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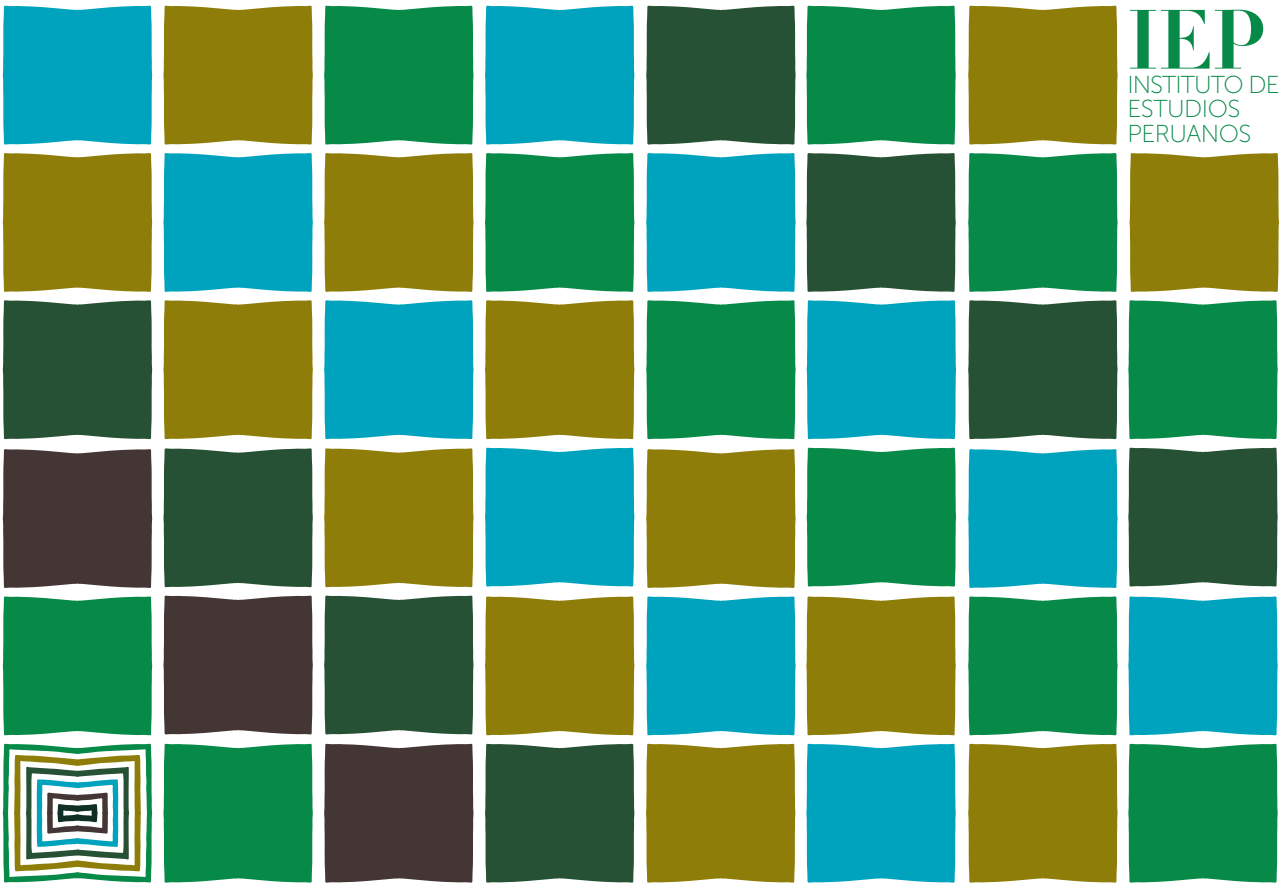
COST-BENEFIT ANALYSIS OF TOBACCO CONSUMPTION IN PERU



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Key Messages

1. Increasing tobacco taxes is pro-poor in the short-term: Increasing the Special Consumption Tax (SCT) on tobacco products reduces spending on cigarettes among the poor. A 10% increase in cigarette prices, as a result of tobacco tax increases, would save low- and middle-income groups a total of 3.3 million soles per year, just by reducing cigarette consumption.
2. Increasing tobacco taxes is pro-poor in the medium- and long-term as well. Reduced consumption translates into lower medical expenses for tobacco-related illness and increases in income as result of the reduction in premature death associated with tobacco use.
3. Combining the short-, medium-, and long-term savings from reduced tobacco consumption, a tax increase would be beneficial for all income groups, but especially the poor.

1

Introduction

The purpose of this study is to estimate the distributive effects of tobacco tax increases using the extended cost-benefit analysis developed by Fuchs and Meneses (2017), which, in addition to the direct, short-term effects associated with decreased cigarette use, incorporates medium-and long-term effects of reduced cigarette smoking in terms of avoided medical expenses and increase in working years.

An argument against increasing cigarette taxes is that is has a negative impact on low-income people, and is thus, regressive[1]. This argument, however, involves two faulty assumptions: 1) population sensitivity to price changes is the same regardless of income level; and 2) price increases on cigarettes only result in less spending due to reduced consumption. By separately examining impacts by income group and including other medium- and long-term impacts, an extended cost-benefit analysis offers a more complete analysis of impacts of price increases through increasing tobacco taxes.

In this study, a distributive analysis of a cigarette price increase associated to excise tobacco tax increases is evaluated by estimating specific responses of each income group, considering short-term effects on tobacco consumption and medium- and long-term effects associated with smoking. This will be done by taking into account three types of effects that stem from an increase in cigarette

1. A tax is progressive when the tax pressure falls on the part of the population with the highest incomes. It is regressive when the tax pressure falls on the lowest-income population, creating greater inequality.

prices: i) spending on tobacco; ii) reductions in smoking-related medical expenses; and iii) increased income resulting from gains in years of employability.

This study uses the National Family Budget Survey (*Encuesta Nacional de Presupuestos Familiares,* ENAPREF (2009)), which allows estimation of the price elasticity of tobacco consumption by income group, the main input into the simulation of the distributive effects of tobacco tax increases. Information is also used from prior studies that have estimated the burden of disease from tobacco use and the economic costs of years of life lost, which are inputs into the calculation of medium- and long-term impacts.

This report is structured as follows: The second section presents the current structure of tobacco taxation in Peru and its most recent modifications. The third section describes the survey used for the estimation of elasticity and explains the sample limitations. The fourth section explains the model used to estimate price elasticity of demand for cigarettes and the results of the estimations. The fifth section presents the extended cost-benefit analysis and simulates a 10% increase in cigarette prices as a result of increasing excise taxes. Finally, the results and policy recommendations are presented.

2

Context

According to the Institute for Clinical Effectiveness and Health Policy (Bardach *et al*, 2016), the use of tobacco products in Peru constitutes a serious public health problem, causing around 17,000 deaths a year as well as more than 15,000 cardiac and cerebral-vascular events, and around 50,000 caused by chronic obstructive pulmonary disease. According to figures from the National Commission for Development and Life Without Drugs (DEVIDA, 2012), approximately 800,000 Peruvians begin using tobacco products each year, starting at around age 13.

According to Bardach *et al* (2016), health care costs directly attributable to tobacco use in Peru are approximately US$ 848 million a year. Tax collection from tobacco products, however, is US$ 77 million a year, less than 10% of the cost of tobacco-related government-funded health care. These disproportionate figures reveal the extremely high smoking-related externalities in Peru's economy, which are not adequately covered by tax revenues.

This section briefly describes the context in which this study was conducted. First, the regulatory framework for tobacco control is presented, summarizing the main policies adopted by the Peruvian Congress. The tax framework is then described, detailing the main taxes on tobacco and changes in recent years, which led to a significant increase in the tax burden through the use of specific taxes.

Regulatory framework for control of tobacco consumption

The Framework Convention on Tobacco Control (FCTC) is the first international public health treaty sponsored by the World Health Organization (WHO). Peru participated actively in the drafting and negotiation of the FCTC and adopted it in May 2003. It was subsequently approved by Congress through Legislative Resolution Nº 28280, in July 2004.

The FCTC took effect internationally in February 2005, and in April 2006, the Peruvian Congress enacted Law Nº 28.705, "General Law for Prevention and Control of the Risks of Tobacco Consumption," which establishes restrictive measures against exposure to tobacco smoke;[2] requires establishments to publicize the smoking ban;[3] regulates advertising on cigarette packs[4] and in places where cigarettes are sold; and establishes measures that regulate tobacco-related advertising, among other things. The enabling regulations for the law were later approved by Supreme Decree Nº 015-2008-SA on 5 July 2008.

In April 2010, Congress enacted Law Nº 29.517, which modifies Law Nº 28.705 to bring it into line with the FCTC. With the promulgation of Supreme Decree Nº 001-2011-SA, new regulations were established that prohibited cigarette smoking in health or education establishments, public offices, and in the interior of enclosed public spaces as well as in workplaces and public transport. Since April 2011, therefore, all enclosed public spaces have been smoke-free. The law also established that 50% of the main surfaces of cigarette packs have warning phrases and images. This modification of the law included a prohibition on the sale of cigarette packs containing fewer than 10 cigarettes.

Tax framework for tobacco

In the ongoing process of FCTC compliance to promote public health, Peru has made significant progress in the use of taxation to reduce tobacco consumption. Extensive studies and reports indicate that increasing taxes is the most cost-effective policy for reducing consumption (WHO, 2011; Jha and Chaloupka, 1999).

The tax framework for cigarettes is simple and consists of three types of taxes: the General Sales Tax (*Impuesto General a las Ventas*, IGV), the Special Consumption Tax (*Impuesto Selectivo al Consumo*, SCT) and tariffs.[5]

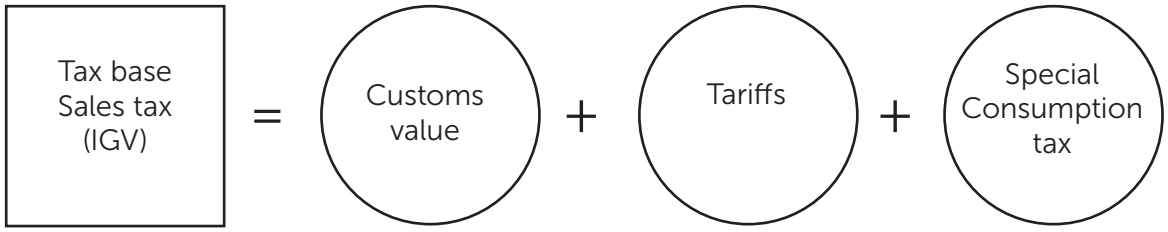
i. General Sales Tax (*Impuesto General a las Ventas, IGV*): These taxes apply on all phases of the production and distribution cycle. This tax is to be assumed by the consumer and is usually included in the retail price.[6] The current IGV rate

2. The law gives owners of public places the option to allow tobacco use in designated smoking areas.
3. Requires signs displayed in a visible place that read: "Smoking is prohibited in public places like this, according to Law Nº___" and "Smoking is hazardous to health; smoke also harms non-smokers" (Article 3, Law Nº 28705).
4. At least 50% of the main faces of all types of packs or packaging of tobacco products must bear printed warning phrases or images about the harm to health caused by smoking (Article 7, Law Nº 28.705). The use of terms such as "light," "smooth," and other synonyms is also prohibited (Article 8, Law Nº 28.705) and additional information about the nicotine and tar content must be included (Article 9, Law Nº 28.705).
5. In general, the tax base for application of IGV to imports is the Customs Value plus tariffs (specific and *ad-valorem*), plus the tariff surcharge and the Special Consumption Tax (*Impuesto Selectivo al Consumo*, SCT).
6. http://orientacion.sunat.gob.pe/index.php/empresas-menu/impuesto-general-a-las-ventas-y-selectivo-al-consumo/

is 18%, which includes a 2% Municipal Promotion Tax (*Impuesto de Promoción Municipal*, IPM). The IGV is a non-cumulative tax in that it taxes only the value added at each stage of the economic cycle, deducting the tax applied in preceding stages. In Peru, the import of goods is taxed with the IGV.

The IGV tax base for imports consists of the "Customs Value" plus tariffs (specific and *ad-valorem*) and other taxes that affect imports, except for the IGV. The Customs Value consists of the merchandise value, shipping, insurance, and corresponding adjustments, and is determined according to the procedures and methods of the WTO Valuation Agreement. The "Customs Value" is determined by the Transaction Value of imported merchandise method.

Figure 1
IGV tax base for tobacco



ii. Special Consumption Tax (*Impuesto Selectivo al Consumo*,[7] *SCT)*: The purpose of this tax is mainly to discourage the use of products that generate negative externalities for society, such as tobacco. The cigarette tax currently is specific, without differentiation by product. This was recently modified with Supreme Decree Nº 092-2018-EF (May 2018) and currently amounts to S/. 0.27 per cigarette.

iii. *Tariffs*[8]: This is an import tax that currently amounts to 6% of the "Customs Value", determined by the Transaction Value of imported merchandise method.

Peru has not produced cigarettes since 2005, mainly because of the closure of the British American Tobacco factory. National tobacco consumption therefore comes solely from imports. The existence of free trade agreements with Chile, Colombia, and Ecuador, where about 98% of the cigarette imports originate[9] make this tax relatively unimportant for tax policy.

impuesto-general-a-las-ventas-igv-empresas; http://orientacion.sunat.gob.pe/index.php/empresas-menu/impuesto-general-a-las-ventas-y-selectivo-al-consumo/impuesto-general-a-las-ventas-igv-empresas/3109-05-calculo-del-impuesto

7. http://orientacion.sunat.gob.pe/index.php/empresas-menu/impuesto-general-a-las-ventas-y-selectivo-al-consumo/impuesto-selectivo-al-consumo-empresas;http://orientacion.sunat.gob.pe/index.php/empresas-menu/impuesto-general-a-las-ventas-y-selectivo-al-consumo/impuesto-selectivo-al-consumo-empresas/3119-05-calculo-del-impuesto-isc

8. http://www.sunat.gob.pe/legislacion/procedim/normasadua/gja-04/ctrlCambios/anexos/DS342-2016-EF.pdf;http://www.aduanet.gob.pe/itarancel/arancelS01Alias

9. The information corresponds to the period from January 2012–March 2018, published by SUNAT.

According to article 61 of the General Sales Tax and Special Consumption Tax Law, the rates and/or fixed amounts of taxes can be modified by Supreme Decree[10] with the support of the Ministry of Economy and Finance, which makes it relatively easy to use this mechanism to adjust cigarette prices.

Among these taxes the SCT is the most powerful tool for impacting prices, because of its flexibility and, because it is easy to change. Since the early 1990s in Peru, most of the tools available for developing cigarette tax policy have been used (COLAT, 2014), particularly the SCT. Since January 2010, a consistent tax policy has been in development, with a fixed special consumption tax undifferentiated by product. The following table shows the recent changes in tax law:

Table 1
Evolution of the tobacco SCT

Legal basis	Date	Amount
DS Nº 004-2010-EF	January 2010	S/. 0.07 per unit
DS Nº 112-2016-EF	May 2016	S/. 0.18 per unit
DS Nº 092-2018-EF	May 2018	S/. 0.27 per unit

Note: The tax as of May 2018 was S/. 3.27. The current tax is equivalent to US$ 1.65 per pack of 20 cigarettes.

With the most recent changes in tax law, the average tax burden on cigarettes is 60% of the retail price, taking as a reference the average price of cigarettes in Peru[11] (S/. 12 per packet of 20 cigarettes). The following table shows the average tax burden per brand:

Table 2
Tax structure

	Pall Mall	Hamilton	Lucky Strike
Market Share	28%	26%	32%
Average price	S/10,0	S/12,0	S/16,0
-Selective Consumption Tax (ISC)	S/.5,4	S/.5,4	S/.5,4
-Sales Tax (IGV	)S/1,5	S/.1,8	S/2,4
Price without taxes	S/.3,1	S/4,8	S/.8,2
Tax burden	69%	60%	49%

Note: The prices correspond to the brands most sold in supermarkets, according to figures from EUROMONITOR as of 2017.
Source: EUROMONITOR (market share), SUNAT (tax structure), PlazaVea (average prices).

As the above table shows, for an average cigarette brand like Hamilton – which, although not the most popular brand, represents the average retail price in the cigarette market — the average tax burden is 60% and is equivalent to an average of S/. 7.2 per packet of 20 cigarettes. Of this amount, 75% comes from the SCT and 25% from the IGV.

3

For the study of demand, the National Family Budget Survey (*Encuesta Nacional de Presupuestos Familiares*, ENAPREF (2019)) was used. The purpose of the survey is to determine the consumption structure of households, based on the use of income in the acquisition of goods and services that make up the family basket. The population studied by the ENAPREF consists of habitual residents of the households.

The survey uses a probabilistic area sample that is stratified (to make it more representative), two-step and independent in each department, attaining inference levels nationwide, by main cities and departmental capitals, and by natural region (Coast, Andean Highlands and Amazon Basin). The survey was applied to slightly more than 35,000 households in 385 districts (of a total of 1,835 districts nationwide).

For spending, the survey includes two distinct and complementary modules, one for household spending and one for daily personal spending. Both modules include information about spending on cigarettes and the number of cigarettes consumed in the week prior to the survey, based on daily information by product.

In this study, both modules are used to obtain total household spending, total household spending on cigarettes, and spending on cigarettes as a percentage of total household spending. From total spending on cigarettes and the number of cigarettes purchased, the unit value paid at the household level is obtained. At the same time, modules for individual income and household characteristics are used to obtain control variables.

The survey does not identify the cigarette consumer; it only identifies what is purchased, given the possibility that one member of the household may purchase

cigarettes for other household members. As a result, it is only possible to identify the households in which there is at least one smoker, not individual smokers.

The ENAPREF presented several challenges. One was related to problems in identifying the presentation of the cigarettes (unit, pack of five, pack of 10 or pack of 20 cigarettes). Using the unit value, the study identified and corrected various reporting errors, taking into account the average price of cigarettes in 2009; the brand of the cigarette pack purchased; the region in which it was purchased; and the point of purchase (supermarket, shop, bar, kiosk, etc.). Outliers were also identified in the proportion of spending on cigarettes; these were eliminated from the sample. Finally, not all households reported income in the survey reference period. One percent of households that had at least one smoker did not report income. These households were excluded from the sample.

Of the slightly more than 35,000 households surveyed, 11% have at least one member who consumes cigarettes; that proportion is significantly lower in lower-income groups. The average number of cigarettes consumed is 18 a week per smoking household, a figure that increases with income group (the poorest tercile smokes 12 cigarettes, while the intermediate smokes 16 and the wealthiest smokes 23 cigarettes). Average weekly household spending on cigarettes was approximately S/. 3.8. The unit value paid per income group increases with the wealth of the group of households.

In the group of households with at least one smoker, approximately 20% of households have a female head of household; the average age of the head of household is 49 years; and the average size of the household is five members, of whom 75% are over age 14. In addition, 96% of the households are in rural areas; 61% of the heads of households with at least one smoker have completed secondary education; and 27% have completed post-secondary studies higher education. On average, 18 cigarettes are smoked weekly in these households with an average of S/. 4.00 expenditure on weekly cigarette consumption.

Table 3
Household characteristics (ENAPREF)

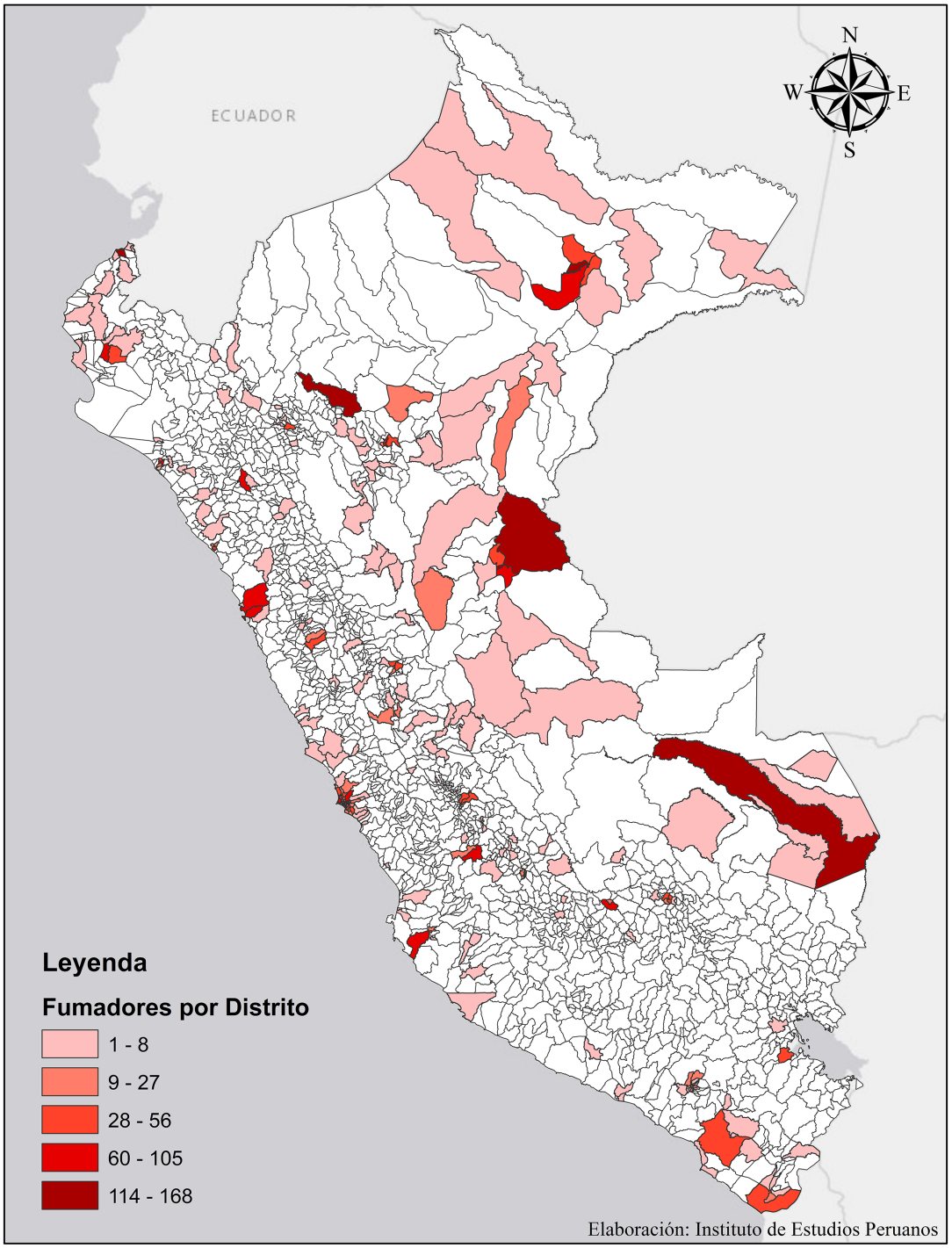
	First Tercile	Second Tercile	Third Tercile	Average
Smoking households (%)	7.7	10.6	14.2	10.8
Number of cigarettes consumed weekly per household	11.6	15.6	22.8	17.8
Weekly spending on cigarettes	2.1	3.2	5.1	3.8
Proportion of people over age 14	0.64	0.73	0.82	0.75
Age of head of household	47	49	50	49
Proportion of female heads of household	0.18	0.20	0.22	0.20
Proportion of heads of household without education	0.40	0.56	0.80	0.61
Proportion of heads of household with higher education	0.06	0.19	0.44	0.27
Proportion of households in rural area	0.09	0.03	0.01	0.04

Compiled by: Institute of Peruvian Studies
Source: ENAPREF

The map shows the high degree of concentration of smokers in a few geographic units (districts). The total sample was collected in 385 districts, in which 249 (65%) have at least one smoking household with 70 percent of all smoking households located in 44 districts (17% of all districts). In 99 districts (40% of districts with at least one smoking household), only one or two households have at least one smoker; these households represent only 3.3% of all smoking households.

Figure 2

Geographic distribution of the sample of districts reporting cigarette purchases



4

Methodology

To calculate the distributive effects of a tobacco tax increase in different areas that affect society using extended cost-benefit analysis, elasticities of demand for cigarettes by spending terciles is used.

Consistent and unbiased estimation of sensitivity to price variation is necessary for effective excise tax policy making (Gruber, 2016). Tax policies on tobacco can be used as instruments to improve the welfare of the population through a change in smoking-related behavior (Chetty, 2015) or to generate increased collection of tax revenue by the state.

Based on price elasticity, a special tax on tobacco could reduce consumption, with a positive effect on public health. This could lead to modifications in health spending as a result of a reduction in smoking-related illness. The decrease in illness, in turn, will increase participation in the work force due to increased life expectancy and decreased workplace absenteeism (Fuchs, 2019).

Different income groups have different elasticities. Tax policy recommendations may have redistributive effects depending on the elasticities of each group, even though the same tax rate applies to the entire population.

To study demand for cigarettes, this study uses the two-part model described by Jones (1989), Hu *et al* (1995) and Kidane *et al* (2015) for cigarette consumption. This type of model assumes that cigarette distribution is bimodal, and therefore examines separately the decision to smoke (smoking prevalence) and the decision about the number of cigarettes to smoke (smoking intensity). The first part models

the decision to smoke using the entire sample. The second part only includes the sample of smokers. These two types of elasticities have different concepts and model two types of behaviors, which are added to obtain the total elasticity. The following is a brief description of each model independently.

Part I: Prevalence elasticity or elasticity at the extensive margin

Prevalence elasticity shows the proportional change in the probability of smoking cigarettes given a proportional change in prices. In general, the prevalence equation that models the decision to smoke is defined as follows:

$$D_{hc} = \alpha + \delta luvcig_{hc} + \beta lnx_{hc} + \gamma Z_{hc} + \eta F_{hc} + f_c, + u_{hc} \qquad (1)$$

Where D_{hc} is a dichotomous variable that takes a value of one if the household h has at least one smoker and zero if the household has no smokers; $luvcig_{hc}$, represents the unit value expressed in logarithms; lnx_{hc}, is total household spending in the reference period; Z_{hc}, represents a series of socio-demographic characteristics of the household (for example, proportion of minor and adult women or educational level of the head of household); F_{hc}, is a series of risk factors associated with smoking (for example, alcohol consumption, level of physical activity, body mass index, recreational activities, etc.); and f_c is the fixed cluster effect.

Equation (1) is estimated using discrete choice models[12] that estimate the conditional probability of smoking. Estimation of equation (1) requires information about the unit value for the entire sample. Non-smokers, however, are not exposed to such unit values, and therefore no information exists for this part of the sample. To resolve the lack of information in non-smoking households, an average cluster price can be assigned, or secondary information about the average price to which households in each cluster have been exposed can be used. Following Hu (1995), prevalence elasticity is estimated as the marginal effect of prices on the probability of smoking.

Part II: Conditional elasticity or elasticity at the intensive margin

Conditional elasticity shows the proportional change in the number of cigarettes consumed given a proportional change in price. Conditional elasticity can be estimated using Ordinary Least Squares (OLS) or by using the Generalized Linear Model (GLM) on the part of the sample that reports consuming cigarettes. Although some authors have developed two-part models using OLS or GLM models for estimation of conditional elasticity (Hu *et al*, 1995; Kidane *et al*, 2015, Tauras, 2005), these estimations are not without problems: (i) problems of identification or endogeneity; (ii) absence of real prices; and (iii) heterogeneity of cigarette quality.

12. Prevalence elasticity can be estimated with probabilistic or logistic discrete choice models (Cragg, 1971).

This study uses the Deaton model (1988)[13] to estimate conditional elasticity in order to resolve the aforementioned problems. As noted above, another problem for analysis of demand, given price variations, is the problem of identification. Although theory states that, *ceteris paribus*, price variations cause variations in the quantity consumed, in fact this can go both ways. There could also be other factors that affect price and demand. In econometrics, this is known as a problem of endogeneity or of identification, and it produces biased results. To address this problem, Deaton (1988) assumes that the price of goods varies significantly between clusters (spatial variation) for exogenous reasons (for example, different transportation costs, or different taxes, etc.). This implies that the price difference between clusters is not affected by demand and can therefore be used as an instrument for identifying the price elasticity of the model.

Another contribution of the model is that, although households do not report the market price in the survey, this can be inferred from decisions about purchases by calculating the ratio between spending and the amount of the good acquired. This ratio is called the 'unit value' and differs from the market price in that the latter is affected by the quality of the good and by measurement error.[14] Deaton develops a model in which this problem is resolved by modeling quality based on spending.

With these assumptions, the equations proposed by Deaton (1988) are defined below:

$$luvcig_{hc} = \alpha^1 + \beta^1 lnx_{hc} + \gamma^1 Z_{hc} + \varphi ln\pi_{hc} + u^1_{hc} \quad (2)$$

$$wcig_{hc} = \alpha^0 + \beta^0 lnx_{hc} + \gamma^0 Z_{hc} + \theta ln\pi_{hc} + f_c + u^0_{hc} \quad (3)$$

Equation (2) models the unit value $luvsig_{hc}$ faced by household h and cluster c, while equation (3) models the proportion of spending on cigarettes $wcig_{hc}$. The variable lnx is total household spending during the reference period, and Z is household characteristics (for example, proportion of minor and adult women or educational level of the head of household), $ln\pi$ is the real non-observable price, and f_c is the fixed cluster effect.

Equation (2) evaluates the presence of the quality effect. A positive and statistically significant relationship between household spending and unit value, controlling for household characteristics, suggests the presence quality effects, which will be used to correct the price elasticity. Note that cluster fixed effects are not included in equation (2) because that would break the relationship between non-observable prices and unit value, making it difficult to recover the parameters of the model for correction of the elasticity. The Deaton model assumes that there is no intra-cluster variation in prices, given that all households face the same price.

13. It should be noted that Deaton (1988) originally includes the entire sample (smokers and non-smokers), including zeroes in the data associated with cigarette purchases for non-smoking households.

14. Measurement errors occur because in the survey, households may erroneously report the measures of quantity that will be transmitted to the unit value.

Equation (3) is a typical demand equation, in which the proportion of spending on cigarettes is explained by income (approximated by spending), some household characteristics, and prices.

Given that the prices are not observable, when estimating the two equations, the effect of price will be found in the error terms of the equations. Price elasticity is estimated as follows:

$$E_{Deaton} = \left(\frac{\theta}{\overline{w}}\right) - \varphi \tag{4}$$

Notwithstanding, coefficients θ and φ are estimated from the residuals of the estimation of equations (2) and (3):

$$\widehat{y_c^1} = \frac{1}{n_c}\sum_{h=1}^{n_c}\alpha^1 + \varphi ln\pi_{hc} + u_{hc}^1 \tag{5}$$

$$\widehat{y_c^0} = \frac{1}{n_c}\sum_{h=1}^{n_c}\alpha^0 + \theta ln\pi_{hc} + f_c + u_{hc}^0 \tag{6}$$

Because elasticity is estimated using household responses at the district level, equations (5) and (6) are based on cluster averages. n_c is the number of households with at least one smoker in a district.

If $\varnothing = \dfrac{\partial wcig / \partial ln\pi}{\partial luvcig / \partial ln\pi} = \dfrac{\theta}{\varphi}$, then

$$\varnothing = \frac{Cov(\widehat{y_c^1}, \widehat{y_c^0}) - \dfrac{\sigma_{10}}{n_c}}{Var\left(\widehat{y_c^1}\right) - \dfrac{\sigma_{11}}{n_c}} = \frac{\theta}{\varphi} \tag{7}$$

The terms $\frac{\sigma_{10}}{n_c}$ and $\frac{\sigma_{11}}{n_c}$ are included to correct the measurement errors discussed above. Where σ_{10} represents the covariance of the residuals of the estimations of equations (2) and (3), and σ_{11}, the variance of the residuals of equation (2). Deaton models quality and obtains the parameter φ based on the estimated parameters:

$$\varphi = 1 - \frac{\hat{\beta}^1\left(\overline{w} - \hat{\theta}\right)}{\hat{\beta}^0 + \overline{w}} \tag{8}$$

Replacing (8) in (7), $\hat{\varnothing}$ is obtained as follows:

$$\hat{\varnothing} = \frac{\theta}{1 - \frac{\hat{\beta}^1 \left(\overline{w} - \hat{\theta} \right)}{\hat{\beta}^0 + \overline{w}}} \tag{9}$$

Next θ is obtained based on the estimated parameters:

$$\theta = \frac{\hat{\varnothing}}{1 + \frac{\hat{\beta}^1 \left(\overline{w} - \varnothing \right)}{\hat{\beta}^0 + \overline{w}\left(1 - \hat{\beta}^1 \right)}} \tag{10}$$

Parameter θ is replaced in equation (4), along with the information from equation (8) and price elasticity is obtained, including corrections for quality. The standard errors of the estimation of price elasticity are obtained using bootstrapping.

Total elasticity

Hu *et al* (1995) and Jones (1989) mention that the decision to smoke (prevalence elasticity) is different from the number of cigarettes consumed by smokers (conditional elasticity); therefore, in order to estimate elasticity for the entire population, the two types of elasticity must be summed, assuming that their error terms in the calculation of both elasticities are independent.

$$E_{total} = E_{prevalencia} + E_{Deaton} \tag{11}$$

The standard error of total price elasticity of demand for cigarettes is given by (Kidane, 2015):

$$s_n = \sqrt{\left(1 - \overline{CS}\right)^2 \left(s_{\alpha_1}{}^2 \right) + \left(\alpha_1 \right)^2 \left(s_{\overline{cs}}{}^2 \right) + \left(s_{\alpha_1}{}^2 \right) \left(s_{\overline{cs}}{}^2 \right) + \left(s_{\alpha_2}{}^2 \right)} \tag{12}$$

Where $s_{\alpha_1}, s_{\alpha_2}$ and $s_{\overline{cs}}$ represent the standard errors of prevalence elasticity, conditional elasticity and probability of smoking, respectively.

5

Results

In this section, the results of the estimations of the price elasticity of cigarettes are presented and compared with the same calculation for Latin America and previous results for Peru.

Part I: Prevalence elasticity or elasticity at the extensive margin

To estimate the probability of smoking, unit value is used to represent the price* to which smoking households are exposed. For non-smoking households, an average price is assigned, using the mean of the unit values per spending tercile and district (cluster) of smoking households. Although the way of imputing unreported unit values has its limitations,[15] this method provides a good approximation to the price to which smoking and non-smoking households are exposed.

15. One important limitation is that not all households in a cluster space-income group face the same price. In principle, smokers do not necessarily smoke in the district in which they live. According to the CAF (2017), in Peru 25% of workers in Lima take more than two hours to reach their workplace, which suggests that habitual smokers smoke outside of their district and may be exposed to prices other than the price where they live. Another important limitation involves the number of observations of smokers in each cluster. With very few observations, it is very likely that the average price measurement error may be high. To estimate prevalence elasticity, therefore, districts that had fewer than two observations with smokers were eliminated.

It is also important to consider that the ENAPREF does not include questions that make it possible to collect risk factors associated with tobacco consumption (for example, consumption of complementary products, such as alcohol, physical characteristics such as body mass index, or behavioral variables, such as exercise or recreation, among others). The absence of these controls may overestimate prevalence elasticity (Hu *et al*, 1995).

Table 4
Probit estimation

Variables	Probability (Purchases cigarettes=1)
log (price*)	-0.266**
	(0.1140)
log (total spending per capita)	0.379***
	(0.0355)
Controls of household characteristics	yes
Controls of characteristics of head of household	yes
Observations	32,028

Compiled by: Institute of Peruvian Studies
Source: ENAPREF
Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

The results show a statistically significant relationship between the price* of cigarettes and the probability of purchasing them, which results in a prevalence elasticity of -.493. These results could be overestimates because of the absence of controls associated with risk factors of smoking. The results are similar to those found by other authors, such as Hu *et al* (1995), who find a prevalence elasticity of -0.54 (without including risk factors) and of -0.33 (including risk factors) in a sample of adults in California.

For the estimation of prevalence elasticity by spending groups, the sample was divided into terciles and the estimation in equation (1) was repeated.[16] Table 5 shows that the prevalence elasticity is much higher and statistically significant among lower-income households (first tercile), while in the higher-income households (second and third terciles) it is lower with low statistical significance.

16. The imputation of prices for non-smokers was done in a general way without considering spending terciles.

Table 5
Prevalence elasticity

Terciles	Elasticity Prevalence
Average	-0.493**
	(0.209)
First tercile	-0.699***
	(0.267)
Second tercile	-0.256
	(0.205)
Third tercile	-0.294*
	(0.160)

Compiled by: Institute of Peruvian Studies
Source: ENAPREF
Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Part II: Elasticity at the intensive margin

A basic assumption in the estimation of price elasticity according to the Deaton (1988) model is spatial variation in prices, which is used to resolve the problem of identification in the estimation of demand for cigarettes. To verify the statistical weight and significance of the spatial variation in prices, a variance analysis (ANOVA) is performed. The results of the ANOVA show that the spatial variation in prices is statistically significant, but it only explains 25% of the total price variation in the sample. The lack of spatial variability in prices could be due to the concentration of the smoking population in just a few districts and the large number of districts with very few observations, which could also be affected by the fact that cigarette consumption does not necessarily occur in the smokers' place of residence, but in the places where they work or engage in recreational activities.

First stage of estimation of elasticity, according to Deaton

As mentioned in the theoretical framework, in the first stage, equations (2) and (3) are estimated to obtain the remainders, variances, and covariances used in the next stage to estimate elasticities. Table 6 shows the results of the partial conditional estimations (only within the sample of smokers), which will provide inputs for estimating the price elasticity. The first column (1) belongs to the estimation related to the unit value and the second column (2) to the estimation related to the proportion of spending on cigarettes. In both cases, the parameter associated with the logarithm of total spending is statistically significant and has the expected sign. This parameter is used for the estimation of the price elasticity of demand for cigarettes in the second stage.

Table 6

Estimation of the first stage equations

VARIABLES	(1) *luvcig*	(2) *Wcig*
log (total spending per capita)	0.0456***	-0.0025***
	(0.0095)	(0.0022)
Household size	0.0033	-0.0006***
	(0.0035)	(0.0000)
Controls of household characteristics	yes	yes
Controls of characteristics of head of household	yes	yes
Other controls	yes	yes
Controls for fixed effects of location	yes	yes
Observations	3,351	3,351
R2	0.3545	0.2683

Compiled by: Institute of Peruvian Studies
Source: ENAPREF
Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

The control variables related to household characteristics that are used in the model are: proportion of women; proportion of men; proportion of members with higher education; proportion of members with secondary education; proportion of members of working age; highest level of education reached by any member; and geographical location of the household. Two parameters are significant at 5%: the parameter of proportion of women in the household for the estimation related to unit value, and the parameter of the proportion of members of working age. The control variables related to characteristics of the head of household are: age; gender (woman=1); educational level (without education, primary, secondary and higher); and working status. The gender parameter is significant for the estimation associated with unit value, and age is significant for the estimation related to the proportion of spending on cigarettes. In addition, control variables are used that represent the quarter in which the survey was conducted.

Second stage of the estimation of elasticity, according to Deaton

The second stage of the estimation uses the parameter of the logarithm of total spending; the variances and covariances of the errors; and the remainder from both estimations to obtain a price elasticity of demand of -0.992. Breaking down the sample by terciles of total spending per capita, the elasticities are progressive and statistically significant; that is, they are higher among lower-income households.

Table 7
Deaton elasticity, by terciles

Terciles	Elasticity Demand
Average	-0.992***
	(0.040)
First tercile	-1.024***
	(0.050)
Second tercile	-0.866***
	(0.119)
Third tercile	-0.556**
	(0.231)

Compiled by: Institute of Peruvian Studies
Source: ENAPREF
Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Although these results show a high sensitivity to prices, they are not unlike those found for Peru in a similar study by González-Rozada and Ramos-Carbajales (2016), in which the price elasticity of consumption of cigarettes is estimated at -0.738. The authors apply the Deaton model to estimate conditional price elasticity using the ENAPREF as a source of data. Although the results are relatively similar, there are two key methodological differences: First, in equation (3), the authors use the amount of cigarettes consumed instead of using the proportion of spending on cigarettes, which could create distortions in the analysis of quality. Second, the authors use only the individual expenses module without incorporating the household expenses module, which implies that the proposed elasticity responds only to individual purchases and not to total household purchases.

Like the results for prevalence elasticity, conditional elasticity results show a high level of progressivity. The conditional elasticity in the lowest-income group is -1.005, almost twice as sensitive as the highest-income group (-0.556). These results contradict the findings of González-Rozada and Ramos-Carbajales (2016), who conclude that "the poorest families do not react more to price changes than the wealthiest families, which means that an increase in tobacco prices could have a regressive effect."

Total price elasticity and discussion of results

Total elasticity is the sum of prevalence elasticity and conditional elasticity if it is assumed that the error terms of the elasticities are independent (Jones 1989; Hu et al 1995; Jimenez-Ruiz *et al* 2007). Table 8 shows the average total price elasticity and price elasticity by spending terciles.

Table 8

Elasticities by spending terciles

Tercile	Elasticity		
	Prevalence	Consumption	Total
Average	-0.493**	-0.992***	-1.485***
	(0.209)	(0.040)	(0.192)
First	-0.699***	-1.024***	-1.722***
	(0.267)	(0.049)	(0.253)
Second	-0.256	-0.866***	-1.122**
	(0.205)	(0.119)	(0.221)
Third	-0.294*	-0.556**	-0.850**
	(0.160)	(0.231)	(0.268)

Compiled by: Institute of Peruvian Studies
Source: ENAPREF
Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

The results show an average total price elasticity of -1.485, a figure that is very high in comparison with other studies of demand for cigarettes conducted in Peru.[17] It is important to note that for the estimations of this model, the number of observations per cluster is key, both for estimation of the prevalence elasticity (the average price per cluster is imputed for non-smoking households) and for the conditional elasticity estimated by the Deaton method, which rests on the spatial variation in prices.

Other studies for Peru show very dissimilar results. For example, De Los Ríos (2019) finds that the formal apparent price elasticity of consumption[18] of cigarettes is -0.398, using time series for the period 1993-2017. Valdivia (2020), meanwhile, estimates the price elasticity of consumption of cigarettes at -0.490, using the DEVIDA (2010) survey of drug use, which presents individual data for cigarette smoking as well as important information about risk factors associated with cigarette use, but does not offer adequate information about income (spending).[19]

Unlike González-Rozada and Ramos-Carbajales (2016), the results of this study show a strong progressive trend in price elasticity, which implies that the lowest-income households are significantly more sensitive to changes in prices than the wealthiest households.

17. During the study, as a test of robustness, the entire sample is included, as Deaton (1988) does. The results obtained, however, show an average elasticity higher than -2.0, on average and in all terciles. This could be because only 11% of the sample reports having smoked at least one cigarette in the past week, and because this sample of smoking households is highly concentrated. In other words, in the dependent variable *budget share*, approximately 31,000 zeroes were included, reducing its variance and the explanatory power of the independent variables.

18. Apparent consumption is the sum of domestic production plus cigarette imports, minus exports. There has been no domestic cigarette production in Peru since 2005; all cigarettes that are consumed are imported.

19. The survey makes a selection of households and within each household randomly selects one member between ages 18 and 65. This person responds individually to the survey questions about the amount, characteristics, consequences and factors associated with drug consumption. The question about income is an open question about total monthly family income, which can create significant response biases associated with the information from some interviewees.

One possible explanation for the differences in results between the studies lies not only in the methodology, but also in the absence of databases that offer necessary and timely information[20] for the estimation of the demand functions. Fortunately, the National Institute of Statistics and Informatics (*Instituto Nacional de Estadísticas e Informática*, INEI)[21] is currently conducting the ENAPREF (2020), which will provide updated information about smoking and enable estimations based on studies of "pooled" data series that would make the estimations of price elasticity more robust.

20. ENAPREF (2009) contains information from the 2008-2009 period, which preceded the tax and non-tax changes (implementation of the Framework Convention on Tobacco Control).

21. http://m.inei.gob.pe/prensa/noticias/inei-ejecuta-la-encuesta-nacional-de-presupuestos-familiares-20192020-11584/

6

Cost-benefit analysis

In the preceding section, results show that different income groups have different sensitivities to changes in tobacco prices; lower-income households, in particular, are significantly more sensitive than households with higher incomes. In this section, a 10% increase in average prices[22] as a result of an increase in the Special Consumption Tax (*Impuesto Selectivo al Consumo*, SCT) is simulated to analyze its impact on households. According to Fuchs and Meneses (2017), the impact of a tax increase can be broken down into three components that combine short-, medium-, and long-term effects:

- Reduction in spending on cigarettes (short term)
- Reduction in health spending associated with reduced tobacco consumption (medium- and long-term)
- Increase in income because of greater number of years of life associated with reduced tobacco consumption; that is, lower mortality (medium- and long-term)

22. For simplicity, the study assumes an average price increase of 10% stemming from an increase in excise taxes, acknowledging that a change in specific tax that increases average prices by 10% would mean bigger price changes for lower priced brands, typically consumed by lower income groups; and smaller price changes for higher priced brands, typically consumed by higher income groups. This implies that impacts would have been even more progressive when analyzing the effects of an increase in excise taxes. Further research is needed to simulate different scenarios of tax increase and reactions from different segments of the population.

The aggregate impact of a tobacco tax increase is simulated as follows:

$$Income\ effect = changes\ in\ spending\ on\ tobacco + lower\ medical\ expenses + increases\ in\ income \quad (13)$$

Variation in tobacco spending

The proportional variation of spending on tobacco after a tax increase is estimated, which measures the change in spending on tobacco, and includes the change in prices ($\triangle P$), price elasticity (ε), spending on tobacco in tercile i during the period 0; relative to total spending by each spending group (tercile) *i*.

$$\triangle Prop.\ spending\ on\ tobacco = \frac{\left(\left(1+\triangle P\right)\left(1+\varepsilon * \triangle P\right)-1\right) * Spending\ on\ tobacco_{i0}}{Total\ spending_i} \quad (14)$$

Spending on consumption of cigarettes and total spending are obtained from the ENAPREF (2009). For each spending tercile, average spending on tobacco and average total spending is estimated.

Variation in medical spending

Variation in medical spending associated with smoking:

$$\triangle Prop.medical\ spending = \frac{\left(\left(1+\varepsilon * \triangle \%P\right)-1\right) * Smoking-related\ medical\ spending_i}{Total\ spending_i} \quad (15)$$

Smoking-related medical spending is taken from Pichon-Riviere *et al* (2016). This indicator is found in aggregate form for the entire population. For this reason, an adjustment is made for each tercile, consisting of a distribution proportional to the number of smoking households in each tercile. Because medical spending is from 2016 and ENAPREF is from 2009-2010, this figure is changed to 2009 soles. This indicator groups private and public medical spending; it therefore refers to an estimated social cost. Nevertheless, this analysis is aimed at households. For this reason, private cost is separated out, using *out-of-pocket expenditure* provided by the World Bank[23] for 2009[24].

Variation in lost income

The increase in income resulting from an increase in years of work because of lower mortality is also estimated. The baseline is the number of years lost associated with smoking and the lost income.

23. https://datos.bancomundial.org/indicador/SH.XPD.OOPC.CH.ZS

24. Medical spending by households corresponds to 40.6% of total health spending.

To calculate years of life lost, deaths caused by tobacco consumption are observed and are related to the additional years that could be lived, based on life expectancy. If the years lost are multiplied by the income lost by not working, the costs of years of working lost are obtained.

The information about years of life lost for Peru is found in Bardach *et al* (2016). Nevertheless, this indicator is found in aggregate form for the entire population and corresponds to 2015. For this reason, this information was adjusted proportionally to the number of smokers in each tercile and to population growth during the years 2009-2015. To obtain the per-household figure, it is divided by the number of smoking households in each tercile. Total annual expenditures for each tercile is used as a proxy for lost income.

$$\Delta\, Prop.Income. = \frac{\left(\left(1+\varepsilon *_{\Delta}\%P\right)-1\right) * Years\ of\ life\ lost_i * Lost\ income_i}{Total\ spending_i} \quad (16)$$

Results

Table 9 shows the indicators used to calculate each element of total variation in income. There are two types of medical costs: those of households and the "social medical cost."[25] Table 9 shows both, but for the cost-benefit analysis only household medical cost is used. The Years of Life Lost indicator is used to obtain the calculation of the cost of labor years lost; the latter is used for estimation of variation in income.

Table 9
Indicators

Tercile	Number of smoking households	Distribution of smokers by tercile (%)	Estimated social medical cost (millions)*	Household medical cost (millions)*	Years of life lost*	Average cost of years of working lost (millions)*
1	230,522	23%	489	199 (6.7%)	77,881	174 (5.9%)
2	207,133	33%	660	268 (5.1%)	68,440	270 (5.2%)
3	265,442	45%	936	522 (3.1%)	89,681	531 (4.3%)

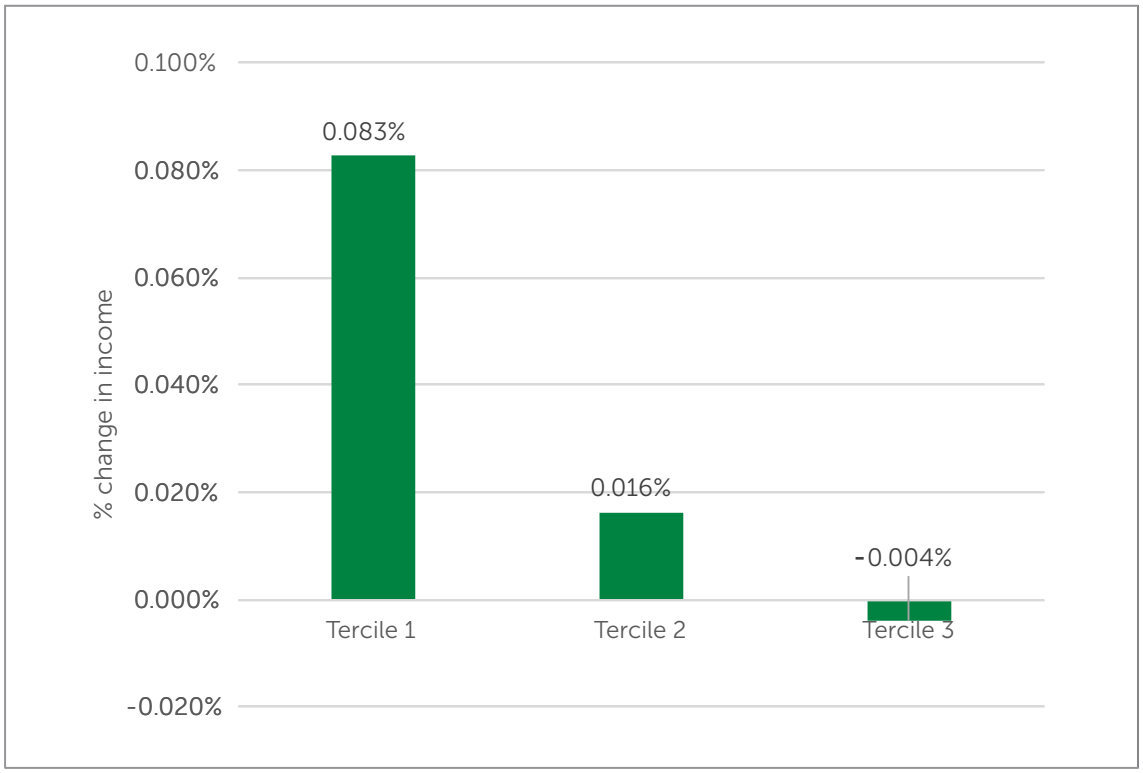
* Annual figure
Proportion of spending with respect to total spending in parentheses.
Compiled by: Institute of Peruvian Studies
Source: ENAPREF

25. This is equivalent to the medical cost that the State spends on patients with a smoking-related illness.

The direct (short-term) impact of higher cigarette prices faced by consumers is the variation in spending. Figure 3 shows that the impact of a tax increase that leads to an average 10% increase in cigarette prices, generates greater income in the lower-income terciles because of the savings generated by lower cigarette consumption. The first and second terciles reduce their absolute spending on cigarettes by 8.94% and 2.34% respectively, while the third tercile increases its absolute spending on cigarettes by 0.65%. The variation in absolute tobacco spending would generate changes in household available income. When combining variation in absolute tobacco spending and the proportion of tobacco expenditure by income group, the first and second tercile show a 0.083% and 0.016% increase in household disposable income, respectively, while the third tercile decreases its household disposable income by 0.004%. This represents a loss of well-being only for the highest-income tercile. Taking into account only the short-term component associated with spending on cigarettes, the increase in the SCT would have a progressive effect.

Figure 3

Proportional change in income associated with reduction in the proportion of spending on cigarettes

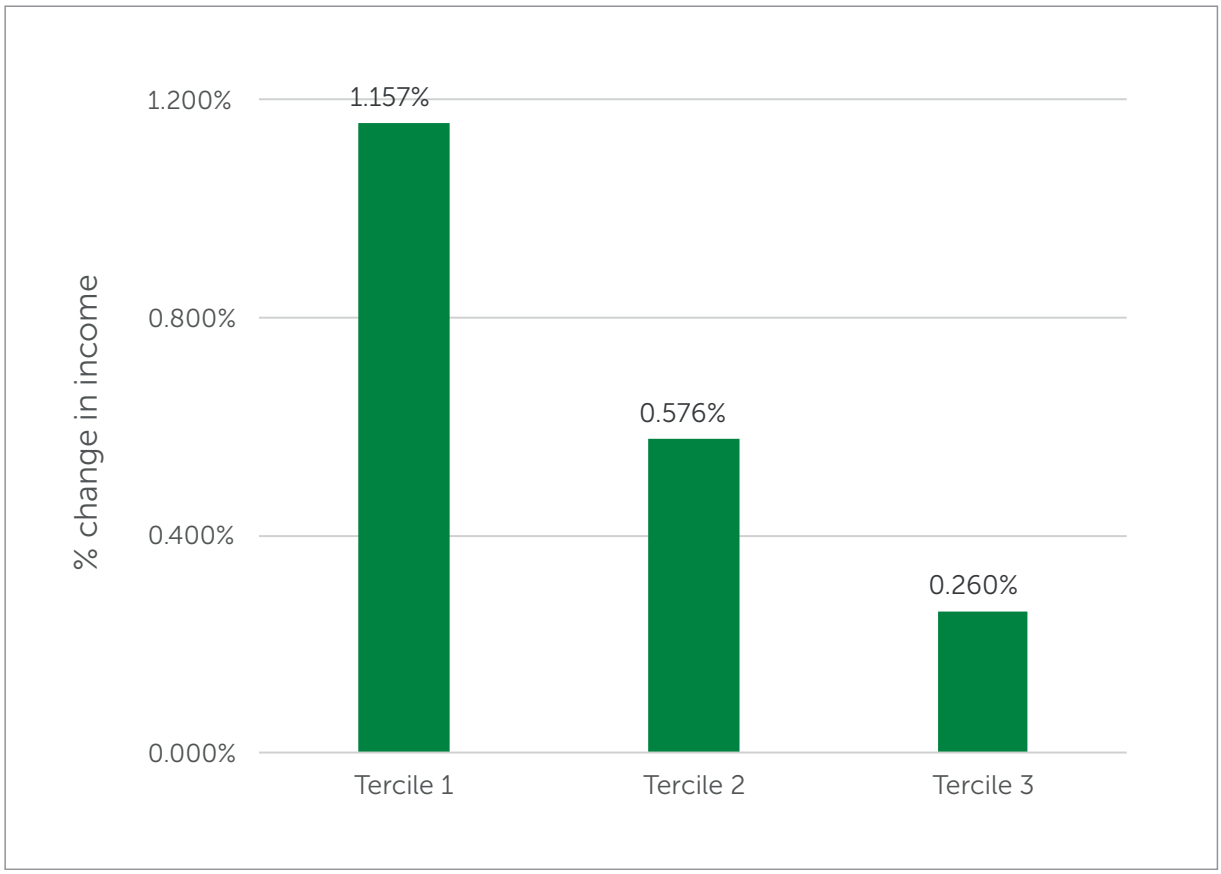


In regard to the decrease in smoking-related medical expenses due to decreased cigarette consumption, only household expenses are considered (not government medical expenses) because the study centers on household behavior given an increase in taxes leading to higher prices for consumers. Following Fuchs and Meneses (2017), the increase in tobacco taxes leads not only to changes in

spending on consumption of this item, but also to indirect effects through changes in smoking-related medical expenses. Figure 4 shows that given a 10% increase in cigarette prices driven by an increase in SCT taxes, the three terciles obtain greater income because of the savings from avoided smoking-related medical expenses. The greatest beneficiaries, however, would be those in the first tercile (the lowest income), with an income increase of 1.16%; followed by the second tercile, with an increase of 0.58%. The third tercile has an increase in income of 0.26%. The lowest-income tercile would benefit most, partly because a greater proportion of total spending in those households corresponds to smoking-related medical expenses. When this component is incorporated into the analysis, an increase in the SCT would have a progressive pattern.

Figure 4

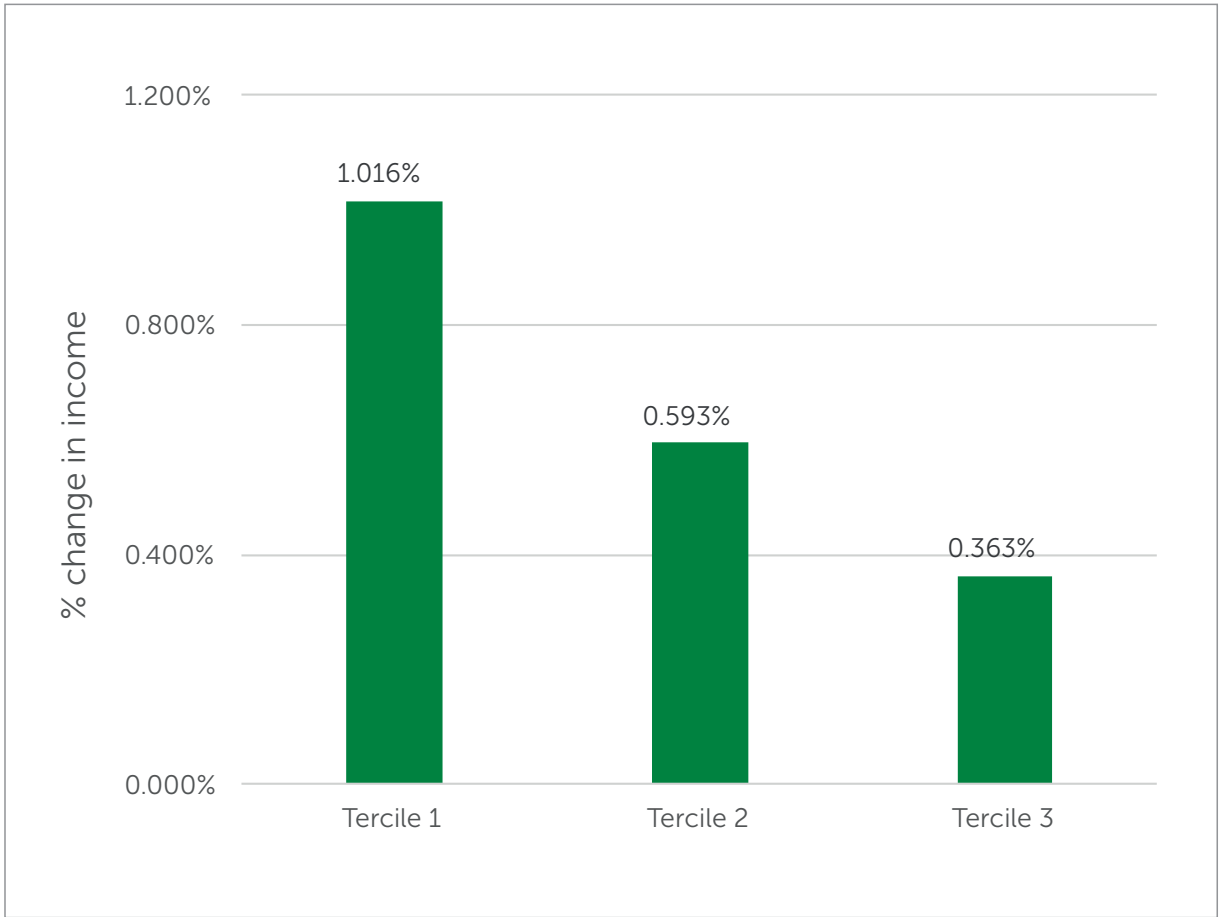
Proportional increase in income associated with a reduction in smoking-related medical expenses



Fuchs and Meneses (2017) incorporate a third component related to the income gains associated with more productive years due to reduced mortality. Figure 5 shows that the response to higher prices is that all terciles would have more income because of avoided smoking-related early mortality. The first tercile would see the greatest benefit from this component, with a 1.01% increase in income, mainly because it is the tercile with the most years of life lost; the second and third tercile would gain 0.59% and 0.36%, respectively. Therefore, an increase in SCT on cigarettes leading to higher average cigarette prices, would have a progressive pattern.

Figure 5

Proportional increase in income associated with more working years as a result of lower mortality



Finally, the total effect of the 10% increase in prices due the increase in excise taxes (SCT) is the sum of the effects on income caused by the variation in spending on cigarettes; the savings generated by the reduction in household medical expenses; and the increase in income associated with more productive years because of the decrease in mortality. Table 10 shows the result of the total effect on income and its components. All terciles would experience an increase in income in both the short- and long-term. The group benefiting most would be the lowest-income tercile, mainly because of the decrease in smoking-related medical expenses. In all components, the lowest-income tercile benefits most, so a tax increase would have a progressive effect.

Table 10

Short-, medium- and long-term effects on household income from an increase in SCT leading to a 10% in prices faced by consumers

Proportional increase in income because of:

Tercile	Decreased spending on cigarettes (i)	Reduction in medical expenses (ii)	More productive years (iii)	Total effect (i)+(ii)+(iii)
1	0.083	1.157	1.016	2.255
2	0.016	0.576	0.593	1.186
3	-0.004	0.260	0.363	0.619

Compiled by: Institute of Peruvian Studies
Source: ENAPREF

7

Conclusiones and recommendations

The results of this study show that the increase in the cigarette tax has a significant impact on household income in the short-, medium-, and long-term, with the latter two being the most important. This impact on proportional household income is transmitted to households both through decreases in spending on cigarettes in the short-term and through lower medical expenses related to smoking and a larger number of productive years resulting from lower mortality in the medium- and long-term.

The results also show evidence of the progressive effect of a tax measure in the short-, medium-, and long-term. In other words, the effect of the tax increase on the poorest households would be more than three times greater than the effect on the wealthiest households (2.26% compared to 0.62%).

Finally, this research finds that the tax increase would mean that many potential smokers would not start smoking and many smokers would reduce the number of cigarettes consumed. This is turn would result in an overall decrease in cigarette consumption and a decrease in the social cost associated with smoking-related illnesses.

Bibliography

Bardach, A.E.; Caporale, J.E.; Alcaraz, A.; Augustovski, F.; Huayanay-Falconí, L.; Loza-Munarriz, C.; et al.
2016 *Carga de enfermedad por tabaquismo e impacto potencial del incremento de precios de cigarrillos en el Perú*. Rev Peru Med Exp Salud Publica. 2016;33(4):651-61. doi: 10.17843/rpmesp.2016.334.2548

Bishop, J. A., Haiyong, L. I. U., & Qi, M. E. N. G.
2007 *Are Chinese smokers sensitive to price?* China Economic Review, 18(2), 113-121.

Chetty, R.
2015 *Behavioral economics and public policy: A pragmatic perspective*. American Economic Review, 105(5), 1-33.

Chen, C. M., Chang, K. L., & Lin, L.
2013 *Re-examining the price sensitivity of demand for cigarettes with quantile regression*. Addictive behaviors, 38(12), 2801-2804.

Daude, C., Fajardo, G., Brassiolo, P., Estrada, R., Goytia, C., Sanguinetti, P., & Vargas, J.
2017 *Crecimiento urbano y acceso a oportunidades: un desafío para América Latina*. RED 2017.

Deaton, A.
2019 *The Analysis of Household Surveys (Reissue Edition with a New Preface): A Microeconometric Approach to Development Policy*. Washington, D.C.: The World Bank.

Deaton, A.

1988 *Quality, Quantity and Spatial Variation of Price*. American Economic Review 78: 418-430.

De Los Rios, C.

2019 *Acelerando la fiscalidad efectiva al tabaco en Perú. Hacia una política sostenible*. Documentos de Base series for the "Tobacco Taxes in Latin America" project. Country study Nº 4/2019.

DEVIDA

2012 Informe Ejecutivo. IV Encuesta Nacional de Drogas en la Población General de Perú. Población General, 2010. Observatorio Peruano de Drogas, Comisión Nacional para el Desarrollo y Vida sin Drogas (DEVIDA)

Fuchs Tarlovsky, A.; Gonzalez Icaza, M. F.; Paz, D.

2019 Distributional Effects of Tobacco Taxation: A Comparative Analysis. Poverty and Equity Global Practice Working Paper Series; no. 196. Washington, D.C.: World Bank Group. http://documents.worldbank.org/curated/en/358341554831537700/Distributional-Effects-of-Tobacco-Taxation-A-Comparative-Analysis

Fuchs Tarlovsky, A.; Meneses P., Francisco J.

2017 *Are tobacco taxes really regressive? Evidence from Chile*. Washington, D.C.: World Bank Group. http://documents.worldbank.org/curated/en/389891484567069411/Are-tobacco-taxes-really-regressive-evidence-from-Chile

Gonzalez-Rozada, M., & Ramos-Carbajales, A.

2016 Implications of raising cigarette excise taxes in Peru. Revista Panamericana de Salud Pública, 40, 250-255.

Gruber, Jonathan

2016 Public finance and public policy. Fifth edition. Massachusetts Institute of Technology.

Heckman, J. J.

1976 The common structure of statistical models of truncation, sample selection and limited dependent variables and a simple estimator for such models. In *Annals of Economic and Social Measurement*, Volume 5, number 4 (pp. 475-492). NBER.

Hu, T. W., Ren, Q. F., Keeler, T. E., & Bartlett, J.

1995 The demand for cigarettes in California and behavioural risk factors. *Health Economics*, 4(1), 7-14.

Jha, P. and F.J. Chaloupka

1999 Curbing the epidemic: Governments and the economics of tobacco control. World Bank, Washington D.C. http://documentos.bancomundial.org/curated/es/914041468176678949/pdf/multi-page.pdf

Jimenez-Ruiz, J. A., De Miera, B. S., Reynales-Shigematsu, L. M., Waters, H. R., & Hernández-Ávila, M.

2008 The impact of taxation on tobacco consumption in Mexico. Tobacco Control, 17(2), 105-110.

John R., Chelwa G., Vulovic V., Chaloupka F.

2019 *Using Household Expenditure Surveys for Research in the Economics of Tobacco Control*. A Tobacconomics Toolkit. Chicago, IL: Tobacconomics, Health Policy Center, Institute for Health Research and Policy, University of Illinois at Chicago.

Nargis, N., Ruthbah, U. H., Hussain, A. G., Fong, G. T., Huq, I., & Ashiquzzaman, S. M.

2014 The price sensitivity of cigarette consumption in Bangladesh: evidence from the International Tobacco Control (ITC) Bangladesh Wave 1 (2009) and Wave 2 (2010) Surveys. Tobacco Control, 23(suppl 1), i39-i47.

Pichon-Riviere A, et al

2016 *Impacto económico del tabaquismo en los sistemas de salud de América Latina: un estudio en siete países y su extrapolación a nivel regional*. Rev Panam Salud Publica;40(4):213–21

Ramos Carbajalesa, A; Vallarino,H; González-Rozada, M.

2014 *Perú: tributación sobre los productos del tabaco. Panorama general y propuesta de reforma*. Lima, Comisión Nacional de Lucha Antitabáquica – COLAT.

Kidane, A., Mduma, J., Naho, A., Ngeh, E. T., & Hu, T. W.

2015 The demand for cigarettes in Tanzania and implications for tobacco taxation policy. Advances in Economics and Business, 3(10), 428.

WHO

2011 *WHO technical manual on tobacco tax administration*. http://www.who.int/tobacco/publications/tax_administration/en/

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