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Tobacco taxes in Argentina: Toward a comprehensive cost-benefit analysis♣

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Key messages

- Tobacco taxes benefit the poor and young people as well as generate more public revenues.
- Over the long term, higher taxes on tobacco result in the generation of higher individual income, enhanced well-being and living conditions, especially among the poorest sectors of society. This is because tax increases reduce tobacco consumption, and the reduction is relatively larger among low-income households.
- In 2015, diseases related to tobacco represented a direct cost of around 0.75% of the GDP in Argentina. Put in perspective, that nation dedicated 0.5% of its GDP to the *Asignación Universal del Hijo* (Universal Child Allowance) program, its largest income transfer program dedicated to fighting poverty (UNICEF, 2017).
- Traditionally, analyses of the impact of tobacco taxes have only taken into consideration the burden of the taxes on household resources; they have not examined the indirect effects of higher taxes. This research incorporates indirect effects and finds the following:
    - Reduced consumption of tobacco products results in better health, lower medical expenses, longer life expectancy and more time for income-generating activities.
    - Faced with a tax increase that results in a 20 percent increase in the price of cigarettes, the poorest decile of households would save 4 percentage points of their income; these savings are derived primarily from decreased medical expenses and higher labor income.
    - Young people (ages 15-24) are the most impacted by a change in the price of cigarettes. Duplicating the price of a pack of cigarettes reduces the number of smokers in the overall population by 3%, but among this age group the reduction is 6.5%.

Executive Summary

Tobacco use represents an important obstacle to development for countries around the world. Smoking-related diseases cost billions of dollars every year and are the leading cause of preventable death worldwide. These extraordinary health costs also imply high economic costs in terms of direct medical expenses and losses in productivity. The negative effects of tobacco use are especially acute in developing countries, where smoking remains a widespread habit.

One of the most effective measures in fighting the epidemic of tobacco-related diseases, according to the World Health Organization (WHO), is increasing tobacco taxes. Raising these taxes, however, often generates the criticism that they disproportionately affect the poorest sectors of society, given that low-income households often allocate a higher share of their income to tobacco consumption. Yet, such objections stem from two flawed assumptions: i) that all individuals throughout the income distribution react similarly to an increase in the price of cigarettes (caused by tax increases); and ii) that changes in tobacco taxation affect households only through the expenditure on tobacco. First, if lower-income individuals are more sensitive to changes in cigarette prices—that is, they have a higher price elasticity for demand—price increases would then have a higher relative impact on their tobacco use, generating changes in consumption patterns throughout the income distribution. Second, tobacco taxes can affect household spending beyond tobacco expenditures itself. If a tax discourages consumption, households can expect to save on future medical expenses associated with smoking-related diseases, and they can also expect an increase in lifetime earnings due to a lower risk of premature death. As lower-income households consume relatively more tobacco, savings in medical expenses and increases in future labor income will be relatively greater for them. When these factors are taken into account, the regressive pattern of tobacco taxes may be reversed (Fuchs and Meneses, 2017).

This investigation uses data from the Argentina's Household Income and Expenditure Survey (ENGHo) 2004 and 2005 (ENGHo 2004/2005) to estimate the distributive incidence of changes in tobacco taxes. It takes into consideration the two aforementioned assumptions by first, estimating differential price elasticities of demand for cigarettes by income level and second, considering indirect effects of changes in smoking habits.

Results show that individuals' sensitivities to alterations in cigarette prices vary considerably. Lower income consumers present higher price elasticities of demand. Specifically, in Argentina, an

individual with the average income of the wealthiest decile presents a price elasticity of -0.44, as compared to an individual with the average income of the entire distribution, who presents a price elasticity of -0.65, and an individual with the average income of the poorest decile, who presents a price elasticity of -0.85. Considering these results, a 10 percent increase in the price of cigarettes would decrease consumption by 8.5 percent (4.4 percent) for the poorest (richest) smokers.

In addition to examining income heterogeneity, this research also estimates elasticities by age group. Results indicate that young people (15-24 years) are the most sensitive to changes in price of cigarettes. In this case, for example, doubling the price of a pack of cigarettes in Argentina would reduce the number of smokers by almost 3 percent overall, with the most significant response among young people, 6.5 percent of whom would stop smoking. These results are in line with previous findings for other countries.

Results also suggest that, when indirect effects and variations in individuals' sensitivities to price changes are taken into account, an increase in the price of cigarettes (caused by higher taxes) improves income distribution. This is primarily the result of poorer households experiencing a sizeable savings in medical expenses, a consequence of their relatively higher tobacco consumption.

In sum, this research suggests that recent increases in tobacco taxes in Argentina should have improved welfare, particularly among low-income and younger sectors. The adoption of the World Health Organization's recommendations to place a higher tax burden on tobacco is likewise confirmed from a distributional perspective. These conclusions can help improve legislative agendas by providing strong evidence that tobacco taxation not only has a positive impact on health and other dimensions (i.e., higher fiscal revenues) but also generates positive redistributive effects.

1. Introduction and background

Tobacco use represents a major hurdle to development of countries around the world. In addition to being the leading cause of preventable death, smoking-related diseases cost billions of dollars every year; they impose high economic costs in terms of direct medical care as well as losses in productivity (WHO, 2015a).[1] Given this, the WHO has made reducing tobacco consumption among persons over the age of fifteen by 30 percent one of its global targets. (WHO, 2015b). To achieve this goal, several measures have been adopted, including regulations to protect the public from tobacco smoke, programs to assist those looking to quit, awareness campaigns that publicize the dangers of tobacco, advertising bans, and increased taxes on tobacco products. Although this final recommendation is considered to be the most effective measure to reduce tobacco use, it is the least adopted.[2] Particularly, World Health Organization's guide on best practices recommends that taxes on cigarettes should be at least 75 percent of the retail price, but this suggestion is not usually put into practice. (WHO, 2015a).

Generally, incidence analysis indicates that the introduction of a tax in a partial equilibrium framework increases the market price, reduces consumption, generates fiscal revenues and introduces deadweight loss. The magnitudes of these effects depend on the elasticities of market supply and demand (Gruber, 2016, Rosen y Gayer 2014). In the specific case of tobacco, taxation can be justified along different conceptual frameworks. First, in goods that generate negative externalities (like tobacco), taxation can be used to correct pre-existing distortions.[3] Second, as tobacco products have a relatively small demand price elasticity, higher (as compared to other goods) taxation is justified from an optimal taxation perspective (Ramsey, 1927; applications to the Argentine case are noted below; Berlinski and González-Rozada, 2018 and Rodríguez-Iglesias, Schoj, Chaloupka, Champagne and González-Rozada, 2017). Finally, literature on behavior suggests that issues of self-control, lack of attention, and false beliefs can lead individuals to overconsume tobacco. Given these conditions, a rise in tobacco taxes may produce improvements in social welfare (Chetty, 2015, Mullainathan et al., 2012, and Bernheim and Rangel, 2009).

[1] According to the World Health Organization (WHO) one out of ten deaths worldwide is tobacco-related. (WHO, 2017).
[2] See for example, Asaria, Chisholm, Mathers, Ezzati, and Beaglehole (2007); Laxminarayan and Ashford (2008); Ranson, Jha, Chaloupka, Nguyen and Mundial (2000).
[3] These taxes are known in the economic literature as Pigouvian taxes (Pigou, 1920).

These arguments and findings suggest that setting high taxes on cigarettes is an attractive and justifiable policy option that serves the common good. Cigarettes are not only detrimental to the health of the individual who smokes, but also negatively affect persons around him. If higher taxes incentivize smokers to either quit or reduce their consumption, the tax will have a positive effect on public health. However, even if taxes do not change behavior and people continue to smoke, the government has an important and justified source of fiscal revenues. Either way, this reasoning assumes that consumers do not differ in terms of their marginal utility of income; that is, policy makers would consider a unit of tax revenue to be the same regardless of whether those taxed were the richest or poorest in the country. A common objection to tobacco taxes is that they are regressive—they tend to fall disproportionately on the poorest households, who allocate a larger share of their income to the purchase of tobacco products. However, this reasoning implies at least two faulty assumptions: first that individuals across the income distribution exhibit the same price elasticity of demand for cigarettes, and second, that shifts in tobacco taxation affect households only through changes in the expenditure of the tobacco products themselves.[4]

In regards to the first assumption, if the poorest consumers are sufficiently sensitive to price changes, which is to say they have a higher price elasticity for cigarettes, raising the price on tobacco products could have a greater impact on their consumption, generating changes in consumption patterns across the income distribution.[5] In fact, evidence gathered in developed countries shows that the poorest households have greater price elasticities of demand of cigarettes, in absolute value. (Colman and Remler, 2008; Farrelly et al., 2001; Hersch, 2000). For Argentina, González-Rozada (2019) finds a price elasticity of demand of -0.35 for the poorest individuals and of -0.21 for the richest.

Regarding the second assumption, tobacco taxes can affect households' expenditures beyond the consumption expenditure itself. Given that taxation discourages consumption, households may be able to save on future medical expenditures associated with tobacco-related diseases; too, individuals who reduce tobacco use may increase their life expectancy and thus spend a longer time in the labor market. As the poorest households are those that consume relatively more tobacco, savings in medical costs and increases in future labor income would be relatively greater for them.

[4] It is also assumed that households are homogenous in terms of their knowledge about the product, awareness of its damaging effects, their capacity of self-control, and other factors that are outside the scope of this work.
[5] In other words, if poorer individuals are more sensitive to changes in tobacco prices, even given the patterns of consumption observed in the surveys, a rise in tobacco prices could be non-regressive.

When these effects are taken into account, the regressive nature of this tax could be reversed (Fuchs and Meneses, 2017).

This research estimates the distributional incidence of an increase in tobacco taxes in Argentina using data from the Encuesta Nacional de Gastos de los Hogares de Argentina (Argentina's National Survey of Household Expenditures or ENGHo) for the years 2004 and 2005 (ENGHo 2004/2005). To do this, the two points noted above are taken into consideration. First, the price elasticities of demand for cigarettes are estimated by income level using a two-stage methodology that differentiates between two types of decisions: smoking or not smoking, and the number of cigarettes consumed by smokers. Results show that sensitivities to changes in cigarette prices differ significantly among individuals. Poorer individuals present higher price elasticities of demand, in absolute value. Specifically, while the elasticity for a person with the average income in Argentina is -0.65, this value is -0.85 for someone in the poorest decile. An individual in the richest decile of income distribution has a price elasticity of -0.44. Given the obtained results, a 10 percent increase in cigarette prices would decrease consumption by 8.5 percent (4.4 percent) for the poorest (richest) smokers.

In addition, this study also estimates differences in price elasticities by age groups. The obtained results indicate that young people (15-24 years) are the most sensitive to changes in cigarette prices. According to our results, doubling the price of a pack of cigarettes would reduce the number of smokers by almost 3 percent overall, with the largest response seen among young people, 6.5 percent of whom would stop smoking. These results are in line with previous findings from other countries (WHO, 2015a).

Second, beyond the estimates of price elasticity by income deciles and age groups, this report keeps in mind that changes in the price of tobacco generate indirect effects. Increases in tobacco taxes have an impact on individuals' expenditures through a reduction in medical expenditures as well as increases in labor income resulting from a lower probability of premature death. To estimate these effects this study uses the Fuchs and Meneses (2017) model (originally applied to the case of Chile) with data for Argentina from Alcaraz, Caporale, Bardach, Augustovski, and Pichon-Riviere (2016) about the cost of treating tobacco related diseases and estimated years of life lost by smoking. A 20 percent increase in the price of cigarettes is simulated, in line with the recent increase in the ad valorem component of the tax in Argentina.[6] Results suggest that when indirect effects are included in the

[6] Argentina has modified its tobacco consumption tax scheme in recent years, following the recommendations of international consensus. At the beginning of 2016, the excise tax on cigarettes had an ad valorem rate of 60 percent. In

analysis along with the heterogeneity in individual sensitivities to price changes, the increase in the tobacco tax is progressive and generates reductions in household spending for all deciles of the income distribution.

A number of prior studies inform the analysis. In one recent study for Argentina, Berlinski and González-Rozada (2018) use time series data and find that the long-term price elasticity of cigarette consumption is -0.441, while the long-term income elasticity of cigarette consumption is 0.127. Rodríguez-Iglesias, Schoj, Chaloupka, Champagne, and González-Rozada (2017) also use time series data to estimate cigarette demand for Argentina and simulate a fiscal policy to reduce tobacco consumption. They find that long-term price elasticity is -0.279 and a 100 percent increase in the price of cigarettes through taxation would maximize revenues and reduce consumption. Likewise, several studies examine distributional incidences of taxes in Argentina. In their recent study, Fernández Felices, Guardarucci and Puig (2014) find that cigarette taxes are regressive.

Beyond these studies, which offer background on the Argentine case, this work also builds on González-Rozada (2019) and Fuchs and Meneses (2017). González-Rozada (2019), using a two-stage strategy and data from the 2012 Global Adult Tobacco Survey (GATS) conducted in Argentina in 2012, estimates demand price elasticity of cigarettes by tertiles of household per capita income. This research provides complementary evidence by using the major survey of household expenditures in Argentina to differentiate elasticities by income deciles and age groups. By using the elasticities for income deciles, this study uses the Fuchs and Meneses (2017) model for the first time in Argentina, including the indirect effects generated by changes in taxation. To the authors' knowledge, this work constitutes the first exhaustive study (that takes into account indirect effects) on how tobacco taxation affects income distribution in Argentina.

The remainder of this work is structured as follows. Section 2 details how cigarette consumption is taxed in Argentina and outlines the most recent changes in regulations. Section 3 describes the survey used to estimate incidence. It presents descriptive statistics related to tobacco consumption. Section 4 describes the methodology used to calculate elasticities and illustrates how to incorporate indirect effects into incidence analysis. Results are presented in Section 5, demonstrating

May 2016 the tax increased to an ad valorem component of 75 percent of the consumer sale price. The price of a pack of cigarettes between January and May of 2016 was -on average- 12.70 (in 2013 pesos). The price between June and December (after the 2016 reform) of the same year was -on average- 15.20 (in 2013 pesos). This represents a change of approximately 21 percent.

a simulation of a 20 percent increase in the price of cigarettes. Section 6 of this report summarizes the key findings of this research and offers policy recommendations.

2. Tobacco taxation in Argentina

In Argentina, tobacco taxation includes a number of different taxes that jointly set up a complex tax structure, composed as follows:

i) An excise tax (INT) with a rate of 70 percent on the final sale price (PF) excluding the additional emergency tax on tobacco, the tax associated with the special tobacco fund and the value-added tax. This ad valorem excise tax must remain higher than a minimum value set by the consumer price index (CPI);[7]

ii) An additional emergency tax (impuesto adicional de emergencia, IAE) with a rate of 7 percent on the PF;[8]

iii) The tax associated with the special tobacco fund (fondo especial de tabaco, FET) with a rate of 8.35 percent on the PF excluding the value-added tax (VAT) and the IAE and a fixed updatable amount;[9]

iv) The value-added tax (VAT) with a rate of 21 percent on the PF excluding the IAE, FET, INT and the gross income tax.

v) The subnational turnover tax with an implicit rate of 4.77 percent on PF excluding the IAE, FET, INT and VAT.

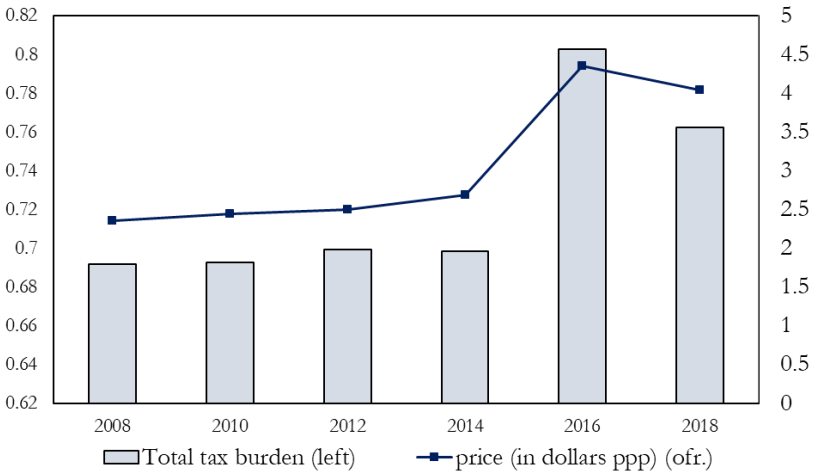
Since 2016, the cigarette tax has undergone several reforms. At the beginning of that year the excise tax (INT) had an ad valorem rate of 60 percent but could not be less than 75 percent of the tax on the best-selling brand. It could also not exceed the rate (60 percent) plus 25 percent. In May 2016, the ad valorem rate of tobacco excise tax was increased to 75 percent of the consumer sale price (Decree 626/2016). Finally, in December 2017, an additional reform set a 70 percent rate on the excise tax and established a minimum tax of 28 pesos per pack of 20 units.[10]

Thus, tobacco taxation in Argentina has been increasing, in line with WHO recommendations. According to WHO's estimates, the total tax burden on tobacco was around 70 percent between 2008

[7] Fixed at $28 as of December 2017. Law 24.674.
[8] Law 24.625.
[9] Fixed at $1.7 as of December 2017. Law 19.800.
[10] This tax is now around $43, but the law does not apply due to a judicial interference by small tobacco companies.

and 2014. After the May 2016 reform, this burden increased to about 80 percent.[11] If the retail price of cigarettes is measured in dollars and at purchasing power parity, it approximately doubled (Figure 1). The increase in tobacco taxation generated the classic economic effects of partial equilibrium analysis: a rise in the price of the taxed product and a decrease in quantity (Figure 2). Tax revenue from tobacco has increased. (Figure 3).

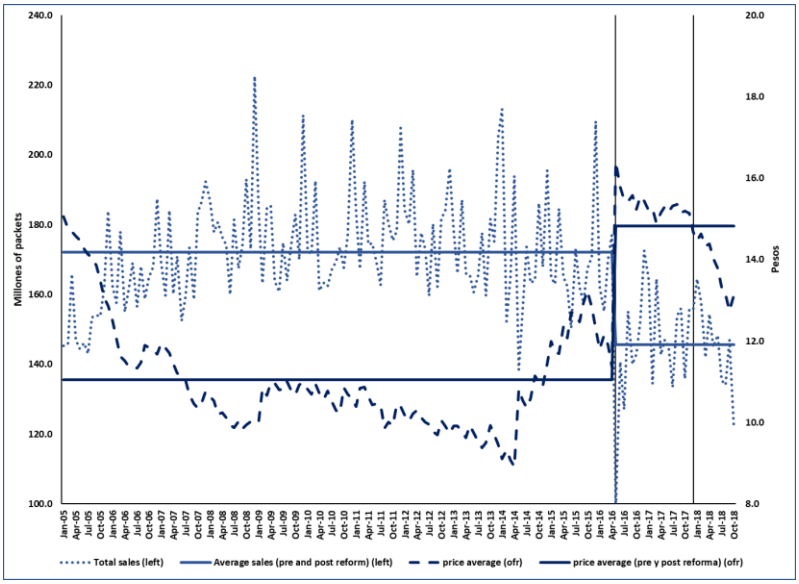
Figure 1. Total tax burden on tobacco in Argentina and price of best-selling brand, 2008-2018.



Source: Own elaboration based on World Health Organization (WHO 2019) data. Note: tax burden measured as a percentage of the total sale price and package price in dollars at purchasing power parity.

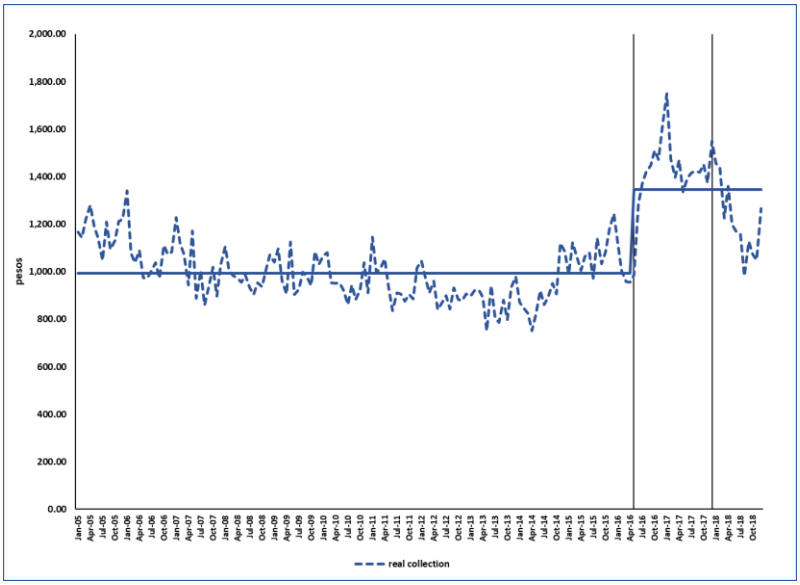
[11] Note that between 2016 and 2018 the tax burden decreased due to a judicial suspension on the minimum tax, an initiative led by tobacco companies. If the law had been enforced, the tax burden would have remained at 2016 levels.

Figure 2. Volume of cigarette packages equivalent to twenty units sold and their actual price, from 2005 to 2018. In millions of packages and in 2013 pesos.



Source: Own elaboration based on data from the Ministry of Agribusiness of Argentina. Note: vertical lines indicate the tax reforms for the tobacco sector in May 2016 and December 2017.

Figure 3. Tobacco tax revenue in Argentina, 2005-2018, in real terms (2013 pesos).



Source: Own elaboration based on data from the Federal Administration of Public Revenue. Note: vertical lines indicate the tax reforms for tobacco sector in May 2016 and December 2017.

3. Data

This study uses data from the National Survey of Household Expenditures (ENGHo) conducted by the National Institute of Statistics and Census (INDEC); the primary aim of this survey is to provide information on the living conditions in Argentina using data on household participation in the distribution and acquisition of goods and services. Most relevant here, the survey provides information on tobacco consumption at the individual level. The survey includes all towns in the country that have at least 5,000 inhabitants.

Microdata from the most recent survey are used in this analysis. The ENGHo 2004/2005 was carried out between October 2004 and December 2005 throughout the country and included urban and rural areas.[12] Table 1 shows some of the findings of this survey as related to cigarette consumption by decile of household per capita income. The prevalence of cigarette consumption was approximately 32 percent on average, with relatively homogenous distribution across income deciles.[13] On average, a household purchases twenty packs of cigarettes (of 20 units) per month, each at an average price of $3.95.[14] This level of consumption and price are lower in the lowest deciles of the income distribution: the price per pack paid, on average, by a household in the richest decile is 33 percent higher than that paid by a household in the poorest.

Using the tobacco consumption pattern and the income distribution obtained from ENGHo 2004/2005 and taking into account the regulatory changes in tobacco taxation in recent years, the

[12] After conducting the ENGHo 2004/2005, Argentina conducted the survey again in 2012/13 (ENGHo 2012/13), during a period in which public statistics in the country were profoundly questioned. As is the case for the Instituto Nacional de Estadística y Censos (INDEC), we do not here take the ENGHo 2012/13 into consideration given the serious defects of the survey, including a high rate of non-response, and a lack of adequate documentation to evaluate, among other things, the input procedures of household expenses. The rate of non-response of the ENGHo 2012/13 is too high when compared to the 2004/05 survey. Less than 27 percent of the homes in the sample for the City of Buenos Aires were taken into account (as compared to 53 percent for 2004/05), while only 40 percent of the households in Greater Buenos Aires (compared to 69 percent from 2004/05) were included. At the same time, the quality of the data for ENGHo 2012/13 could not be evaluated given that there are no detailed records of the methods used to collect and compile information. In fact, the administration that regulated national statistics as of December of 2015 developed a new measurement of poverty with a basic basket that was principally based on the ENGHo 2004/2005, given the above-mentioned doubts about the ENGHo 2012/13. (INDEC, 2016).

[13] The evidence on the prevalence rate is also consistent with what has been documented in other sources. According to the Encuesta Nacional de Factores de Riesgo (ENFR, National Survey of Risk Factors), in 2005 the prevalence of cigarette consumption in the adult population (18+) was 29.7 percent. The ENFR is part of the Sistema de Vigilancia de Enfermedades No Transmisibles (System for Surveillance of Noncommunicable Diseases) and the Sistema Integrado de Encuestas a Hogares (Integrated System of Household Surveys, SIEH). The field operation is carried out under the general coordination of INDEC, the National Ministry of Health and the Provincial Directorates of Statistics. It provides reliable and timely information on risk factors, health care processes and the major NCDs prevalent in the Argentine population.

[14] 2005 values; 3.95 pesos in 2005 would be nearly 87 pesos in today's currency.

static incidence of this tax is shown descriptively. This static analysis applies the ad valorem tax on cigarette consumption patterns without considering the role of elasticities or the indirect effects on other household expenses. Particularly, households are ordered according to their household per capita income (hpci), which is used as a measure of well-being, and then, the proportional expense on tobacco taxes for the different households is calculated.[15] As the prevalence of cigarette consumption per household is relatively proportional across deciles, and the expenditure on cigarettes is a greater proportion of income on the lowest deciles, the tax has a greater proportional burden on those sectors, making it regressive. (Figure 4).[16] Note, however, that this descriptive result is completely static, since responses in tobacco consumption to changes in prices (i.e., elasticities) are not being considered.

To estimate the incidence of a possible change in tobacco taxes with greater precision, individual sensitivities to price changes (price elasticity of demand) need to be taken into consideration. Too, given the literature on indirect effects, changes in health expenses associated with a lower risk of acquiring tobacco-related diseases and in expected labor income due to a longer projected life expectancy must be taken into account. In the following sections these considerations are addressed in order to obtain a more comprehensive incidence analysis.

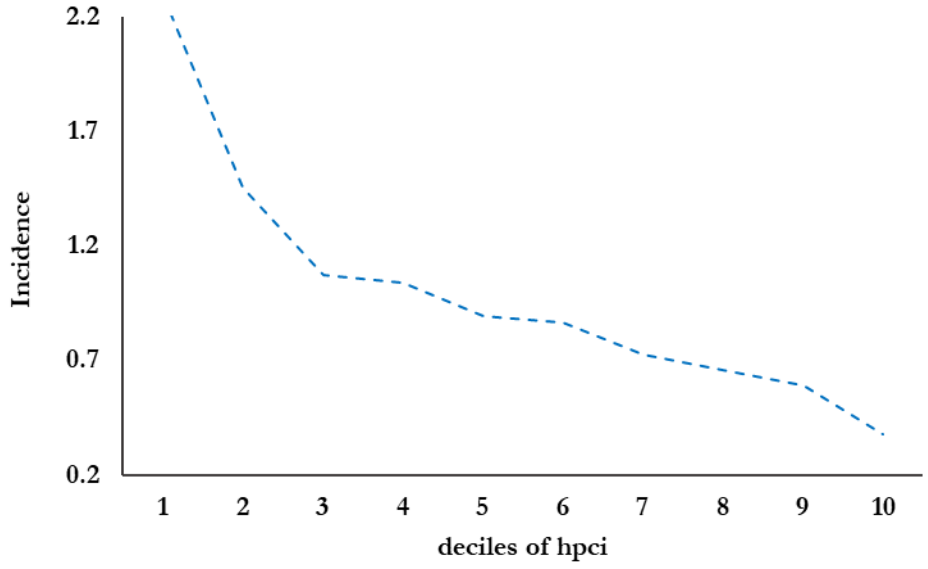
[15] Here the consumption patterns of the ENGHo 2004/2005 are used, as well as the laws in place in December 2018.
[16] The regressive or progressive nature of a tax is assessed by comparing the distribution of the burden of each tax with that of welfare. The literature usually expresses the tax incidence as a ratio between the decile's share of tax allocation and its share of total welfare. Thus, a value equal to 1 for all deciles indicates a proportional tax. A progressive (regressive) tax is that in which the tax pressure rises (falls) the greater the income of the decile (Gasparini, 1998).

Table 1. Static descriptive statistics, ENGHo 2004/2005, by deciles of household per capita income. As percentages, the quantity of packages and in 2005 pesos.

	Prevalence	Share of the expense	Number of packages	price per pack	HPCI
1	28.9%	4.6	13.99	3.30	61.73
2	32.2%	2.5	15.56	3.51	116.29
3	32.8%	2.4	17.80	4.01	163.72
4	36.4%	2.4	18.74	3.81	212.26
5	35.2%	2.0	16.95	3.93	268.90
6	30.0%	1.5	18.86	3.98	337.84
7	31.3%	1.6	21.29	3.70	422.04
8	32.7%	1.4	21.66	3.99	542.54
9	32.8%	1.2	21.67	4.25	755.17
10	31.4%	0.8	22.14	4.40	1736.41
Average	32.4%	1.8	19.45	3.95	565.87

Source: Own elaboration using data from the ENGHo 2004/2005.

Figure 4. Distributive (static) incidence of the cigarette tax in Argentina, by decile of household per capita income (hpci).



Source: Own elaboration based on the Encuesta Nacional de Gastos de los Hogares (ENGHo, 2004/2005) and relevant legislation.

4. Methodology for a more accurate estimate of the incidence of tobacco taxes in Argentina

To estimate the distributive incidence of an increase in the excise tobacco tax, the two considerations discussed above must be taken into account. First, not all individuals may have the same sensitivity to changes in the price of cigarettes; thus, price elasticities per decile of the distribution of household per capita income are calculated. Second, indirect effects of the change are considered; this means taking into account not only adjustments in household spending, but also expected changes in medical expenses for the treatment of tobacco-related diseases, and in labor income. These two factors are relevant given that, when individuals reduce their tobacco consumption, they, consequently, reduce their exposure to tobacco-related disease and also increase their projected life expectancy.

4.1. Methodological considerations for estimating elasticities by deciles[17]

The distribution of tobacco use is usually bimodal as people who smoke tend to consume at least a moderate number of cigarettes. The literature thus suggests using a two-stage model to calculate the price elasticity of the demand for cigarettes (Jones, 1989; Colman and Remler, 2008; González-Rozada, 2019), modeling the decision to smoke (extensive margin) separately from the amount of cigarettes consumed by smokers (intensive margin). This strategy is applied here. To account for the fact that individuals with different socioeconomic statuses may have different sensitivities to changes in the price of cigarettes, an interaction between individual household per capita income and the price of cigarettes is included.[18] Specifically, the prevalence equation defines the first stage and models the decision to smoke as follows:

$$F_i = \beta_0 + \beta_1 p_i + \beta_2 p_i Y_i + \beta_3 Y_i + \beta_4 Y_i^2 + X'\beta + \epsilon_i \qquad (1)$$

[17] Empirically, the elasticity of the demand for tobacco can be estimated using time series data (for example, per capita sales of cigarettes and average annual price in a country over time) or cross-sectional data. Of the latter, cross-sectional data for countries and data found for individuals from household surveys are understood as distinct. Time-series data allow us to calculate the percentage change in the total consumption of tobacco and the percentage change in the average price from one time period to another. The ratio of these two percentages provides the elasticity of the average price during the time interval. Cross-sectional data allow for the estimate in price elasticity by using a cross-sectional variation in consumption and price to determine price sensitivity across the population at a given time.

[18] Note that the prices in the household expenditure survey are approximated using the unit values that result from the relationship between an expense and the quantity consumed. For a discussion of the advantages and limitations (e.g. measurement error, quality capturing, etc.) of the use of unit values, see Deaton (1998) and John (2008).

Where F_i is a binary variable that takes the value one if the individual *i* smokes, and zero otherwise; p_i is the logarithm of the unit price of cigarettes, Y_i is the logarithm of the household per capita income and the vector X' is composed of a set of observable characteristics referring to first, characteristics at the observable level (individual) and second, to environmental aspects (home). The first group includes age, squared age, gender, and binary variables that indicate the highest educational level achieved, if the individual is a domestic employee, and if the individual is unemployed. Variables at the household level include the logarithm of the household's per capita household income (and its square), the gender and maximum educational level of the household head, the presence of other smoking members, and the number of members in the household, by age: the number of infants (0-5 years), the number of children (6-14); the number of young people (15-24), the number of adults (25-64) and finally, the number of older persons (+65). From the estimation of this prevalence equation the price elasticity of the participation in cigarette consumption is obtained, which is defined for the individual *i* as:

$$\Omega_i^{\mathrm{p}} = \beta_1 + \beta_2 Y_i$$

Then, in a second stage, the number of cigarettes that smokers consume is modeled using the following consumption equation:

$$C_i = \alpha_0 + \alpha_1 p_i + \alpha_2 p_i Y_i + \alpha_3 Y_i + \alpha_4 Y_i^2 + X'\alpha + \epsilon_i \qquad (2)$$

Where C_i is the logarithm of the number of cigarettes consumed by individual *i*, and the other regression variables are the same as those described for the prevalence equation (1). The major difference in estimating the prevalence and consumption equations is the individuals included in each regression. While the first regression included all persons in the survey—smokers or otherwise—the second stage (price elasticity of consumption) includes only those who report consuming a positive number of cigarettes. The price elasticity of cigarette consumption for individual *i* is calculated as:

$$\Omega_i^{\mathrm{c}} = \alpha_1 + \alpha_2 Y_i$$

Thus, the total price elasticity of demand for cigarettes for individual *i* is calculated as the sum of the prevailing price elasticity and the consumption price elasticity:

$$\Omega_i^t = \Omega_i^p + \Omega_i^c$$

The estimation of the prevalence equation (1) presents two main challenges. First, a household survey only indicates the price paid for cigarettes by persons who smoke, thus generating a potential sample selection problem. Second, prices can be a decision variable for individuals and not an exogenous variable, generating an endogeneity problem. To resolve the first issue a price must be assigned for non-smoking individuals so as to include them in the first stage of the regression equation (if they are not included, the binary dependent variable would not have variability). To do this, equation 3 is estimated to explain the price smokers paid for (*f*) among a set of observable characteristics:

$$p_f = \beta_0 + X_f'\beta + \epsilon_f \qquad (3)$$

where p_f is the logarithm of the price of cigarettes paid by the smoker *f* in the sample y X_f' a vector of observable characteristics: highest level of education reached, age, number of children, presence of other smoking household members in home, condition of labor activity, gender, a binary variable for working in domestic service, and a binary variable for province of residence. Once the regression coefficients are estimated, the price that non-smoking individuals (*nf*) should pay for cigarettes if they smoked is calculated, according to observable characteristics and a random error from a normal distribution with the same deviation as ϵ_f:

$$\hat{p}_{nf} = \hat{\beta}_0 + X_{nf}'\hat{\beta} + \mu_{nf}$$

In addition to the potential selection problem explained above, estimating the prevalence equation may present an additional endogeneity problem if the individuals choose what price they pay for cigarettes. This endogeneity problem can also be present in the consumption (2) equation. In the presence of endogeneity, one must estimate both equations using the instrumental variables method, instrumenting the price that individual i pays (or should pay) with the average price of cigarettes in their province of residence, exploiting the spatial variability of the independent variable. In this way, the first stage of the instrumental variables method consists on a regression (4) of the price paid for

cigarettes (or imputed in the case of non-smokers that are included in the participation equation) in province fixed effects, so as to exploit price variability that is only explained by spatial differences.

$$p_i = \delta_i Province_i + \epsilon_i \qquad (4)$$

Moreover, the interaction of the price and income must be instrumented in an analogous way. In a second stage, the prevalence (1) and the consumption (2) equations are estimated using only the variation in the price that can be explained by regional (exogenous) differences in cigarette prices.

4.2. Estimate of elasticities by income deciles

Following the methodology described previously, equations (1) and (2) are estimated using the instrumental variables method.[19] Since the dependent variable in equation (1) is binary, both a probabilistic model (probit) and a linear probability model are estimated. The results are presented for the average of the income distribution and its deciles.

Table 2 presents the results when the prevalence equation is estimated using a probabilistic model. It is worth noting that the values for the total price elasticity of the demand for cigarettes are higher (in absolute value) for the poorest deciles. While the elasticity for an individual with an average income is -0.65, this value is -0.85 for an individual who has the average income of the poorest decile, and -0.44 for an individual who has the average income of the upper-most decile. Taking into account these results, a 10 percent increase in the price of cigarettes would decrease consumption by 8.5 percent (4.4 percent) for poorest (richest) individuals. The same increase reduces the number of smokers by 0.29 percent, on average. This price increase generates more significant changes in the consumption patterns of the poorest segments of the population, which exhibit prevalence and consumption elasticities that are relatively higher. Since poorer smokers are more sensitive to changes in price than richer ones, as the tobacco tax increases, smoking prevalence and consumption gap between different income groups decrease. Thus, a tobacco tax increase is a marginally progressive policy.

Table 3 shows the results of the prevalence equation estimated using a linear model of probability. It can be observed that results are robust to this alternative estimation.

[19] The coefficients associated with the results of the prevalence and consumption regressions are presented in the Annex, estimated using an instrumental variables method.

Table 2. Prevalence and consumption elasticities estimates by decile of hpci. Prevalence equation estimated with the *Probit* model.

Decile	Prevalence	Consumption	**Total price elasticity**
1	-0.084	-0.765***	**-0.849*** **
	(0.0615)	(0.0068)	**(0.0546)**
2	-0.063*	-0.707***	**-0.769*** **
	(0.0367)	(0.0087)	**(0.0281)**
3	-0.051**	-0.675***	**-0.726*** **
	(0.0236)	(0.0097)	**(0.0139)**
4	-0.042***	-0.65***	**-0.692*** **
	(0.0133)	(0.0105)	**(0.0029)**
5	-0.033***	-0.628***	**-0.662*** **
	(0.0042)	(0.0111)	**(0.0069)**
6	-0.026***	-0.607***	**-0.633*** **
	(0.0045)	(0.0119)	**(0.0164)**
7	-0.018	-0.587***	**-0.604*** **
	(0.0133)	(0.0125)	**(0.0258)**
8	-0.009	-0.562***	**-0.571*** **
	(0.0233)	(0.0133)	**(0.0366)**
9	0.003	-0.531***	**-0.528*** **
	(0.0363)	(0.0144)	**(0.0507)**
10	0.028	-0.465***	**-0.437*** **
	(0.0639)	(0.0166)	**(0.0806)**
Average	-0.029***	-0.618***	**-0.647*** **
	(0.0001)	(0.0116)	**(0.0117)**

Source: ENGHo (2004/2005), INDEC. Note: standard errors in parentheses, calculated using Bootstrap, with 100 repetitions. Statistical significance *** p<0.01, ** p<0.05, * p<0.1.

Table 3. Prevalence and consumption elasticity estimates. By deciles of hpci. Prevalence and consumption elasticities estimated with a linear probability model.

Deciles	Prevalence	Consumption	**Total price elasticity**
1	-0.016	-0.765***	**-0.781*** **
	(0.0171)	(0.0068)	**(0.0103)**
2	-0.012	-0.707***	**-0.719*** **
	(0.0103)	(0.0087)	**(0.0017)**
3	-0.01	-0.675***	**-0.685*** **
	(0.0067)	(0.0097)	**(0.003)**
4	-0.009**	-0.65***	**-0.659*** **
	(0.0038)	(0.0105)	**(0.0066)**
5	-0.007***	-0.628***	**-0.636*** **
	(0.0013)	(0.0111)	**(0.0098)**
6	-0.006***	-0.607***	**-0.613*** **
	(0.0011)	(0.0119)	**(0.013)**
7	-0.005	-0.587***	**-0.591*** **
	(0.0035)	(0.0125)	**(0.016)**
8	-0.003	-0.562***	**-0.565*** **
	(0.0063)	(0.0133)	**(0.0195)**
9	-0.001	-0.531***	**-0.532*** **
	(0.0099)	(0.0144)	**(0.0242)**
10	0.003	-0.465***	**-0.461*** **
	(0.0175)	(0.0166)	**(0.0341)**
Average	-0.007***	-0.618***	**-0.624*** **
	(0.0001)	(0.0116)	**(0.0115)**

Source: ENGHo (2004/2005), INDEC. Note: standard errors in parentheses, calculated using Bootstrap, with 100 repetitions. Statistical significance *** p<0.01, ** p<0.05, * p<0.1.

4.3. Estimation of elasticity by age group

This subsection presents elasticities by population age groups. The literature has indicated that young people tend to have a greater sensitivity to changes in cigarette prices because they have lower levels of addiction and also have less income than other age groups (Joseph and Chaloupka, 2013). Moreover, young people are often poorly-informed about the future costs of tobacco addiction; as a result, many countries' efforts to curb tobacco focus on reducing the prevalence of smoking among youth.

To calculate elasticities by age group, the population is divided into four segments: young people (15-24), young adults (25-44), adults (44-64) and elderly persons (65+). Calculating age group

elasticity is analogous to the process described for income deciles. In both equations (prevalence and consumption) the interaction between the price of cigarettes and household per capita income is replaced with an interaction between price and age. Then, elasticities are calculated for the average age of each subgroups separately. As before, results are presented with the prevalence equation estimated with a linear probability model and with a probit model. Both the prevalence equation and the consumption equation are estimated using the instrumental variables approach.[20]

Results are presented in Tables 4 and 5 and show a greater price elasticity of demand for cigarettes among young people. Specifically, the group of young people aged 15-25 presents an elasticity of -0.77 while the group of elderly individuals (65+) presents an elasticity of -0.45. The estimated average elasticity of -0.65 is consistent with the results calculated by income levels. These results are also in line with findings for other countries (WHO, 2015a). In terms of the prevalence of the use of cigarettes, for example, a duplication in the price of a pack of cigarettes would reduce the number of smokers by almost 3 percent, but the greatest effects would be found among young people—6.5 percent of that population would quit smoking. Moreover, this group would also respond most significantly in terms of number of cigarettes consumption, reducing their consumption by 77 percent. According to the Risk Factors National Survey (ENFR), in 2018 the prevalence of cigarette consumption in the population between 18 to 24 years old was 20.5 percent. These findings could have strong policy implications as they indicate that higher taxes and prices prevent young people from taking up tobacco as a habit.

[20] Coefficients associated with the results of the prevalence and consumption regressions are shown in the Annex, with interactions by individuals ages, estimated using the instrumental variables method.

Table 4. Estimation of prevalence and consumption elasticities. By age group. Prevalence equation estimated with a *Probit* model.

Age group	Prevalence	Consumption	**Total price elasticity**
[15-24]	-0.065***	-0.702***	**-0.767*** **
	(0.0034)	(0.003)	**(0.0063)**
[25-44]	-0.041***	-0.643***	**-0.684*** **
	(0.0007)	(0.0082)	**(0.0089)**
[45-64]	-0.009**	-0.561***	**-0.571*** **
	(0.003)	(0.0154)	**(0.0124)**
[+65]	0.024	-0.478***	**-0.454*** **
	(0.0068)	(0.0228)	**(0.016)**
Average	-0.029	-0.612***	**-0.641*** **
	(0.0007)	(0.0109)	**(0.0103)**

Source: ENGHo (2004/2005), INDEC. Note: standard errors in parentheses, calculated using Bootstrap, with 100 repetitions. Statistical significance *** *** p<0.01, ** p<0.05, * p<0.1.

Table 5. Estimation of prevalence and consumption elasticities. By age group. Prevalence equation estimated with a linear probability model.

Age group	Prevalence	Consumption	**Total price elasticity**
[15-24]	-0.011**	-0.702***	**-0.713*** **
	(0.0007)	(0.003)	**(0.0037)**
[25-44]	-0.009**	-0.643***	**-0.651*** **
	(0)	(0.0082)	**(0.0083)**
[45-64]	-0.005***	-0.561***	**-0.566*** **
	(0.0008)	(0.0154)	**(0.0146)**
[+65]	-0.002***	-0.478***	**-0.479*** **
	(0.0017)	(0.0228)	**(0.0211)**
Average	-0.007***	-0.612***	**-0.619*** **
	(0.0003)	(0.0109)	**(0.0107)**

Source: ENGHo (2004/2005), INDEC. Note: standard errors in parentheses, calculated using Bootstrap, with 100 repetitions. Statistical significance *** p<0.01, ** p<0.05, * p<0.1.

5. Results of distributional incidence of tobacco taxes in Argentina

5.1. The role of indirect effects on the distributional incidence of tobacco taxes

Although the literature has viewed tobacco taxes as regressive due to the fact that the poorest households allocate a greater proportion of their income to tobacco consumption, tobacco taxes can affect household expenses beyond the specific cost of the tobacco itself. Given that taxes discourage consumption, when smokers reduce their consumption, households can save on medical expenses associated with tobacco-related illnesses and individuals can enjoy a longer life expectancy. As the poorest households are those that consume the most tobacco, savings on medical bills and an increase in labor income will be relatively greater for those same groups. This means that the indirect effects of the tobacco tax could reverse the regressive result observed when only direct effects are taken into account. In this sense, Fuchs and Meneses (2017) calculate the total effect of a change in the tobacco tax scheme on the income of decile *j* as:

$$\Delta Income = \underbrace{\Delta\ tobacco\ expense_j}_{1} + \underbrace{\Delta\ health\ expense_j}_{2} + \underbrace{\Delta\ labor\ income_j}_{3}$$

The first term on the right (1) is the direct effect of the tax change, which depends on the price elasticity of the demand for cigarettes of decile *j* and the share of cigarette expenses in total expenditures. The second term (2) considers the changes in health-related expenses given the decrease in need of treatments for smoking-related diseases; the third term (3) represents the changes in income given that smokers will likely work for a longer period of time due to longer life expectancy.

To calculate the variation in cigarette spending given a price change, it is first assumed—as a form of illustration—that all consumers have the same demand price elasticity. Then, the elasticities by decile are calculated using the ENGHo 2004/2005, presented in the previous section. It is important to allow elasticity to vary by decile as it implies that the poorest households have a greater reaction to the rise in prices as compared to the richest households. The change in tobacco expenditures is calculated by household depending on their cigarette consumption and the elasticity associated with their corresponding income decile. The average of these changes by decile is then calculated.

To calculate the change in projected health expenditures related to smoking-related diseases and variations in labor income related to the reduced likelihood of premature death, it is necessary to combine the elasticity data (calculated above) with data on the cost of smoking-related diseases and death attributed to tobacco-related causes in Argentina. For the latter, calculations are modeled on Alcaraz, Caporale, Bardach, Augustovski and Pichon-Riviere (2016), which estimated the cost for treating smoking-related diseases in Argentina and the years and quality of life lost by smoking. Their results signal that smoking-related diseases represent an annual direct cost of approximately 89 billion pesos in 2015, of which 37 percent were attributable to tobacco, equivalent to approximately 0.75 of the Gross Domestic Product (GDP). To take into account the scope of this value, Argentina allocated around 0.52 of its GDP in 2016 to its most significant conditional cash transfer program for the fight against poverty, the Asignación Universal por Hijo (Universal Child Allowance) (UNICEF, 2017). Alcaraz et al. (2016) also estimated that approximately 884 thousand years of life are lost in Argentina per year due to tobacco consumption, with 72.3 percent lost to premature death and 27.7 percent lost to low quality of life related to tobacco-related health issues.

5.2. Empirical results: indirect effects and the distributional incidence of tobacco taxes

In order to analyze the proportional change in household spending (with respect to income) given an increase in cigarette pricing, a 20 percent increase is assumed.[21] The ENGHo 2004/05 data and the costs of tobacco-related illnesses drawn from Alcaraz et al. (2016) are expressed in 2005 constant currency in order for the comparison to be valid.

Figure 5, Panel A shows the proportional change in cigarette expenses given the simulated price increase, using the average elasticity calculated in Table 2. This effect is called the direct effect, given that the only rise in expense is grounded in the increase in the tobacco tax itself. We can observe that if we only consider this effect, and one supposes a homogenous elasticity across deciles, the conclusion would be that a rise in the price of cigarettes due to an increase in tax would be regressive as it disproportionately affects the household expenses of the poorest sectors. In particular, a 20

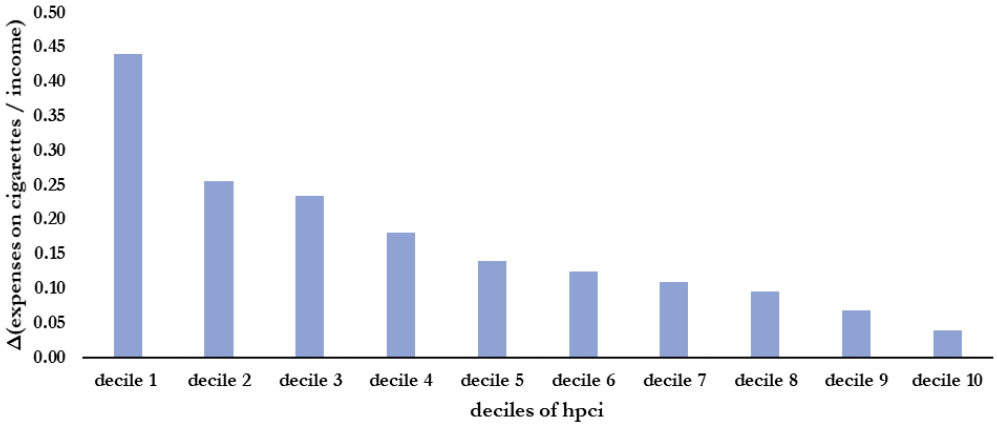
[21] The price of cigarettes between January and May of 2016 was - on average- 12.70 (in 2013 pesos). The price between June and December (after the 2016 reform) of the same year was - on average- 15.20 (in 2013 pesos. This represents an approximate change of 21 percent. A 20 percent change is thus simulated here. Fuchs and Meneses (2017) simulate a similar price change of 25 percent.

percent increase in the price of cigarettes has an effect 11 times greater for the poorest decile compared to the richest decile. The poorest decile would increase its proportion of tobacco spending in relation to income by 0.44 percentage points. Panel B of Figure 5 shows that by incorporating indirect effects (on health spending and labor productivity) and heterogeneity in price elasticities, a change in the price of cigarettes has a progressive pattern, and is in fact beneficial for all the deciles of the distribution. The poorest decile would experience savings of about 4 percentage points of their income due to lower medical expenses and higher labor income.

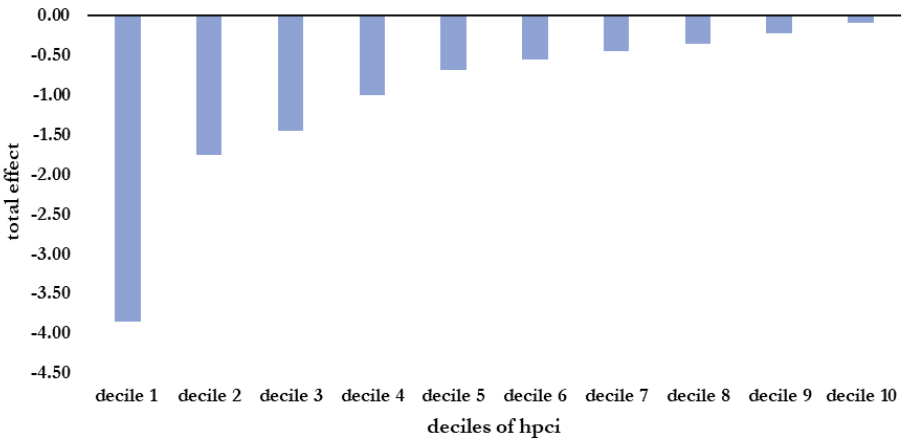
Figure 6, Panels A and B replicate the previous exercise but use the elasticities calculated in Table 3. That is, those elasticities where the prevalence equation is estimated through a linear probability model. It can be observed that the results are robust.

Figure 5. Incidence of change in cigarette tax. 20 percent price increase. Estimated prevalence equation with *Probit* model and price elasticities for demand reported in Table 2.

Panel A. Direct effect and average elasticity.



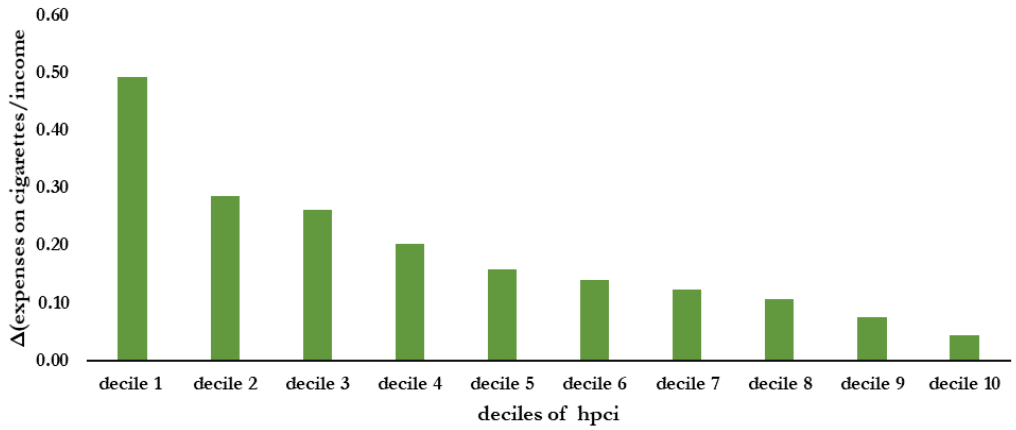
Panel B. Direct and Indirect effects and heterogenous elasticities.



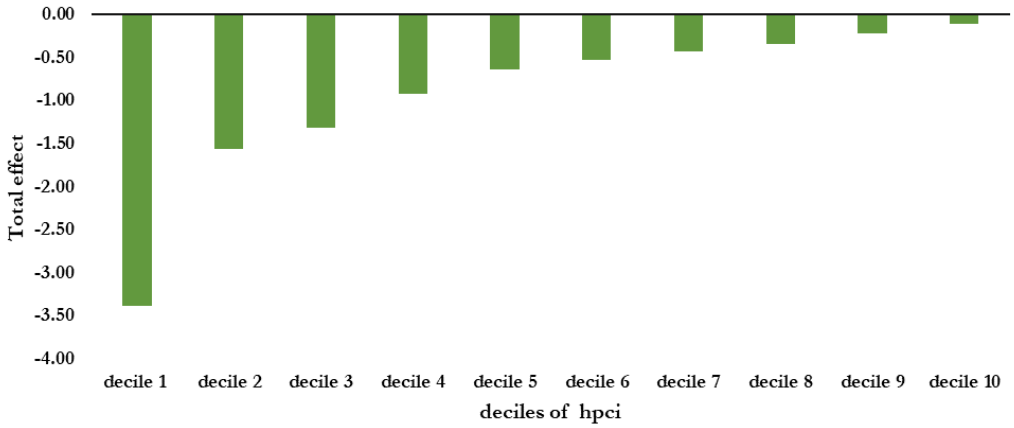
Source: Own elaboration based on ENGHo 2004/2005 and Alcaraz, Caporale, Bardach, Augustovski and Pichon-Riviere (2016)

Figure 6. Incidence of a change in the cigarette tax. 20 percent price increase. Estimated prevalence equation with a linear model of probability and price elasticities of demand reported in Table 3.

Panel A. Direct effect and average elasticity.



Panel B. Direct and indirect effects and heterogeneous elasticities.



Source: Own elaboration based on ENGHo 2004/2005 and Alcaraz, Caporale, Bardach, Augustovski and Pichon-Riviere (2016)

6. Final comments and policy recommendations

This research complements previous studies that were by nature partial and static. First, this study accounts for heterogeneity in consumption patterns throughout the income distribution using an estimation of price elasticities for the demand for cigarettes by income level. Results indicate that there is an important difference in individuals' sensitivities to changes in cigarette prices. Poorer consumers present price elasticities of demand for cigarettes that are higher in absolute value than those of their higher-income counterparts. Specifically, while the elasticity for a person with the average income in Argentina is -0.65, this value is -0.85 (-0.44) for a person with the average income of the poorest (richest) decile In addition, heterogeneity is included in price sensitivity by age group, indicating that young people are the most elastic group for cigarette price changes. These findings may have powerful policy implications as they indicate that higher taxes and prices incentivize the poorest sectors to reduce their use of tobacco products and prevent the youngest sectors from taking up the habit. Although standard analysis of distributive incidence has viewed increases in tobacco taxes as regressive, the vast majority of these studies are based on at least two implicit assumptions that have been proven false in this study and lead us to the following conclusions. First, not all individuals across the income distribution have the same price elasticity of demand for cigarettes. Secondly, changes in tobacco taxes do not only affect household spending on tobacco products, but generate other changes in expenditures as well.

Second, this study takes into account the indirect effects generated by changes in cigarette prices. Indirect effects impact individual expenditures by reducing medical expenses related to the treatment of diseases caused by smoking and increasing expected lifetime labor income, a result of a lower likelihood of contracting tobacco related diseases and facing premature death. The results of this broader analysis indicate that, if only the direct effects of an increase in cigarette prices are taken into account (that is, the change in the proportional expenditure on cigarettes by individuals) and individual sensitivities to price change are not taken into account, an increase in the tobacco tax will be read as regressive—that is, the burden would appear to disproportionately fall on the poorest households. However, if indirect effects are taken into consideration, the increase in the ad valorem component of tobacco taxation is in fact, progressive, and it generates savings in household expenditures for all deciles of the income spectrum.

In sum, this research suggests that recent increases on tobacco taxes in Argentina should have improved welfare, especially for the poorest sectors. Reductions in tobacco consumption result in better health, lower medical expenses, increased expected years of life, and more time for income generating activities. When considering the decreased medical expenses and higher labor income, a tax increase that effectively raises cigarette prices by 20% would result in about 4 percentage points of savings for the poorest decile, resulting in savings in income.

The adoption of World Health Organization's recommendations to move towards higher taxation on tobacco appears here to be correct from a distributional perspective. The conclusions of this study, and others like it, can help to reinforce this legislative agenda by providing strong evidence of the positive redistributive effects of tobacco tax increases, in addition to the impact on health and other dimensions (i.e., higher fiscal revenues).

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Annex

Table A1. Estimation of the prevalence equation with interaction between price and income. Instrumental variables method.

Dependent Variable: Prevalence		
	Probit	MLP
PANEL A: Second stage		
Log unit price	-0.244	-0.044
	(0.554)	(0.139)
Log unit price* income	0.037	0.006
	(0.095)	(0.024)
Man	0.673***	0.147***
	(0.017)	(0.003)
Age	-0.038***	-0.013***
	(0.003)	(0.001)
Age 2	0.000***	0.000***
	(0.000)	(0.000)
Homemaker	-0.005	-0.008
	(0.043)	(0.008)
Not in workforce	0.228***	0.050***
	(0.033)	(0.008)
Number of children	-0.138***	-0.036***
	(0.012)	(0.003)
Other smokers in household	1.929***	0.592***
	(0.024)	(0.006)
Male head	-0.463***	-0.102***
	(0.019)	(0.004)
Education of Household Head	-0.043***	-0.010***
	(0.003)	(0.001)
Elementary complete	0.173***	0.035***
	(0.030)	(0.005)
High school incomplete	0.376***	0.079***
	(0.036)	(0.007)
High school complete	0.371***	0.075***
	(0.040)	(0.008)
Higher education incomplete	0.431***	0.091***
	(0.048)	(0.010)
Higher education complete	0.383***	0.073***
	(0.051)	(0.010)
Household per capita income	0.167	0.032
	(0.258)	(0.066)
Household per capita income 2	0.002	0.001
	(0.009)	(0.002)
Constant	-0.484	0.429
	(1.260)	(0.319)
PANEL B: First stage		
Log unit price prov	0.968***	0.968***
	(0.014)	(0.011)
Log unit prov * income	0.000***	0.000***
	(0.000)	(0.000)
Observations	44,821	44,821
Weak IV F-stat	58.70	58.70

Standard errors in parenthesis
*** p<0.01, ** p<0.05, * p<0.1
Source: ENGHo (2004/2005), INDEC. Note: The F Statistic refers to the Kleibergen Paap rk wald F statistic.

Table A2. Estimation of the consumption equation with interaction between price and income. Instrumental variables method.

Dependent Variable: Consumption	
	MLP
PANEL A: Second stage	
Log unit price	-1.193*
	(0.630)
Log unit price* income	0.098
	(0.111)
Man	0.171***
	(0.019)
Age	0.047***
	(0.003)
Age 2	-0.000***
	(0.000)
Homemaker	-0.145***
	(0.050)
Not in workforce	-0.107***
	(0.035)
Number of children	0.038***
	(0.013)
Other smokers in household	0.102***
	(0.018)
Male head	-0.039*
	(0.020)
Education of household head	0.003
	(0.003)
Elementary complete	0.054
	(0.033)
High school incomplete	0.048
	(0.037)
High school complete	0.034
	(0.040)
Higher education incomplete	-0.007
	(0.046)
Higher education complete	-0.036
	(0.050)
Household per capita income	1.057***
	(0.308)
Household per capita income 2	-0.053***
	(0.011)
Constant	-1.398
	(1.453)
PANEL B: First stage	
Log unit price prov	0.967***
	(0.050)
Log unit price prov * income	0.000
	(0.000)
Observations	10,316
Weak IV F-stat	10.80

Standard errors in parenthesis
*** p<0.01, ** p<0.05, * p<0.1
Source: ENGHo (2004/2005), INDEC. Note: The F Statistic refers to the Kleibergen Paap rk wald F statistic.

Table A3. Estimation of the prevalence equation with interaction between price and age. Instrumental variables method.

Dependent Variable: Prevalence		
	Probit	MLP
PANEL A: Second stage		
Log unit price	-0.096	-0.014
	(0.099)	(0.022)
Log unit price*age	0.002	0.000
	(0.002)	(0.000)
Man	0.673***	0.147***
	(0.017)	(0.003)
Age	-0.035***	-0.013***
	(0.005)	(0.001)
Age 2	0.000***	0.000***
	(0.000)	(0.000)
Homemaker	-0.004	-0.008
	(0.043)	(0.008)
Not in the workforce	0.228***	0.050***
	(0.033)	(0.008)
Number of children	-0.138***	-0.036***
	(0.012)	(0.003)
Other smokers in household	1.928***	0.592***
	(0.024)	(0.006)
Male head	-0.463***	-0.102***
	(0.019)	(0.004)
Education of the household head	-0.043***	-0.010***
	(0.003)	(0.001)
Elementary complete	0.170***	0.034***
	(0.029)	(0.005)
High school incomplete	0.372***	0.079***
	(0.035)	(0.007)
High school complete	0.368***	0.075***
	(0.040)	(0.008)
Higher education incomplete	0.428***	0.090***
	(0.048)	(0.010)
Higher education complete	0.380***	0.072***
	(0.051)	(0.010)
Household per capita income	0.073	0.016
	(0.082)	(0.018)
Household per capita income 2	0.004	0.001
	(0.007)	(0.002)
Constant	-0.127	0.498***
	(0.322)	(0.072)
PANEL B: First stage		
Log unit price prov	0.997***	0.997***
	(0.045)	(0.032)
Log unit price prov * age	0.970***	0.970***
	(0.043)	(0.035)
Observations	44,821	44,821
Weak IV F-stat	1168	1168

Standard errors in parenthesis
*** p<0.01, ** p<0.05, * p<0.1
Source: ENGHo(2004/2005), INDEC. Note: The F Statistic refers to the Kleibergen Paap rk wald F statistic.

Table A4. Estimation of the consumption equation with interaction between price and age. Instrumental Variables Method.

Dependent Variable: Consumption	
	MLP
PANEL A: Second stage	
Log unit price	-0.782***
	(0.122)
Log unit price* Age	0.004
	(0.003)
Man	0.171***
	(0.019)
Age	0.054***
	(0.006)
Age 2	-0.000***
	(0.000)
Homemaker	-0.144***
	(0.050)
Not in workforce	-0.109***
	(0.035)
Number of children	0.038***
	(0.013)
Other smokers in household	0.102***
	(0.018)
Male head	-0.040*
	(0.020)
Education of household head	0.003
	(0.003)
Elementary complete	0.049
	(0.033)
High school incomplete	0.041
	(0.036)
High school complete	0.028
	(0.040)
Higher education incomplete	-0.011
	(0.046)
Higher education complete	-0.042
	(0.050)
Household per capita income	0.794***
	(0.094)
Household per capita income 2	-0.046***
	(0.008)
Constant	-0.387
	(0.375)
PANEL B: First stage	
Log unit price prov	1.132***
	(0.143)
Log unit price prov * Age	0.799***
	(0.150)
Observations	10,316
Weak IV F-stat	77.71

Standard errors in parenthesis
*** p<0.01, ** p<0.05, * p<0.1
Source: ENGHo (2004/2005), INDEC. Note: The F Statistic refers to the Kleibergen Paap rk wald F statistic.