.18
30.0%	$36,888.81	10.62%	$3,795.76

Source: Computed by the authors.

Hence, the percentage of smokers that need to quit to reduce the tobacco-attributable expenditures by $12,586.7 million MXN (see section 1), after 10 years of an anti-smoking policy being implemented, is around 10.4 percent. This means that if such a policy is implemented in 2012, tobacco-attributable expenditures will reduce from $52,000.0 million MXN to $39,518.7 million MXN in 2022. This latter amount is almost the same as the

[20] Though it can have any other form.

industry's contribution to the overall economy, assuming a constant real production between the periods (see sections 1 and 3).

5. COST-BENEFIT ANALYSES

In section 3, it was found that if tobacco's specific quota of IEPS increases from the current $7.00 MXN to $22.00 MXN per 20-cigarette pack, the total tax collection will, at least, be the same as the total tobacco-attributable expenditures (including the treatment of illness and losses in productivity). Similarly, in section 4, it was concluded that a reduction in the number of smokers by 10.4 percent can achieve, after a period of 10 years, the required reduction of around $12,586.7 million MXN, thereby bridging the gap between the tobacco industry's economic contribution and tobacco-attributable expenditures (idem). Nonetheless, this section analyzes which one has a better efficiency and which is a lesser burden to society in terms of costs.

Optimal Tax: As mentioned in section 3, the increase in the specific quota from $7.00 MXN to $22.00 MXN represents a reduction in consumption, of around 31.37 percent or some 552,187,605 packs of cigarettes, using the elasticity figure of Waters et al. (2010) and the midpoint change in prices. So, assuming an average price of $9.13 MXN per pack, this approach will mean an economic loss of around $7,749.4 million MXN. Given that this optimal tax represents an extra tax collection of $25,131.0 million MXN (considering the extra contribution of the VAT), this policy has a benefit-cost ratio of $3.24 MXN in taxes per $1 MXN of economic loss (including retailers' margin loss of 10.72 percent over the retail price). VAT contribution was also considered, given that without the IEPS it will be much lower; therefore, it is an indirect tax collection of the IEPS. Now, if we consider as benefit the theoretical gain that the government may also have given the consumption reduction seen after this policy, the ratio would be much higher. It is uncertain as to how much of the 31.37 percent of reduction in consumption comes from smokers becoming ex-smokers or light smokers (ORs may vary significantly between each other and, therefore, the benefits may vary too). Nonetheless, this benefit, using the methodology explained in section 4, could go up to $38,649.0 million MXN (with 31.37 percent of consumers becoming ex-smokers).

Benefits in the long run: Given a 10.4 percent reduction in the current number of smokers, the TAC will be reduced, over the next 10 years, by about $12,481.3 million MXN. In contrast, this same reduction during the same period of time will mean an economic loss of around $13,551.6 million MXN. Both figures are at the present value, with a discount rate of 5 percent. So, ceteris paribus, the benefit-cost ratio is 0.92, representing $0.92 MXN of end benefits for each $1 MXN of economic costs. It is important to mention here that this economic loss was computed using the reduction in production and the average cigarette prices (as in the optimal tax). This ratio is significantly lower than the previous one because of the heavy burden of economic losses in the initial years, compared to the benefits that will be seen in the final years of the policy implementation (the discount rate will make the eventual benefits appear smaller compared to the short-term costs of having a reduced number of smokers and, therefore, less economic production).

6. INCIDENCE ANALYSIS

This section will analyze the national consumption of cigarettes by dividing and arranging the Mexican households according to their income level. The ENIGH 2010 was the survey used for this purpose, given that it has the following characteristics: it is representative at a national level, it captures a household's information on consumption, and it is officially the survey used to measure poverty in Mexico – given that it also has the information on the households' income. Only cigarettes were taken into consideration for the computation of the following tables, because there were very few observations with a positive consumption of other tobacco products (such as cigars and loose tobacco) in the ENIGH.

If all the households are considered on the basis of whether or not they consume tobacco, a positive correlation between the income quintiles and their expenditure on cigarettes can be seen (Table 6.1). On an average, in monetary terms, the last quintile spends 5.69 times more on cigarettes than the first quintile. This represents a 0.86 percent share of the latter's total expenditure and a 0.33 percent share of the former's (a 0.53 percent change). On the other hand, considering only the households that reported tobacco consumption, the expenditure share on cigarettes is around 6.59 percent for the first quintile and 7.11 percent for the last one (a 0.52 percent change). However, there is no evident correlation between the income quintiles and their expenditure – either positive or negative – as in the previous case. For instance, the quintile that had the most consumption was the second quintile and the one that had the least was the third. The average consumption in monetary terms for a smoking household in the first quintile is $189.50 MXN per month and $356.49 MXN for those in the last quintile (which is 1.88 times more).

Table 6.1: Average household expenditure on cigarettes

Monthly figures in MXN of 2010

Quintile	Tobacco (all HHs)	% of Tobacco Exp. (all HHs)	Tobacco (consumers only)	% of Tobacco Exp. (consumers only)
I	$6.28	0.33%	$189.50	6.59%
II	$11.20	0.45%	$249.61	8.28%
III	$13.81	0.48%	$203.75	5.71%
IV	$21.87	0.65%	$253.12	6.06%
V	$35.71	0.86%	$356.49	7.11%
National	**$18.34**	**0.61%**	**$269.45**	**6.65%**

Source: Computed by the authors. Note: In the first column tobacco expenditure is given as % of the total expenditure for all the households. Same for the second column, except that it takes into account only the consumer households

In Table 6.2 it can be seen that, 41.32 percent of the total consumption comes from the last quintile while a 5.94 percent comes from the first one. Accordingly, 3.31 percent of all households in the first quintile reported a positive consumption, with a constantly increasing figure that ends in a 10.02 percent for the last quintile.

Table 6.2: Distribution of tobacco consumption

Quintile	Consumption	% of consumers
I	5.94%	3.31%
II	11.99%	4.49%
III	15.51%	6.78%
IV	25.24%	8.64%
V	41.32%	10.02%
Total	**100.00%**	**6.81%**

Source: Computed by the authors. Note: Average expenditure for each household. The third column represents the expenditure for the whole decile.

In the ENIGH 2010, the amount of tobacco that is consumed by a household is given in kilograms. Assuming that a kilogram represents 40 cigarette packs of 20 cigarettes each (Sáenz de Miera Juárez et al. 2007), Table 6.3 shows how much each quintile consumes on an average and how much of the extra $15.00 MXN per cigarette pack (passing from $7.00 to $22.00 MXN) is contributed by it per month. As shown, lower quintiles would be relatively worse off compared to the upper quintiles, considering the percentage that this extra burden would represent to its total expenditure and to its expenditure on tobacco (without modelling any behavior). Nonetheless, the upper quintiles, given that they consume more, would represent a larger share of the total tax collection.

If consumption behaviors are taken into consideration, some smokers may change their preferences in consuming cigarettes (that are becoming, after this tax increase, more expensive, obviously) and switch to consuming other kinds of tobacco products, such as rustic tobacco (which may not be subjected to an excise tax). Nonetheless, according to Waters et al. (2010), these kind of products (i.e. other than cigarettes) only represented around 0.4 percent of the total value of tobacco products nationwide in 2004.[21] So, it could be assumed that such behaviors may marginally change the total tax collection estimated here. However, an increase in smuggling has not been considered in the previous results, which can be an important issue to consider.

Table 6.3: Tobacco consumption and Tax Incidence

Quintile	Packs per month	Extra tax per month	Extra tax as % of exp.	Tax distribution	As % of Tobacco Exp.
I	2.24	$33.55	1.89%	8.05%	23.07%
II	2.23	$33.49	1.45%	13.02%	16.31%
III	2.05	$30.78	1.13%	17.79%	14.98%
IV	2.07	$31.01	1.13%	21.21%	16.01%
V	3.00	$45.01	1.11%	39.92%	13.50%
Total	**2.40**	**$36.00**	**1.23%**	**100.00%**	**15.65%**

Source: Made by the authors. Note: A kilogram of tobacco represents 40 cigarette packs of 20 cigarettes each. Figures only computed for households that reported a positive tobacco consumption.

[21] This figure has not been updated.

7. CONCLUSIONS AND FINAL REMARKS

The difference between what the tobacco industry contributes to the economy and what it takes away from it in the form of externalities (i.e. tobacco-attributable diseases and losses in productivity) presents a big challenge to the government. The concern is not only with generating higher revenues, but also with ensuring that the society will have all the necessary resources to treat the tobacco-attributable illnesses and to still have this industry running in the economy (in a rational economic sense). The amount of money needed to bridge this gap is $12,586.7 million MXN (see section 1).

Given that an ex-smoker, even after 10 years of quitting, is still at a relatively high risk of getting ill compared to a never-been smoker, preventive measures should be preferred over policies aimed at getting smokers to quit. Nonetheless, once a person starts to smoke and it becomes a habit, the most cost-beneficial policy option is an increase in cigarette prices through its excise tax. This achieves two main goals: one, the government will have more revenues to meet its health obligations to society and, two, even when tobacco has an addictive component, consumers do adjust their consumption patterns after a price increase (it is inelastic, but not perfectly inelastic); therefore, this will mean fewer ill people in the future.

Results suggest that a specific tax of $22 MXN per cigarette pack – according to the 2010 figures, the total number of cigarette packs sold is 1,760,143,000 – works out to the same as reducing the number of smokers by 10.4 percent (although the latter policy must wait 10 years to see such benefits). If the former policy is adopted, the richest quintiles will probably be the ones to lose the most, given that it is they who consume more cigarettes, have more households consuming these products, and spend more money in absolute terms. The cost-benefit analysis estimates that the ratio for the excise tax is 3.24; in contrast, this ratio is 0.92 considering any policy whose objective is to reduce the number of smokers by a certain percentage (without any estimation of its probable implementation costs).

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