Prevalence of Daily Smoking and Initiation in Latin America

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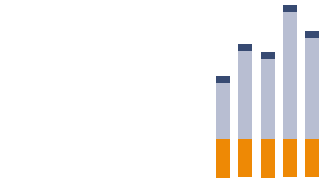

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Prevalence of Daily Smoking and Initiation in Latin America

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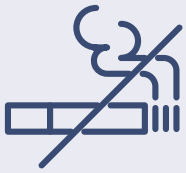
Key Messages



Increasing cigarette prices would reduce daily smoking prevalence across the population in Latin America.

Evidence from Argentina, Brazil, and Mexico shows that increasing cigarette prices through excise tax increases would delay the age of daily smoking initiation.

An increase of 10 percent in cigarette prices would delay smoking initiation by one year and four months in Mexico, by almost two and a half years in Brazil, and by five months in Argentina, which is conducive to reducing smoking prevalence.

In Brazil and Argentina, daily smoking prevalence decreases with wealth, which means that daily smoking is associated with being poor. In contrast, daily smoking prevalence in Mexico increases with wealth, meaning that richer individuals smoke daily, on average, more than poorer ones.

Executive Summary

There is abundant evidence documenting the negative consequences of smoking. Over the last decades, public smoking bans, taxation, and public health tobacco control campaigns induced a decline in smoking prevalence in Brazil, Argentina, and Mexico, three major economies in Latin America.

Argentina implemented effective policies to reduce tobacco consumption, and smoking prevalence has decreased over the past 15 years. In Brazil, there has been progress in reducing smoking prevalence since 2006. And in Mexico, as a result of tobacco control efforts, smoking prevalence at the national level has declined from 28 percent in the 1990s to 17 percent in 2017.

Despite the development of tobacco control policies over the years,[1] overall prevalence of smoking is still high in these three countries. According to the World Bank's World Development Indicators, prevalence decreased in the three countries during the period from 2000 to 2018, but that decrease appears to have ended according to most 2020 data. In Brazil and Mexico, prevalence decreased from nearly 24 percent to just above 13 percent in 2018, and in Argentina it declined from 34 percent to below 25 percent. This means that more can still be done to help people turn away from smoking and avoid negative health consequences.

To help better understand the determinants of daily smoking prevalence and smoking initiation, as well as the potential impact of increasing excise taxes, the authors of this research report quantify the magnitude of this impact in these three Latin American countries. Daily smokers are the most likely to become addicted and therefore suffer worse health consequences. Therefore, it is relevant to focus on how to disincentivize smokers from smoking every day.

Daily smoking prevalence in these three countries ranges from eight percent in Mexico to almost 17 percent in Argentina. The reported average age of daily smoking initiation is similar in the three countries, around 17–18 years old. In Brazil and Argentina, prevalence decreases with wealth, which means that daily smoking is associated with being poor. In contrast, daily smoking prevalence in Mexico increases with wealth, meaning that richer individuals smoke daily, on average, more than poorer ones.

In these three Latin American countries an increase in cigarette prices is associated with a decrease in daily smoking prevalence. Specifically, if prices increase by 10 percent, prevalence would be reduced by 4.1 percent in Mexico, by 2.6 percent in Brazil, and by 1.1 percent in Argentina.

Increases in excise taxes that increase cigarette prices would also delay the starting age of daily smoking. An increase of 10 percent in prices would delay the daily smoking initiation age by one year and four months in Mexico, by around two years and six months in Brazil, and by five months in Argentina. Although the effect seems at first subtle, delaying smoking initiation is imperative for long-term health benefits. As an individual ages, the probability that they will start smoking is decreased. Consequently, as less people take up smoking, smoking prevalence is, in turn, reduced, meaning that this policy can lead to less people who will become regular smokers.

Overall, the evidence presented in this research report suggests that increasing excise taxes on cigarettes that lead to higher retail prices would reduce daily smoking prevalence and induce a delay in smoking initiation in the three Latin American countries analyzed.

[1] For a discussion of recent progress of tobacco control polices across the region, see the country reports.

1. Introduction

Addiction to nicotine is the fundamental reason that individuals persist in using tobacco products, and persistent tobacco use contributes to many diseases (USDHHS, 2010). Global evidence shows that nicotine dependence symptoms can manifest soon after initiation of smoking in some adolescents, often well before they start smoking daily or even regularly (DiFranza et al., 2000; DiFranza et al., 2007; Gervais et al., 2006; O'Loughlin et al., 2003, 2009) and that early initiation predicts long-term adult smoking (Chassin et al., 1990).

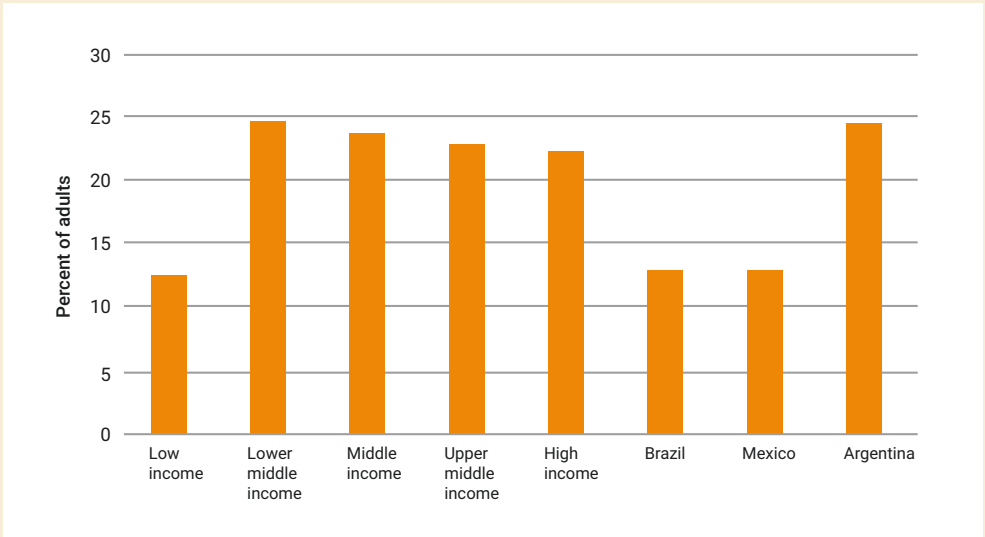
In practice, it is not possible to predictively identify potential smokers. Therefore, there is a compelling need to universally address the issues of initiation and prevalence of smoking in young individuals (Klein, 2006; Gervais et al., 2006). Moreover, there is evidence that higher cigarette prices are less effective at reducing consumption among those with a longer history of addiction compared to those who have been smoking for a shorter period (Gonzalez-Rozada & Montamat, 2019). This evidence highlights the importance of addressing the tobacco epidemic through control policies targeted at early ages, since delaying the age at which individuals start smoking by even a few years can have substantial health benefits (USDHHS, 2010).

Over the last few decades tobacco control policies such as public smoking bans, taxation, and public health campaigns induced a decline in smoking prevalence in these three major economies in Latin America.

Argentina implemented effective policies to reduce tobacco consumption, and smoking prevalence has decreased over the past 15 years (Franco-Churruarin & González-Rozada, 2022). Smoking prevalence in Argentina was 34 percent in 2000, but it declined to almost 29 percent in 2010 and stabilized around 24 percent between 2018 and 2020 (World Bank, 2022).

Figure 1

Prevalence of current tobacco use in 2020



Source: World Bank (2022)

In Brazil, the proportion of smoking adults[2] has decreased from more than 16 percent in 2006 to currently about 10 percent of the population (Divino et al., 2019). The decrease is even greater, from 24 percent in 2000 to 13 percent in 2020, when considering broader measures of prevalence.

In Mexico, smoking prevalence decreased from 28 percent in the 1990s to 17 percent in 2017 (Liu et al, 2020). Despite the development of tobacco control policies over the years, there is more that can still be done to reduce smoking. Figure 1 shows prevalence of current tobacco usage in 2020, grouped by country income level (World Bank classification).[3]

To help better understand the determinants of smoking prevalence and smoking initiation, as well as the potential impact of increasing excise taxes, this research report quantifies the magnitude of this potential impact in the three Latin American countries. To this end, authors focus on the determinants of smoking prevalence and initiation.

There is evidence that, among those individuals who have ever tried smoking, about one-third become daily smokers (USDHHS, 1994). And among those smokers who try to quit, less than five percent are successful at any time (CDC, 2002, 2004). Consequently, any efforts to reduce tobacco initiation must take into consideration that, when a person starts smoking, there is a substantial possibility that they will continue to smoke and will smoke more. This suggests that it is important to prevent initiation.

There is a window in which some young people are much more likely to try smoking. If they do not start smoking during this time, it is likely that they will not start smoking altogether. Therefore, a policy that makes individuals start smoking later might push them out of that window during which the probability of starting is higher. All in all, this leads to less people smoking regularly.

This research report analyzes the determinants of daily smoking initiation and, in particular, the impact of increasing the price of cigarettes—via increasing cigarette excise taxes—on prevalence and the onset of cigarette use. There is a very subtle point that relates the two components. When one considers smoking onset, it usually refers to how people start smoking. For each person, this is not related to the probability of smoking. However, when estimating smoking onset, typical models of onset assume that every person will eventually "fail," which in this case represents starting to smoke. In the case of smoking this is not a reasonable assumption, since not everyone starts to smoke. Therefore, a reasonable model of onset needs to account for this fact.

The standard way to do this is to include a constant probability for every person that is estimated as an extra parameter in the model, but this approach has two inherent challenges. First, it is not obvious that every person has the same probability of smoking. Second, the high nonlinearity of the model makes numerical approximations less accurate.

[2] This is measured using data from VIGITEL (Risk Factor Surveillance and Protection for Chronic Diseases by Telephone Survey), that measures prevalence of smoking as "five or more days a week" (Bernal et al., 2017).

[3] For additional details about other the other survey's measures of prevalence in each of the three countries, refer to the country reports: Argentina https://tobacconomics.org/research/the-impact-of-cigarette-price-increases-on-daily-smoking-prevalence-and-initiation-in-argentina/

Brazil https://tobacconomics.org/research/the-impact-of-cigarette-price-increases-on-the-prevalence-of-daily-smoking-and-initiation-in-brazil/

Mexico https://tobacconomics.org/research/the-impact-of-cigarette-price-increases-on-the-prevalence-of-daily-smoking-and-initiation-in-mexico/

To surmount these challenges, the authors estimate smoking onset in two steps. That is, the probability that a person will start smoking based on their characteristics is estimated in a first step, stemming from the prevalence estimates, and the results are then used as input in the smoking onset estimation. For the estimation of the determinants of smoking prevalence authors first estimate a probit model and then integrate this estimation into a split-population duration model to address the impact of change in cigarette prices over the duration.

The report is organized as follows. Section 2 describes the data used in the estimations. Section 3 discusses the methodology and presents the split-population model. Results are presented in Section 4. Finally, sections 5 and 6 discuss these results and present the conclusions.

2. Data

The authors use data from the Global Adult Tobacco Survey (GATS) 2015 for Mexico, the National Health Survey (Pesquisa Nacional de Saúde, PNS) 2013 for Brazil, and the National Risk Factors Survey (Encuesta Nacional de Factores de Riesgo, ENFR) 2018 for Argentina.

The Global Adult Tobacco Survey (GATS) of Mexico is a nationally representative household survey of adults 15 years of age and older. The survey systematically monitors adult tobacco use and tracks key tobacco control indicators.

The ENFR of Argentina was carried out in 2018 by the National Statistics and Census Institute (INDEC). This survey is part of the Surveillance System for Non-Communicable Diseases and the Integrated System of Household Surveys and provides information on risk factors, such as tobacco consumption, as well as nutrition, physical activity, alcohol consumption, medical attention processes and the main noncommunicable diseases.

Finally, the 2013 edition of the National Health Survey (PNS) carried out by the Brazilian Institute of Statistics and Geography (IBGE) has the objective of producing data on the health situation and lifestyle of the Brazilian population. Module P of the survey includes questions related to current and past smoking behavior. In particular, it asks whether the individual smokes or not, the frequency of smoking, quantity of cigarettes (and other tobacco products) smoked per week, starting age, price and quantities bought in the last purchase, and quitting age.

The price variable

Cross-sectional price variable

The surveys used for these countries have questions regarding the quantities and the amount paid for the last purchase of cigarettes for personal consumption. This research report uses the survey of self-reported implicit paid price per cigarette in order to estimate the daily smoking prevalence. A price constructed in this way could potentially be an endogenous variable in the smoking prevalence estimation. For example, if retailers had some market power, the use of price discrimination is a possibility, and this could induce correlation between the price paid and factors that affect whether a person is a smoker or not.

Following the recommendations in the *Economics of Tobacco Toolkit: Economic analysis of demand using data from the Global Adult Tobacco Survey (GATS)*, the authors first check for endogeneity of the self-reported price using the Rivers-Vuong (1988) test statistic. The Rivers-Vuong procedure is similar to the Hausman (1978) test for endogeneity in the linear model, but applied to prevalence estimation.

Since the surveys do not assign cigarette prices for non-smokers, the authors have to impute a price as if they had been smokers before applying the Rivers-Vuong test. This is done by using random regression

imputation. The details of this methodology and the results of estimation of the prices, the derivation of the instruments, and the endogeneity tests for each country are described in each country report (Franco-Churruarin & Gonzalez-Rozada, 2021, 2022a, 2022b).

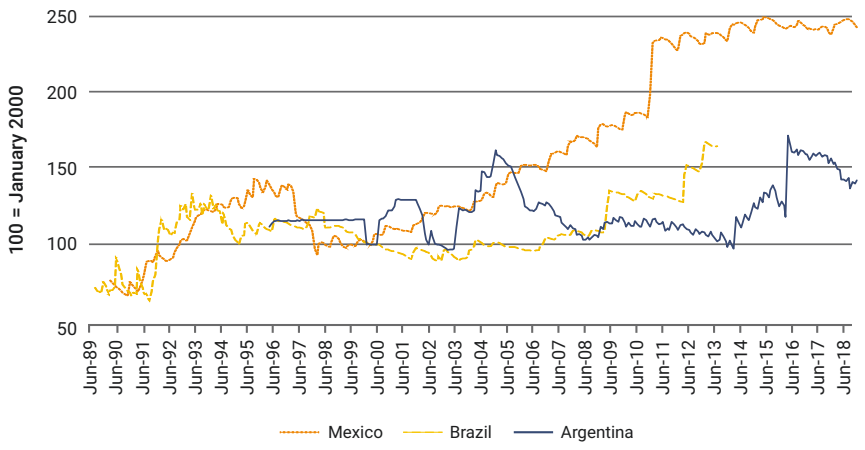
To summarize the results of the three country reports, authors find evidence for endogeneity of prices in Brazil, but not in Argentina or Mexico. These results are important for the modeling of the smoking prevalence equation. When the price variable is exogenous, as in the cases of Argentina and Mexico, the authors estimate the daily smoking prevalence using a regular probit model. For Brazil, since there is evidence that the price variable is endogenous, smoking prevalence is estimated using an instrumental variable (IV) probit model.

Time-series average real price of cigarettes

For the estimation of the impact of cigarette prices on smoking onset, the data first need to be transformed into a pseudo panel, so that it is possible to assign to each smoker the cigarette price at their smoking initiation date. The monthly time-series price variable is constructed using a weighted average of cigarette prices for each country. Then, the corresponding consumer's price index is used to deflate the nominal prices and, thus, express the price of cigarettes in real terms. Once this variable is constructed, authors assign to the daily smokers, the price for the year-month they began smoking, and for those who never started smoking, the price at the survey year-month date is assigned.

In the case of Mexico, this index is calculated with data from the National Institute of Statistics and Geography (INEGI) for the period January 1990 to May 2015. INEGI elaborates an index that aggregates cigarette prices in different package types and cities. The authors calculate the cigarette price index as the ratio of INEGI's index to the consumer price index (also produced by INEGI). In the case of Brazil, the authors use a monthly index for the real price of cigarettes constructed with consumer price

Figure 2
Evolution of the real cigarette price index by country



Source: Authors' elaboration based on INEGI (Mexico); IBGE (Brazil); Ministry of Agriculture, Livestock and Fisheries of the Nation of Argentina and INDEC (Argentina)

index (CPI) data and the cigarette disaggregation from IBGE, which is available from June 1989. Lastly, in the case of Argentina, the authors use a weighted price of a 20-cigarette pack constructed by the Ministry of Agriculture, Livestock and Fisheries of the Nation.[4] The authors use the consumer price index (CPI) to convert this price into real terms.

Figure 2 shows the evolution of the real cigarette price index in each of the countries analyzed. The figure shows all prices normalized such that January 2000 is the base level of 100 of each index to focus on the evolution of the real prices rather than on the levels. The figure shows very different patterns of real cigarette prices in each country. All countries show that there are episodes of sharp increases in price, but also periods in which cigarettes become cheaper relative to other goods.

3. Methodology

The authors use survival analysis estimation, focusing not only on smoking probability but also on the onset of cigarette use. For smoking prevalence, the authors estimate a probit model, as mentioned above, and they use a split-population model for smoking onset based on the model by Schmidt and Witte (1989). Since all the surveys used here have a single record per individual for their starting age of smoking, the authors construct a pseudo panel for each country.

Based on the reported age of initiation, authors create for each individual a duration spell. Duration refers to the time that elapses between the risk age of smoking onset and the actual age of starting. Therefore, a spell begins at the risk age (which this report assumes to be 10 years old in all three countries) and either ends in the year the individual reported to have started smoking or at the survey date if they never started. The pseudo panel is created in terms of months, and it is constrained by the availability of data in the time-series price variable. Details of the creation of the pseudo panel regarding the specific years and ages of individuals in each country are found in the specific reports.

The main idea behind the use of a split population model is to account for the fact that not all individuals who have an incomplete spell will eventually start smoking, as opposed to the traditional assumption of standard duration models that they all will. The duration process applies then only to those individuals who are predicted to eventually "fail." The likelihood of each observation is weighted with the probability that the individual will ever start smoking.

Formally expressed, the log-likelihood function to be maximized is:

$$\ln(L) = \sum_i w_i \cdot \Big\{ c_i \cdot \ln\left[\phi(\alpha' z_i) \cdot f(t|s_i = 1, x_i(t))\right] + (1 - c_i) \ln\left[1 - \phi(\alpha' z_i) + \phi(\alpha' z_i) \cdot S(t|s_i = 1, x_i(t))\right] \Big\} \quad (1)$$

where c_i is a dummy variable equal to 1 if individual *i* ever smoked and 0 otherwise, si is another dummy equal to 1 if the individual will eventually start smoking and 0 if they never do. The standard normal cumulative function is Φ, and z_i is a vector of time-invariant covariates. The chosen conditional density function to model duration is *f*, *S* is the respective survival function, and *w* is a survey weight. Time-varying covariates, including the price of cigarettes, are $x_i(t)$.

The contribution to the log likelihood (1) for individual *i* observed smoker in the sample (c_i = 1, uncensored observations) is simply the natural logarithm of the probability of daily smoking, $\Phi(\alpha' zi)$, multiplied by the probability density function of starting

[4] This average weighted price can be found here: https://www.magyp.gob.ar/sitio/areas/tabaco/estadisticas/_archivos/000001-Volumen%20de%20Paquetes%20de%20Cigarrillos%20Vendidos%20por%20Rango%20de%20Precio%20(2008-2019).pdf

smoking at the observed starting age $f(t/s_i = 1, x_i(t))$. For those i observed not starting smoking ($c_i = 0$, censored observations) the contribution is the natural logarithm of the probability of no daily smoking, $1 - \Phi(\alpha' zi)$, plus the probability of starting after the age observed in the survey, $\Phi(\alpha' z_i)S(t/s_i=1, x_i(t))$ (Forster & Jones, 2001).

Smoking prevalence depends on the socioeconomic characteristics of the individuals. That is,

$$\Pr(y_i = 1|z_i) = \Phi(\alpha' z_i) \tag{2}$$

where $y_i=1$ indicates that individual i smokes, and z_i is a vector of explanatory variables including the log of the imputed self-reported cigarette price, the wealth index, a dummy for female, education, and labor categories, and dummy variables for region[5] of residence. In using these region-fixed effects, the authors assume there is no movement of individuals between regions.

Using (2) as part of the log likelihood (1) means that the authors need to estimate the coefficients of a nonlinear function. This makes the log likelihood (1) highly nonlinear and difficult to fit because the convergence to a maximum is more likely to fail (Jenkins, 2001). To avoid this problem, the strategy adopted here is first using a probit model to estimate equation (2) $\hat{\Phi}(\alpha' zi)$ and then introduce this estimation into equation (1) to estimate the duration coefficients.

This procedure has the advantage of allowing the authors to compute the prevalence elasticity directly from equation (2), using:

$$\epsilon_i = \frac{\partial \Phi(\alpha' z_i)}{\partial \ln(cp_i)} \times \frac{1}{\Phi(\alpha' z_i)} \tag{3}$$

where $\ln(cp_i)$ is the log of the imputed self-reported cigarette price. Equation (3) is a function that gives a different elasticity for each i. Therefore, when reporting the estimated elasticity, the average prevalence price elasticity is presented for the relevant group of people.

This study follows Forster and Jones (2001), who also use a split-population model to study the effect of tobacco taxes on smoking initiation, choosing the distribution of duration time to be log-logistic. This means that the density function in (1) is:

$$f(t|s_i = 1, x_i(t)) = \frac{1}{\gamma} \frac{\psi^{1/\gamma} t^{1/\gamma - 1}}{[1 + (\psi t)^{1/\gamma}]^2} \tag{4}$$

where $\psi = \exp(-\beta' x_i(t))$. The authors refer to γ as the "shape parameter" because it governs the shape of the density and the hazard. The hazard function of the log-logistic model is:

$$\lambda(t|s_i = 1, x_i(t)) = \frac{1}{\gamma} \frac{\psi^{1/\gamma} t^{1/\gamma - 1}}{[1 + (\psi t)^{1/\gamma}]} \tag{5}$$

The log-logistic model belongs to the continuous time accelerated failure time (AFT) class of models. Since this study uses monthly data and the event of interest happens years after starting to be at risk, the assumption of continuous time is a reasonable one. The AFT class of models leads to an intuitive interpretation of coefficients because they are interpreted as the proportional change in survival time for a unit change in the regressor (Jenkins, 2005). In the case of regressors measured in logarithms, the coefficient accompanying it is an elasticity. The authors seek to estimate the price elasticity of daily smoking onset η_p, which is:

$$\eta_p = \frac{\partial \ln(T)}{\partial \ln(p)} = \beta_1 \tag{6}$$

So this study's results can be interpreted as a one-percent increase in prices (in real terms) leads to a β_1% increase in daily smoking onset. As mentioned previously, an

[5] The word "region" is used without loss of generality to refer to the greatest subnational administrative divisions of a country for which the authors have data. In the cases of Mexico and Brazil, it is states. In Argentina, the corresponding areas should be provinces, but the Argentinian survey collects data on regions, which are groups of provinces.

increment in smoking onset suggests a delay in the age at which individuals start smoking. The delay is calculated in months after the risk age of 10, which is the (dependent) time variable in the model. Thus, the delay in months at a given age *a* and risk age *r* (both in years) after a given percentage price change of Δ_p is:

$$D(\beta_1, \Delta_p, a, r) = \beta_1 \cdot \Delta_p \cdot 12(a - r) \qquad (7)$$

where $\Delta_p = (p_1 - p_0)/p_0$.

As an example of this calculation, consider evaluating the effect of a 10-percent increase in prices at the average age of initiation, assuming risk age is 10 and average starting age is 17. If the coefficient using logged prices is 1.55, then the elasticity of smoking onset to prices is 1.55. This means that the expected delay is 1.55 (coefficient) times 10/100 (the price change) times 12*(17-10), which means that the average delay is 13 months, or one year and one month. After calculating this, it is easy to recover the delay in years. It is important to acknowledge that the delay cannot be compared to the results of studies in which the individuals are assumed to be at risk at other starting ages (Guindon, 2014).

4. Results

This section describes the smoking data and reproduces the estimations of the three country reports. One matter to take into consideration when reading the results is that the Mexican sample includes individuals aged 15 and older, whereas the Brazilian and Argentinian samples include only individuals aged 18 and older.

Table 1 shows some descriptive statistics based on surveys that are nationally representative for each of the three countries. The table shows the prevalence of daily smoking, which ranges from eight percent in Mexico to almost 17 percent in Argentina. When considering a broader measure of prevalence by adding occasional smokers to the daily smokers, smoking prevalence jumps to around 17 percent in Mexico, which is larger than Brazil's prevalence figure of 15 percent. Argentina has the highest prevalence of occasional and daily smoking at around 23 percent.

The reported average age of daily smoking initiation is similar in the three countries at around 17–18 years old. The distribution of education captured by the surveys is very different between the countries. In Argentina and Mexico, between 40 and 50 percent of people in the survey have a secondary level education, while the Brazilian survey includes almost 41 percent of people with no formal education. The price of a 20-cigarette pack, measured in US$ using the purchasing power parity (PPP) of 2019, is around $8 in Argentina and Mexico but is less than half that value in Brazil.

Table 2 shows daily smoking prevalence disaggregated by age groups. In Mexico, prevalence is mostly stable, at around 8.5 percent for adults aged 18–64 and 5.3 percent for people aged 65 and older. In Brazil and Argentina, the data show a different picture: within both countries, daily smoking is most prevalent in the age ranges of 25–44 and 45–64. Smoking prevalence among young adults of all three countries is lowest in Brazil, at 7.4 percent. Prevalence for those aged 25–44 in Brazil is 9.6 percent, and for those aged 45–64, it is 14.9 percent. In Argentina, daily smoking prevalence is the highest of the three countries for each age group, at 14 percent for the youngest group, 8.7 percent for the eldest group, and about 19 percent for the middle age groups.

Table 1

Descriptive statistics by country

	Mexico	Brazil	Argentina
Daily smoker	8.0%	10.4%	16.8%
Occasional and daily smoker	17.2%	15.1%	23.5%
Average age of daily smoking initiation	18.2	17.0	17.0
Highest level of education achieved			
• No formal education	16.8%	40.9%	7.3%
• Primary	18.9%	14.9%	35.4%
• Secondary	49.1%	31.1%	39.3%
• Tertiary and university	15.1%	13.1%	17.6%
Average age at survey	41	44	44
Price per pack (20 cigarettes) (US$ year of survey)	4.05	1.94	1.93
Price per pack (20 cigarettes) (PPP 2019)	8.58	3.45	7.73
Year of survey	2015	2013	2018
Number of observations	13,914	60,202	29,224

Source: Authors' elaboration based on the Global Adult Tobacco Survey (GATS) 2015 for Mexico, the National Health Survey (Pesquisa Nacional de Saúde, PNS) 2013 for Brazil, and the National Risk Factors Survey (Encuesta Nacional de Factores de Riesgo, ENFR) 2018 for Argentina. Data for Mexico are adjusted to consider only individuals who are over age 18, in order to be comparable with the Brazilian and Argentinian surveys.

Table 2

Daily smoking prevalence by age groups

Age groups	Mexico	Brazil	Argentina
18 to 24	8.29%	7.43%	14.01%
25 to 44	8.08%	9.59%	19.07%
45 to 64	8.63%	14.86%	19.58%
65 and older	5.29%	5.54%	8.71%

Source: Authors' elaboration based on the Global Adult Tobacco Survey (GATS) 2015 for Mexico, the National Health Survey (Pesquisa Nacional de Saúde, PNS) 2013 for Brazil, and the National Risk Factors Survey (Encuesta Nacional de Factores de Riesgo, ENFR) 2018 for Argentina

Table 3 shows how daily smoking prevalence varies with wealth. Here, wealth is defined as an index of household and socioeconomic characteristics.[6] In Brazil and Argentina, prevalence decreases with wealth, which means that daily smoking is associated with being poor. In contrast, daily smoking prevalence in Mexico increases with wealth, meaning that richer individuals smoke, on average, more than poorer ones. In Argentina almost 21 percent of those in the poorest wealth quartile smoke daily, compared to only 14 percent in the richest wealth quartile. The table shows a similar picture for Brazil. Almost 12 percent of the individuals in the poorest wealth quartile smoke daily, compared to only eight percent in the richest quartile. In Mexico, it is the other way around, with daily smokers accounting for six percent of the poorest wealth quartile and almost nine percent of the richest quartile.

Table 3

Daily smoking prevalence by wealth quartiles

Wealth quartiles	Mexico	Brazil	Argentina
4th quartile (richest)	8.92%	8.03%	13.84%
3rd quartile	9.07%	10.17%	15.82%
2nd quartile	7.82%	11.83%	16.43%
1st quartile (poorest)	6.41%	11.61%	20.94%

Source: Authors' elaboration based on the Global Adult Tobacco Survey (GATS) 2015 for Mexico, the National Health Survey (Pesquisa Nacional de Saúde, PNS) 2013 for Brazil, and the National Risk Factors Survey (Encuesta Nacional de Factores de Riesgo, ENFR) 2018 for Argentina

Smoking hazard

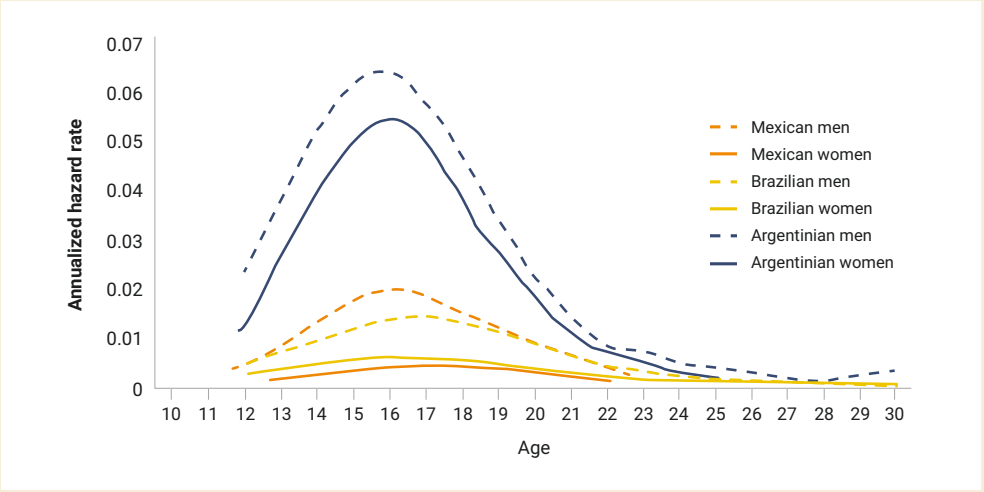
The risk of initiating daily smoking starts in pre-adolescence. In all three countries, people have a positive risk of initiating daily smoking from around age 12 or 13, and the risk is highest at age 17. Then the risk decreases until it is very low in a person's late 20s. In all cases, men are at a higher risk of smoking than women, but the differential varies by country.

Regarding the age of maximum risk, in Argentina and Mexico male teenagers between the ages of 16 and 17 have the highest risk of picking up a smoking habit, while for women this risk is highest at around 17 years old. However, when considering the age of earliest risk, in Mexico boys start smoking earlier than girls, at the age of 12, whereas girls start at around 13 years old. Meanwhile, in Argentina young girls start at roughly the same age as boys, at around 12 years old. In Brazil, teenagers of both genders start at the same age, but the risk for female teenagers peaks earlier, with the highest risk at 16 for young men and 17 for young women.

[6] See the individual country report [Franco-Churruarin & González-Rozada (2021, 2022a, 2022b)] for a detailed explanation of the construction of the wealth index.

Figure 3

Daily smoking initiation pattern, by gender and by country



Source: Authors' elaboration based on the Global Adult Tobacco Survey (GATS) 2015 for Mexico, the National Health Survey (Pesquisa Nacional de Saúde, PNS) 2013 for Brazil, and the National Risk Factors Survey (Encuesta Nacional de Factores de Riesgo, ENFR) 2018 for Argentina

Smoking prevalence

Table 4 shows a summary of the probit estimation results of smoking prevalence for the three countries. In all the countries, an increase in cigarette prices is associated with a decrease in daily smoking prevalence. In particular, prevalence price elasticity is negative, statistically significant, and less than one in absolute value, which suggests that if prices increase by a certain percentage, prevalence is reduced by less than that percentage.

An increase in prices of 10 percent is associated with a decrease of 4.1 percent in prevalence in Mexico, 2.6 percent in Brazil, and 1.1 percent in Argentina. In all three countries the coefficient on the gender (female=1) variable is negative and statistically significant, indicating that, on average, smoking prevalence is lower for women than for men. In Brazil, prevalence is negatively associated with wealth. This means that smoking prevalence diminishes as wealth increases. The opposite is true for Mexico.

Age is also an important determinant of smoking prevalence. For all three countries, prevalence is lower for the eldest age groups, but this effect is stronger for Argentina and Brazil than for Mexico. In Mexico, the age categories of 25–44 and 45–64 do not differ significantly from the base category, and prevalence is significantly lower in the age group of 65 and older. In Brazil and Argentina, prevalence is highest in the middle age categories.

Smoking onset

Table 5 shows a summary of the results of the estimation of the determinants of smoking onset in each of the analyzed countries. Smoking onset is defined as the time that elapses between the risk age of daily smoking and the age of starting. The duration component of the model is

Table 4

Estimation of daily smoking prevalence by country

	Mexico	Brazil	Argentina
Price of cigarettes (in logs)	-0.2129	-0.1374	-0.0605
	(0.042)***	(0.065)**	(0.144)
Gender	-0.5511	-0.2549	-0.1571
	(0.075)***	(0.015)***	(0.039)***
Wealth index	0.3309	-0.2746	-0.0012
	(0.144)**	0.043)***	(0.175)
Age categories			
(Base category: 18-24 years old)			
25-44 years old	0.0393	0.2039	0.2170
	(0.082)	(0.026)***	(0.065)***
45-64 years old	0.0734	0.4370	0.1654
	(0.098)	(0.028)***	(0.069)***
65 and over	-0.2088	-0.0084	-0.3346
	(0.106)*	(0.036)	(0.085)***
Labor categories	YES	YES	YES
Education categories	NO	NO	YES
Region-fixed effects	NO	NO	YES
Intercept	YES	YES	YES
Prevalence price elasticity	-0.4070	-0.2642	-0.1079
	(0.080)***	(0.1182)**	(0.017)***

*Source: Authors' elaboration based on the Global Adult Tobacco Survey (GATS) 2015 for Mexico, the National Health Survey (Pesquisa Nacional de Saúde, PNS) 2013 for Brazil, and the National Risk Factors Survey (Encuesta Nacional de Factores de Riesgo, ENFR) 2018 for Argentina. Standard errors in parentheses. Significance levels: * 10%, ** 5%, *** 1%*

presented in accelerated failure time format, and thus the estimated coefficients can be interpreted as regression coefficients for the logarithm of time until failure.

For an explanatory variable expressed in natural logarithms, the coefficient can be interpreted as an elasticity (see Forster & Jones, 2001). A positive coefficient indicates that higher values of the explanatory variable delay the initiation of smoking (that is, it increases the smoking onset duration). Onset elasticity is quite different between countries, but, regardless of the country, increasing retail cigarette prices delays daily smoking initiation.

In Mexico, onset elasticity is 1.6. This positive and statistically significant elasticity suggests that increasing prices by 10 percent delays the age of daily smoking initiation by almost 16 percent. The onset price elasticity implies that, at the average starting age of 18 years, an increase of 10 percent in prices is expected to delay the onset of daily smoking by one year and four months.

In Brazil, the elasticity coefficient is 3.55. At the average starting age of smoking (17 years old), a 10-percent price increase would delay daily smoking initiation by around two years and six months. Finally,

Table 5

Estimation of smoking onset elasticity by country

	Mexico	Brazil	Argentina
Price of cigarettes (in logs)	1.5982	3.5465	0.4973
	[0.211]***	[0.850]***	[0.250]*
Gender (female=1)	0.3445	0.1481	0.0224
	[0.161]**	[0.099]	[0.062]
Wealth index quartiles			
• 1st quartile (poorest)	0.0304	0.1196	-0.0603
	[0.195]	[0.126]	[0.097]
• 2nd quartile	0.0085	0.1440	0.0504
	[0.191]	[0.129]	[0.115]
• 3rd quartile (wealthiest)	0.0653	0.0123	-0.0234
	[0.188]	[0.168]	[0.120]
Residence (rural=1)	0.0244		
	[0.122]	NO	NO
Age categories	NO	YES	YES
Labor categories	YES	YES	YES
Education categories	YES	YES	YES
Intercept	3.1038	-13.9810	1.6651
	[0.768]***	[4.697]***	[1.281]
Shape	0.3275	0.3369	0.2385
	[0.018]***	[0.019]***	[0.014]***
Observations	5,988	21,534	7,450

*Source: Authors' elaboration based on the Global Adult Tobacco Survey (GATS) 2015 for Mexico, the National Health Survey (Pesquisa Nacional de Saúde, PNS) 2013 for Brazil, and the National Risk Factors Survey (Encuesta Nacional de Factores de Riesgo, ENFR) 2018 for Argentina. Price data are from INEGI (Mexico), IBGE (Brazil), Ministry of Agriculture, Livestock and Fisheries of the Nation of Argentina and INDEC (Argentina). Bootstrapped standard errors in brackets. Significance levels: * 10%, ** 5%, *** 1%*

in Argentina, the elasticity is 0.50, suggesting that a 10-percent increase in prices would delay smoking onset by five percent, which, at the average starting age, is around five months. Wealth does not show a significant effect on onset in any of the countries, after accounting for the effect of the price. In Mexico, rural residence does not have a significant effect either. Gender has a significant effect on onset in Mexico, but such an effect is not detected for Argentina nor Brazil.

5. Discussion

Results for the three Latin American countries show that increasing retail cigarette prices reduces the probability of smoking and delays the age at which people start daily smoking. Additionally, research consistently shows that delays in initiation lead to a lower probability of regular smoking. Therefore, a public policy of increasing excise taxes on cigarette consumption that leads to an increase in

prices is a relevant strategy to induce a reduction in the proportion of people that smoke daily, as well as to delay the age of starting daily smoking.

For Argentina, the authors found that increasing cigarette prices by 10 percent would reduce the probability of smoking by 1.1 percent. A 10-percent increase in cigarette prices would also delay smoking initiation age by around five months (from the mean starting age of 18). Since the duration data set includes all individuals who, at the time of the survey, were between 18 and 32 years old, this delay in smoking initiation applies mostly to young individuals that smoke daily. The data used in the estimation of the elasticity of smoking onset includes persons between 18 and 32 years old, which means this evidence shows that young smokers are sensitive to increases in cigarette prices. This finding suggests that increasing excise taxes on cigarette consumption could be an important public policy to delay smoking initiation in Argentina.

In Brazil a 10-percent increase in cigarette prices would induce a reduction of 2.6 percent in smoking prevalence and delay smoking initiation by almost two and a half years. Since the data set includes all individuals who, at the time of the survey were between 18 and 34 years old, this finding on smoking initiation applies mostly to young individuals.

Results of the prevalence and duration analyses suggest that cigarette prices in Mexico have a statistically significant effect on the probability of smoking daily and on the age of starting smoking. Increments in cigarette prices are associated with declines in smoking prevalence and could also delay daily smoking initiation. Increasing cigarette prices by 10 percent would induce a reduction in daily smoking probability of 4.1 percent. The price elasticity of smoking onset is estimated at 1.6, indicating that a 10-percent increase in the real retail price would delay the age of starting smoking daily by almost one year and four months.

In all three cases the sample used to estimate the smoking onset price elasticity includes young people less than 35 years old, which shows they are very sensitive to increasing cigarette prices.

The three countries have very different tax structures, implying that one should be careful in choosing the excise tax to increase. Argentina has a very complex tax structure on cigarette consumption. There are four federal taxes affecting cigarettes consumption: the additional emergency tax (IAE), the value added tax (VAT), the special tobacco fund (FET), and the internal tax (II). The tax base of each one is different, but almost all are ad valorem types of taxes. The ad valorem tax rate of the II is the excise tax that has the largest impact on prices; therefore this is the one rate to be increased (see González-Rozada, 2020).

In Brazil, at the time writing this report, there are four tobacco taxes charged at the federal level and one excise tax charged at the state level. The four federal taxes are: industrialized products tax (IPI), tax for Social Integration program financing (PIS), tax for Social Security financing (COFINS), and an import duty (II). The only subnational tax is the Merchandise and Service Circulation Tax (ICMS), which varies depending on the state. The general rule for the industrialized product tax is an ad valorem excise tax (for a more detailed description of the cigarette tax structure see Ribeiro & Pinto, 2019). The industrialized product tax is the fiscal policy instrument that most likely would induce an increment in cigarette prices across regions in Brazil.

In the case of Mexico, the total tax load in 2018 on the sale price of a pack of 20 cigarettes reached 67 percent, where 39.6 percentage points are from the ad valorem tax, another 13.4 points are added as a specific component; and finally, the VAT completes the charge on the consumption with 13.8 percent of the total (ETHOS, 2019). In 2019, the Mexican government approved the Economic Package, which included a series of tax reforms, with one of them being a modification to the special tax (Impuesto Especial sobre Producción y Servicios, IEPS, or special tax on products and services) on tobacco products. This tax has an ad-valorem component of 160% of the manufacturing price and a specific component that, from 2011 to 2019, accounted for MX$ 0.35 per cigarette. In 2020, this component was updated for inflation and raised to MX$ 0.4944 per cigarette.

6. Conclusion

In this policy report, the authors estimate the impact of increasing cigarette prices on daily smoking prevalence and on the age of starting smoking in Argentina, Brazil, and Mexico. The empirical evidence presented suggests that an increase in cigarette prices is associated with a decrease in daily smoking prevalence and a delay in the starting age of smoking in all three countries.

The addictive nature of tobacco products is at the center of many health problems, and adolescence is a key phase in which addiction might develop. The evidence presented in this report suggests that increases in cigarette prices are, on average and in the three countries, linked to a delay in the development of the habit of daily smoking. These delays in initiation are known to mitigate the probability that an individual will become a regular smoker, which, in turn, is expected to improve health outcomes over the life course. A policy of increasing excise taxes with the objective of increasing cigarette prices could be very effective to delay smoking initiation and ultimately lead to healthier populations.

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