



# Cigarette taxes and demand in Colombia\*

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## ABSTRACT

**Objective.** Estimate price and income elasticities of aggregate demand for cigarettes in Colombia by controlling for structural market changes since the late 1990s, to identify tax policy opportunities that could improve public health and increase tax revenues.

**Methods.** Measurement of aggregate demand for cigarettes using gross income reported on value-added tax returns submitted to Colombia's National Tax and Customs Office (DIAN, the Spanish acronym) by the tobacco product manufacturing industry, subtracting exports. A quarterly time series was obtained for the period 1994-2014. The econometric estimation using two-stage least squares controls for price endogeneity and uses a set of dummy variables to control for structural changes in the market and its regulation.

**Results.** Demand is, from a statistical standpoint, sensitive to price and income. Price elasticity of demand is -0.78 and income elasticity is 0.61.

**Conclusions.** Inelastic demand implies that it is possible, through cigarette excise taxes, to meet public health targets and increase revenues simultaneously. The results also suggest that the considerable increase in household income in Colombia in the first decade of the 21st century increased purchasing power, which, lacking an accompanying tax increase, promoted cigarette consumption, with negative effects on public health, and wasted an opportunity to increase tax revenues.

## Key words

Health economics; smoking; disease prevention; taxes; regression analysis; Colombia.

In Colombia, smoking is responsible for 26 460 deaths per year and direct treatment costs of US\$2.26 billion (1) (0.6% of the gross domestic product).<sup>3</sup> The burden of disease from noncommunicable diseases has increased, and the most frequent causes associated with smoking are ischemic disease,

cerebrovascular events, and chronic obstructive pulmonary disease (COPD) (2). Smoking prevalence in Colombia is moderate in comparison with other countries in the region, but during the first decade of the 21st century there were signs that the epidemic was spreading: rising indicators of smoking among young people (3) and women (4), prevalence rates of over 25% in urban areas, and an average starting age of 12 (5, 6).

In 2008, Colombia adhered to the Framework Convention on Tobacco Control (FCTC) and made progress with

interventions such as smoke-free spaces, a ban on the promotion and advertising of tobacco products and their sponsorship of events, and health warnings with pictograms that cover 30% of the pack surface. After the adoption of these measures, prevalence fell to 13% in 2013, although in some regions, the levels are close to 20% (7). Nevertheless, with respect to cigarette taxes (Article 6 of the FCTC), the country is significantly behind, and cigarette prices are among the three lowest in the region, together with those of El Salvador and Paraguay (8).

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<sup>3</sup> Based on an estimate for 2013 in Colombian pesos, using the official exchange rate of 1 870 pesos per 1 US\$.

\* Official English translation provided by the Pan American Health Organization. In the case of discrepancy between the two versions, the Spanish original shall prevail.

Although the evidence shows that higher taxes reduce cigarette consumption, policymakers argue that this measure can reduce fiscal revenues due to a more than proportional drop in aggregate demand.

Specifically, the estimation of aggregate demand for cigarettes in Colombia presented below provides information on price and income elasticities for a discussion of the effects on consumption and revenues derived from cigarette tax increases. The results supplement those of other studies for Colombia (9-11) and make it possible to produce reliable estimates of tax revenues.

## MATERIALS AND METHODS

### Model and identification

The estimated demand for cigarettes is based on the consumption behavior of individual  $i$ . The quantities demanded by individual  $i$  ( $q_i$ ) are determined by the price at which individual  $i$  purchases cigarettes ( $p_i$ ), individual  $i$ 's income ( $y_i$ ), and a set of exogenous variables ( $x_i$ ) that affect decisions about consumption. Demand should consider the price of substitute or complementary goods. Substitution occurs between cigarette brands and tends to be low, due to strong brand loyalty. In some rural areas, there is substitution with other tobacco products, but its weight in aggregate consumption is very low. As for complementary goods, there is a relationship with products such as alcohol (12, 13) or other psychoactive substances such as marijuana, although in this latter case, the evidence points to an addiction process in which cigarettes temporally precede other psychoactive substances (14).

The addictive nature of consumption is captured by past ( $q_{i,t+k}$ ) or future values ( $q_{i,t+k}$ ), which represent myopic or rational addictions (15). Equation [1] yields the function to estimate.

$$q_i = f(p_i, y_i | x_i, q_{i,t+k}), k > 0 \quad [1]$$

The economic behavior of cigarette smokers is determined by the sensitivity of function  $f$  to changes in the price of cigarettes and other related goods, as well as income. An increase in the tax, which translates into an increase in the price, discourages people who are still non-smokers from taking up the habit

and motivates more smokers to quit (16-19), leading to a reduction in  $q_i$ . An increase in income, in turn, increases the overall budget and, depending on whether the quality of the good is normal or inferior, increases or decreases the demand, respectively. The effect on fiscal revenues is determined by the equilibrium between the higher revenues that a higher tax on each cigarette represents and the drop in revenues caused by lower consumption, due either to fewer smokers or less frequent consumption by each smoker.

The aggregate demand for year  $t$  is obtained by aggregating the consumption of all smokers  $I$  in that year. Thus, the aggregate quantities of cigarettes demanded in year  $t$ ,  $Q_t = \sum_{i=1}^I q_{i,t}$ , are a function  $g(\cdot)$  of the average price of cigarettes that year ( $P_t$ ), and the aggregate income  $Y_t$ , conditional to the exogenous variables  $X_t$ --that is,  $Q_t = g(P_t, Y_t | X_t)$ . This function excludes the addiction term,  $Q_{t-k}$ ,  $k > 0$ , following the standard in the literature (20). The aggregate demand elasticities are estimated with equation [2], which is the logarithmic parametric version of the aggregate demand function for cigarettes. Since the parameters of interest are price and income elasticities, the appropriate functional form is the logarithmic form, and the coefficients of interest are  $\beta$  and  $\gamma$ . It should be noted that the functional form has limitations because it captures only linear relationships.

$$\ln Q_t = \alpha + \beta \ln P_t + \gamma \ln Y_t + \rho X_t + E_t \quad [2]$$

The estimation of equation [2] is subject to simultaneity bias caused by the endogeneity of cigarette price  $P_t$ , which although exogenous for individual demand (equation [1]), could be endogenous for aggregate demand. The correction of simultaneity bias and the identification of parameters ( $\alpha$ ,  $\beta$ ) are accomplished through instrumental variables, using the natural instruments suggested by the model's structure, which are the price lags ( $Tp-m$ ,  $m > 0$ ). To guarantee the parsimony of the model, only the first lag is used as an instrument; thus, the model is exactly identified. Estimates with greater lags did not improve the fit of the model. The identification assumption is that cigarette price lags only affect the demand for cigarettes through their effect on current prices.

This is justified, since cigarettes are a product with high turnover, so that stocks in one quarter are not affected by the prices of previous quarters. Furthermore, the market power of cigarette manufacturers (21) strongly limits market agents' ability to sell in the current period at the prices of previous periods.<sup>4</sup>

### Data

For the cigarette price ( $P_t$ ), the series that the period in question covers is the Consumer Price Index (CPI) of cigarettes and tobacco issued by the National Administrative Department of Statistics (DANE), which is a measurement of the nominal price of cigarettes ( $P_t^N$ ). Since  $P_t$  represents relative prices, the cigarette and tobacco CPI is divided by the total CPI. To capture the effect of substitute or complementary goods, the alcoholic beverage CPI, divided by the total CPI, was included. The base period for these monthly price indexes is December 2014, and they were converted to quarterly indexes through geometric means (22).

For aggregate income ( $Y_t$ ), the national gross domestic product (GDP at constant prices), published quarterly by DANE, was used. Real GDP per capita was calculated, dividing by the total population in order to correct for scale. Both the total population and the potential smoker population (people aged 15 or over) are taken from the annual DANE projection (based on the 2005 population census).

The aggregate quantities of cigarettes demanded ( $Q_t$ ) were obtained by dividing annual national sales ( $Q_t P_t^N$ ) by the price ( $P_t^N$ ). These sales are the sum of the gross income of ISIC code 1600 (Manufacture of tobacco products) reported bi-monthly by the companies to the National Tax and Customs Office (DIAN) on the value-added tax (VAT) payment voucher. The data cover the period from the first bimonthly period of 1994 to the last bimonthly period of 2014. The initial period of analysis is based on the fact that DIAN has collected information only since 1994 (the agency was created in 1992). This is the most up-to-date source available for estimating demand. Colombia does not have quarterly consumption measurements, and DANE production data are published annually

<sup>4</sup> Even in the black market, cigarette prices quickly respond to changes in the sales price of legal cigarettes.

with a considerable lag. Also excluded was the information from the National Federation of Departments, which keeps records of the quantities of cigarettes sold and cigarette taxes collected, because the data have not been cleansed, have typos, and the total number of packs estimated for one year is around four times the values obtained through other sources.

Sales are used as a proxy for the quantities demanded, because the relatively rapid product turnover makes the distance between sales and the quantities consumed short. Since sales have a seasonal component (due to the sales policies of tobacco companies) that is not expected to be observed in consumption, to reduce this measurement error and equalize the frequency of the sales series with the other variables, some conversions were made. The bimonthly sales figure was divided by two to obtain monthly figures. Stationarity was corrected for by calculating the fifth-order moving average, adding the smoothed monthly nominal sales to obtain quarterly nominal sales. The quantities of 20-unit packs were obtained by dividing the nominal sales by the price ( $P_t^N$ ). The price was calculated by taking the median of the observations of the DANE price survey 2014, and a back-extrapolation was done, using the growth rate of the cigarette CPI. The estimated pack sales yield a figure that is perhaps below the sales volume when divided by the retail price with taxes, since the available data for the entire study period are from the CPI, which includes taxes. Finally, the quantities of packs were divided by the population of potential smokers to correct for the effects of population growth and changes in the age structure.

Five dummy variables that capture changes in market regulation were included as control variables ( $X$ ).  $D_{Ley\ 1\ 335}$  incorporates the changes associated with Resolution No. 1 956 of 2008 and Law No. 1 335 of July 2009, which implement the FCTC commitments on smoke-free spaces in the national territory and a ban on advertising, promotion and sponsorship of tobacco products. Not all of these provisions went into effect immediately; the advertising ban included a two-year transition period.  $D_{Promoción}$  captures this effect and takes the value of 1 in the third quarter of 2009. The national measure on smoke-free spaces

entered into force with the adoption of Resolution No. 1 956 (May 2008); this effect is captured with  $DELibesHumoN$ , which is equal to 1 as of the third quarter of 2008. Between the end of 2002 and 2005, four territorial entities adopted measures for smoke-free spaces, an effect represented by  $DELibesHumoM$ , which takes the value of 1 in the first quarter of 2003.  $D_{Advertencias}$  is the variable that represents the entry into force of the health warnings provision in July 2010 and takes the value of 1 in the third quarter of 2010. Variables related to measures to control the smoking epidemic are expected to have a negative effect on demand for cigarettes (23-25). The reduction in smoking prevalence between 2008 and 2013 suggests this (7).

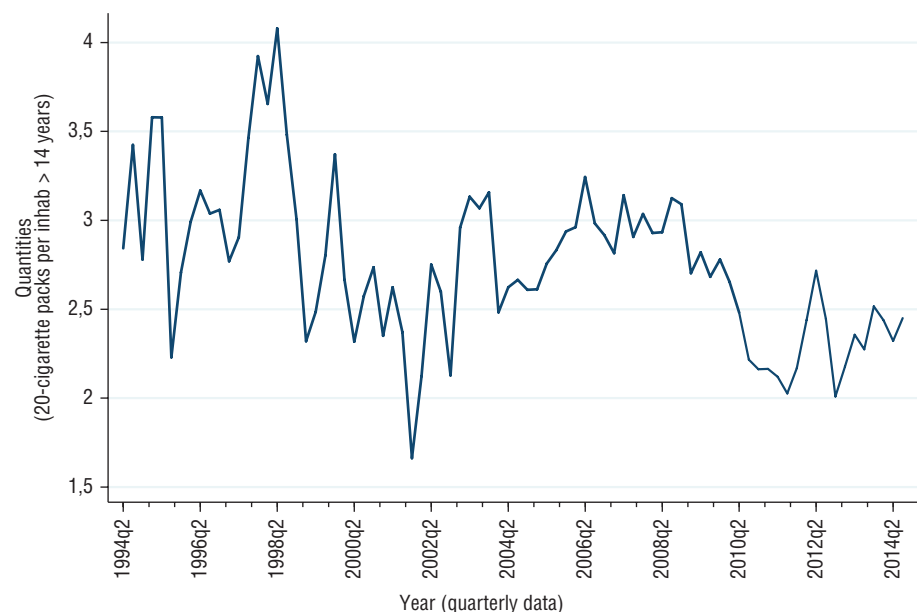
Two dummy variables capture changes in the market structure.  $DCilícito$  reflects organizational changes that heightened measures to control smuggling and takes the value of 1 in the first quarter of 1999. Between the end of the 1990s and 2003, the government was able to weaken cigarette smuggling networks and prosecute the bosses of these networks, while territorial entities took legal action against the tobacco industry for its involvement in this illegal trade (26, 27). These actions may increase prices, since they reduce the quantities of black mar-

ket cigarettes sold in the market at lower prices.

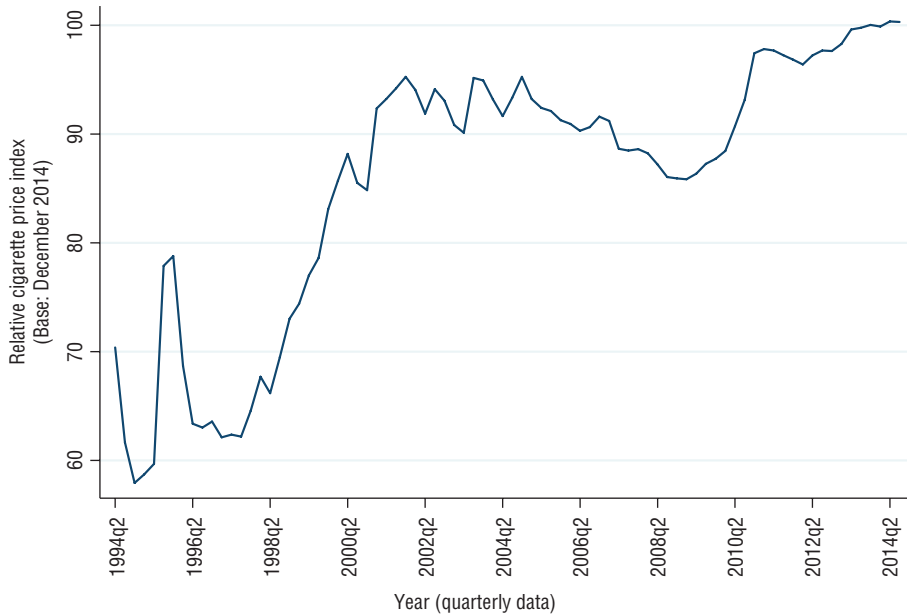
$DCMercado$  represents the change in the market structure that occurred with the purchase of Coltabaco by Phillip Morris, with a transition period of several months; this variable takes the value of 1 in the first quarter of 2006. An increase in demand for cigarettes is expected, due to the market expansion practices of this multinational tobacco company, which employs low-price strategies to position its products in new markets, wages marketing campaigns targeting non-smokers, and has the power to interfere with regulatory policies to reduce smoking (28).

Figures 1, 2, and 3 show the behavior of the continuous variables. Between the first quarter of 1994 and the third quarter of 1997, sales and real prices show instability, while real GDP per capita rises slowly. Then, between the fourth quarter of 1997 and second quarter of 2000, the beginning of an uptick in prices coincides with a drop in GDP per capita and a reduction in per capita sales. In the third quarter of 2000, this sales trend is reversed, prices stabilize at levels higher than those of the second half of the 1990s, and GDP per capita continues to rise. Finally, between the first quarter of 2009 and the fourth quarter of 2014, sales fall,

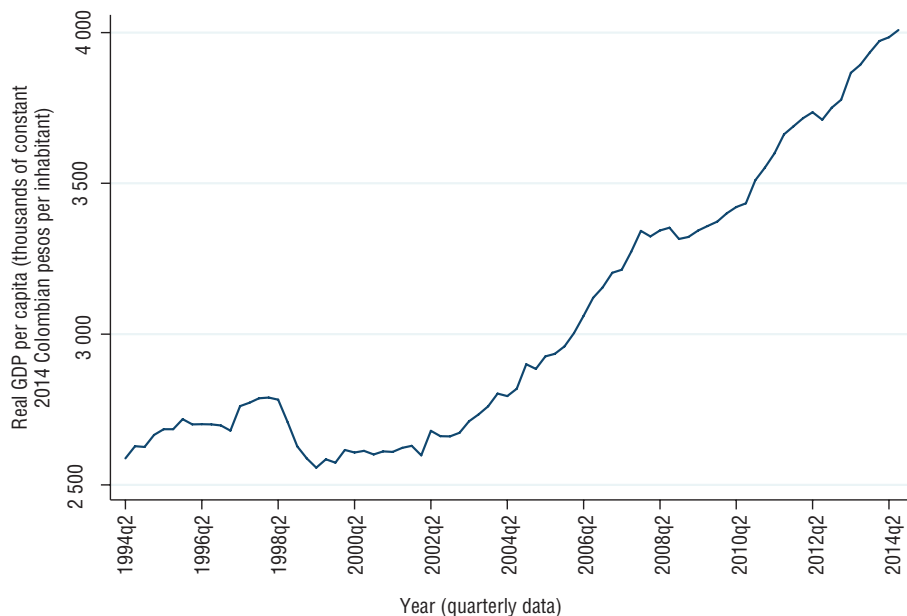
**FIGURE 1. Quarterly cigarette sales in Colombia**



**Source:** Authors' own calculations, using the database of Colombia's National Administrative Department of Statistics (DANE).  
q2=second quarter.

**FIGURE 2. Real cigarette prices in Colombia**

**Source:** Authors' own calculations, using the database of Colombia's National Administrative Department of Statistics (DANE).  
q2=second quarter.

**FIGURE 3. Real GDP per capita in Colombia**

**Source:** Authors' own calculations, using the database of Colombia's National Administrative Department of Statistics (DANE).  
q2=second quarter; GDP=gross domestic product.

real prices rise, and the upward dynamic of GDP per capita continues.

## RESULTS

Table 1 presents the results through the use of instrumental variables (VI) with two-stage least squares under four

different specifications. It is observed that, in model VI1, the variables DPromoción, DELibreshumoN, DCilícito, and DCMercado do not, in principle, have a statistically significant effect on demand for cigarettes. In the case of changes in market conditions (DCMercado), these occur in the same period in which the

highest economic growth rates of the decade are achieved by capturing both the change in the market structure and the changes in income, which affect the magnitude and standard error of income elasticity. It is therefore impossible to identify the effect of changes in market structure, and to identify income elasticity, the variable DCMercado is eliminated and we move from VI1 to VI2.

The variable DPromoción was not statistically significant in any of the models; it was therefore eliminated, moving from VI2 to VI3. Likewise, the variable of institutional strengthening to combat smuggling (DCilícito) was not statistically significant in any model. Because of its indirect effect through prices, when this variable is excluded from the estimate (model VI3 versus VI4), the price captures the variation in institutional strengthening, and, thus, elasticity is overestimated, slipping from -0.78 to -1.068. This produces similar changes in magnitude in income and cross-elasticities. While not statistically significant, this variable is included to prevent omitted variable bias. In conclusion, the appropriate model for estimating elasticities is VI3.

The price elasticity of aggregate demand for cigarettes is -0.78 and is statistically significant to 5% in all the models, indicating that in Colombia, a 10% increase in the relative price of cigarettes reduces aggregate demand by 7.8%. Although the value is higher than in previous studies, the measurements are not directly comparable, since they cover different time periods, do not correct for changes in market structure and regulation (9), do not include the price of substitute/complementary goods, and calculate the estimates by brand (10). The price inelasticity of demand implies that there is room for achieving public health objectives through a reduction in consumption while simultaneously increasing fiscal revenues through taxes. This result is important for the territorial entities, which are responsible for collecting the tax and financing health services in the subsidized system and for the uninsured population, since it indicates that raising the tax on cigarettes will reduce future health care expenditure and increase current revenues to cover the cost of care.

The demand income elasticity is 0.61 and is statistically significant to 5%, suggesting that a 10% increase in income

**TABLE 1. Estimation of the model of aggregate demand for cigarettes (Ln Q<sub>t</sub>), 1994-2014**

Variable	Model VI1	Model VI2	Model VI3	Model VI4
LnPrecioCigarrillo	-0.789 <sup>b</sup> (0.355)	-0.811 <sup>b</sup> (0.35)	-0.781 <sup>b</sup> (0.343)	-1.068 <sup>c</sup> (0.246)
LnPrecioAlcohol	0.975 <sup>b</sup> (0.384)	0.92 <sup>b</sup> (0.367)	0.921 <sup>b</sup> (0.365)	0.684 <sup>a</sup> (0.405)
LnIngresoPCápita	0.344 (0.368)	0.533 <sup>b</sup> (0.242)	0.617 <sup>c</sup> (0.216)	0.613 <sup>c</sup> (0.237)
DLey1335	-0.121 <sup>c</sup> (0.041)	-0.121 <sup>c</sup> (0.041)	-0.124 <sup>c</sup> (0.041)	-0.107 <sup>c</sup> (0.038)
DAdvertencias	-0.174 <sup>c</sup> (0.04)	-0.178 <sup>c</sup> (0.04)	-0.15 <sup>c</sup> (0.051)	-0.115 <sup>c</sup> (0.039)
DPromoción	0.067 (0.044)	0.052 (0.034)		
DELibresHumoN (National)	-0.06 (0.04)	-0.062 (0.039)	-0.069 <sup>a</sup> (0.039)	-0.093 <sup>b</sup> (0.039)
DELibresHumoM (Municipal)	0.117 <sup>a</sup> (0.061)	0.111 <sup>a</sup> (0.061)	0.098 <sup>a</sup> (0.058)	0.1 <sup>a</sup> (0.057)
DCIlícito	-0.161 (0.107)	-0.14 (0.1)	-0.146 (0.098)	
DCMercado	0.04 (0.053)			
Constant	-15.539 <sup>c</sup> (2.915)	-17.052 <sup>c</sup> (1.867)	-17.703 <sup>c</sup> (1.682)	-17.848 <sup>c</sup> (1.863)
F statistic	23.14	24.84	25.86	76.34

<sup>a</sup> Statistical significance to 10% (P < 0.1).

<sup>b</sup> Statistical significance to 5% (P < 0.05).

<sup>c</sup> Statistical significance to 1% (P < 0.01).

increases the per capita demand for cigarettes by 6.1%. This implies that the tax should change proportionately with income over time to keep from indirectly promoting consumption. The cross-elasticity of demand for cigarettes with the price of alcoholic beverages is 0.92 and is statistically significant to 5%, suggesting that alcohol consumption substitutes cigarette use, rather than complementing it. This result calls for a more detailed analysis in future studies, since the literature suggests that cigarettes and alcohol behave as complements.

In the exogenous variables representing structural changes, it is observed that the entry into force of Law No. 1 335 caused a statistically significant reduction in demand for cigarettes. Furthermore, the statistical significance of some of the variables that represent the law's entry into force, such as DAdvertencias and DELibresHumoN, shows that both the enactment of the law and its implementation affect consumption. DELibresHumoM is statistically significant, but its sign is the opposite of what would be expected. This may be because the

population protected by these local measures represents a relatively small percentage of the market or because the industry may have adopted a strategy to promote sales in areas where the measure is not applicable. These hypotheses, however, cannot be confirmed with the available data.

The assumption of relevance is validated with an F statistic greater than the critical values (29) and with the statistical significance of the instrument in the first stage. The use of a single instrument guarantees parsimony, although this does not allow for the use of over-identification tests to statistically validate the exogeneity assumption; thus, its validation is the economic arguments in section 2.

## DISCUSSION

Although multiple studies to estimate demand in countries around the world conclude that price elasticity is between -1 and 0, the estimates for each country support recommendations consistent with the local context and yield more reliable and credible tax scenarios for policymak-

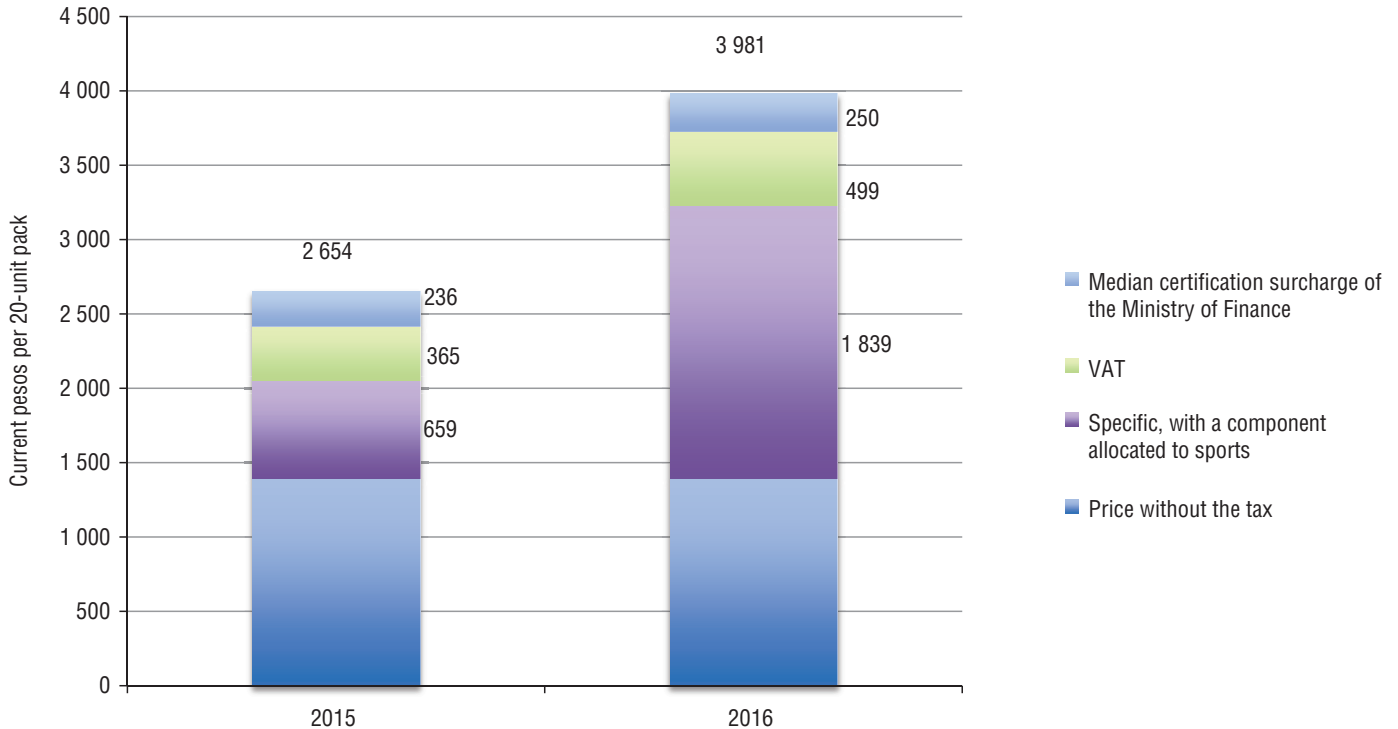
ers. This study presents robust estimates based on aggregate information on the cigarette market in Colombia that are inputs for two financial planning processes: projection and monitoring of tax revenues and forecasting of health system expenditures due to treatment costs.

Unlike previous studies, these estimates control for changes in market structure and regulation. Previous estimates of price elasticities by brand based on a cross-sectional sample (10) and of short- and long-term cigarette consumption elasticities with quarterly information (11) precede the structural changes of Law No. 1 335 of 2009. The new estimates take into account the current consumption patterns, as well as potential changes in elasticity caused by the law's entry into force.

The estimates indicate that in the period studied, the demand for cigarettes in Colombia is similar to that of middle- and low-income countries. Although the evidence indicates that cigarettes behave like a price-inelastic good, the lower limit of one of the confidence intervals obtained is -1.75, which is in the expected range of elasticity for countries with low average consumption and a majority low-income population (30). These two characteristics were present in the Colombian economy during part of the period included in the estimates. However, in the past decade, structural changes have been observed that put the country in the middle-high income bracket and, thus, lower elasticity should be expected.

The results suggest that bringing cigarette prices in the country closer to the regional average is feasible by promoting a 50% increase in 2015 prices. This would result in a 31% drop in consumption under conditions of moderate economic growth (0.2% increase in GDP per capita). To achieve this price increase, the excise tax per pack should be triple its current level (Figure 4).<sup>5</sup> Thus, tax policy would meet the objective of reducing consumption without sacrificing tax rev-

<sup>5</sup> The three taxes in 2015, instituted by laws 633 of 2000 and 1 393 of 2010 are: an excise tax on consumption, adjusted annually by the CPI, which in 2015 was COP \$658.91 (COP=Colombian pesos) per 20-unit pack (which includes a targeted component administered by the Territorial Sports Institutes); an *ad valorem* tax of 10% (called a consumption surcharge, specifically for financing health insurance), calculated using a base price certified by the Ministry of the Treasury; and the value added tax (VAT) of 16%. Import duties are not included, since in Colombia, the majority of imported cigarettes come from countries with tax preferences and enter duty-free.

**FIGURE 4. Pricing and tax structure**

**Source:** Authors' own calculations based on price surveys of the National Administrative Department of Statistics and certifications of the Ministry of Finance of Colombia. q2=second quarter; GDP=gross domestic product.

enues. In fact, under conditions of moderate economic growth, as currently expected, there is an opportunity to increase tax revenues through a substantial increase in cigarette taxes.

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## REFERENCES

- Instituto de Evaluación Tecnológica en Salud (IETS). Radiografía del tabaquismo en Colombia. 2013. Available from: [http://issuu.com/jon\\_snow/docs/tabaquis-modig/1?e=9474489/5540674](http://issuu.com/jon_snow/docs/tabaquis-modig/1?e=9474489/5540674). Accessed 30 May 2016.
- Observatorio Nacional de Salud (ONS), Instituto Nacional de Salud (INS), Ministerio de Salud y Protección Social (MinSalud). Líneas de acción. 2015. Available from: <http://www.ins.gov.co/lineas-de-accion/ons/SiteAssets/Paginas/publicaciones/5to%20Informe%20ONS%20v-f1.pdf>. Accessed 30 May 2016.
- Pardo C, Piñeros M. Consumo de tabaco en cinco ciudades de Colombia, Encuesta Mundial de Tabaquismo en Jóvenes, 2007. *Biomédica*. 2010;30(4).
- Departamento Administrativo de Ciencia, Tecnología e Innovación (Colciencias), Ministerio de Salud y Protección Social de Colombia. Encuesta Nacional de Salud 2007. Bogotá: Ministerio de Salud y Protección Social de Colombia; 2009.
- Dirección Nacional de Estupefacientes (DNE) y Ministerio de Salud y Protección Social de Colombia. Estudio Nacional de Consumo de Sustancias Psicoactivas en Colombia, 2008. Informe Final. Bogotá: Ministerio de la Protección Social (MPS) y Dirección Nacional de Estupefacientes (DNE) del Ministerio del Interior y de Justicia; 2009. Available from: [https://www.unodc.org/documents/colombia/2013/septiembre/Estudio\\_Consumo\\_Adolescentes\\_en\\_Conflicto\\_2009.pdf](https://www.unodc.org/documents/colombia/2013/septiembre/Estudio_Consumo_Adolescentes_en_Conflicto_2009.pdf). Accessed 30 May 2016.
- Secretaría Distrital de Salud (SDS), Oficina de las Naciones Unidas contra la Droga y el Delito (UNDOC), Estudio de consumo de sustancias psicoactivas en Bogotá, 2009. Bogotá: Secretaría Distrital de Salud (SDS), Oficina de las Naciones Unidas contra la Droga y el Delito (UNDOC); 2010. Available from: [http://www.descentralizadrogas.gov.co/pdfs/documentacion/estudios/Estudio\\_consumo\\_SPA\\_en\\_Bogota\\_2009.pdf](http://www.descentralizadrogas.gov.co/pdfs/documentacion/estudios/Estudio_consumo_SPA_en_Bogota_2009.pdf). Accessed 30 May 2016.
- Ministerio de Justicia y del Derecho (MinSalud), Observatorio de Drogas de Colombia (ODC). Estudio Nacional de Consumo de Sustancias Psicoactivas en Colombia, 2013. Informe Final. Bogotá: Ministerio de Justicia y del Derecho (MinJusticia), Ministerio de Salud y Protección Social (MinSalud) y Observatorio de Drogas de Colombia (ODC); 2014. Available from: [https://www.unodc.org/documents/colombia/2014/Julio/Estudio\\_de\\_Consumo\\_UNODC.pdf](https://www.unodc.org/documents/colombia/2014/Julio/Estudio_de_Consumo_UNODC.pdf). Accessed 30 May 2016.
- World Health Organization (WHO). WHO report on the global tobacco epidemic, 2015. Raising taxes on tobacco.

- World Health Organization (WHO); 2015. Available from: [http://apps.who.int/iris/bitstream/handle/10665/178574/1/9789240694606\\_eng.pdf?ua=1](http://apps.who.int/iris/bitstream/handle/10665/178574/1/9789240694606_eng.pdf?ua=1). Accessed 30 May 2016.
9. Araque A. Asesoría técnica en el mejoramiento y recolección de la información asociada a la economía del tabaco. Informe final. Organización Panamericana de la Salud (OPS), Ministerio de Salud y Protección Social (MinSalud); 2011.
  10. Santa María M, Rozo S. La reforma del impuesto al consumo de cigarrillo y tabaco elaborado: impacto sobre el recaudo. Cuadernos Fedesarrollo. 2007;(24):1-55.
  11. Curti D, Llorente B, Ariza M. Estudio de Demanda de Cigarrillos en Colombia. Centro de Investigaciones de la Epidemia del Tabaquismo (CIET) y Universidad Sergio Arboleda; 2010. Available from: <http://tejiendobienestar.blog.com/2015/08/14/impuestocigarrillo/> Accessed 30 May 2016.
  12. Dee TS. The complementarity of teen smoking and drinking. *J Health Econ.* 1999; 18(6):769-93.
  13. Araque A. Tabaco en Colombia: Costos y beneficios? *Civilizar.* 2014;14(26):133-48. Beenstock M, Rahav G. Testing Gateway Theory: do cigarette prices affect illicit drug use? *J Health Econ.* 2002;21(4):679-98.
  14. Wilkins N, Yurekli A, Hu T. Economic Analysis of Tobacco Demand. In: Yurekli A, de Beyer J, editors. *Economics of Tobacco Toolkit.* 80576. The World Bank; 2001. Available from: <http://siteresources.world-bank.org/INTPH/Resources/3Demand.pdf>. Accessed 30 May 2016.
  15. Chaloupka FJ, Wechsler H. Price, tobacco control policies and smoking among young adults. *J Health Econ.* 1997;16(3):359-73.
  16. Carpentera C, Cook P. Cigarette taxes and youth smoking: New evidence from national, state, and local Youth Risk Behavior Surveys. *J Health Econ.* 2008;27(2):287-99.
  17. Frieden TR, Mostashari F, Kerker BD, Miller N, Hajat Aa, Frankel M. *Adult Tobacco Use Levels After Intensive Tobacco Control Measures: New York City, 2002-2003.* *Am J Public Health.* 2005;95(6):1016-23.
  18. International Agency for research on Cancer (IARC). Effectiveness of Tax and Price Policies for Tobacco Control. 2011;14. Available from: <http://www.iarc.fr/en/publications/pdfs-online/prev/handbook14/>. Accessed 30 May 2016.
  19. Chaloupka FJ, Warner KE. The economics of smoking. In: *Handbook of Health Economics.* Elsevier. 2000;1:1539-1627.
  20. Meléndez M, Vásquez T. Análisis de la competencia en la industria colombiana de cigarrillos. Cuadernos de Fedesarrollo. 2009;28.
  21. Spizman L, Weinstein M. A Note on Utilizing the Geometric Mean: When, Why and How the Forensic Economist Should Employ the Geometric Mean. *J Legal Econ.* 2008;15(1):43-55.
  22. United States Department of Health and Human Services (HHS). Preventing Tobacco Use Among Youth and Young Adults. A Report of the Surgeon General. U.S. Department of Health and Human Services (HHS); 2012.
  23. International Agency for Research on Cancer (IARC). Evaluating the Effectiveness of Smoke-free Policies. International Agency for Research on Cancer (IARC). IARC; 2009. Available from <https://www.iarc.fr/en/publications/pdfs-online/prev/handbook13/handbook13.pdf>. Accessed 30 May 2016.
  24. National Cancer Institute (NCI). Changing adolescent smoking prevalence. Where it is and why. National Cancer Institute (NCI); 2001. Available from: <http://cancer-control.cancer.gov/brp/tcrb/monographs/14/m14.pdf>. Accessed 30 May 2016.
  25. Beelman M, Campbell D, Ronderos M, Schelzig E. Exposed: How billions of cigarettes end up on black markets. The International Consortium of Investigative Journalists (ICIJ); 2000. Available from: <https://www.icij.org/node/460/exposed-how-billions-cigarettes-end-black-markets>. Accessed 30 May 2016.
  26. Armendares P, Reynales Shigematsu L. Expansión de la industria tabacalera y contrabando: retos para la salud pública en los países en desarrollo. *Salud Publica Mex.* 2006;48(1):S183-9.
  27. Gilmore A. et al. Exposing and addressing tobacco industry conduct in low-income and middle-income countries. *Lancet.* 2015;385(9972):1029-43.
  28. Stock J, Yogo M. Chapter 5 Testing for weak instruments in linear IV regression. In: Andrews D, Stock J, editors. *Identification and Inference for Econometric Models.* Cambridge University Press; 2005: 80-108.
  29. Jha P, Chaloupka F. *Tobacco control in developing countries.* Oxford, U.K.: Oxford University Press; 2000.

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## RESUMEN

### Impuestos y demanda de cigarrillos en Colombia

**Objetivo.** Estimar elasticidades precio e ingreso de la demanda agregada de cigarrillos para Colombia mediante el control de cambios estructurales en el mercado desde finales de los años 90, para identificar espacios de política de impuestos que mejoren la salud pública y aumenten los recaudos fiscales.

**Métodos.** La medición de la demanda agregada de cigarrillos utiliza los ingresos brutos reportados en la declaración del impuesto al valor agregado (IVA) a la Dirección de Impuestos y Aduanas Nacionales de Colombia (DIAN) por la industria de fabricación de productos de tabaco, con descuento de las exportaciones. Se obtuvo una serie de tiempo trimestral para el período 1994–2014. La estimación econométrica por mínimos cuadrados en dos etapas (2SLS) controla por la endogeneidad del precio y utiliza un conjunto de variables dummy para controlar por cambios estructurales en el mercado y en su regulación.

**Resultados.** La demanda es, desde el punto de vista estadístico, sensible al precio y al ingreso. La elasticidad precio de la demanda es -0,78 y la elasticidad ingreso es 0,61.

**Conclusiones.** La demanda inelástica implica que es posible, a través de impuestos al consumo de cigarrillo, alcanzar metas de salud pública y aumentar el recaudo de manera simultánea. Los resultados también sugieren que el aumento considerable del ingreso de los hogares de Colombia en la primera década del siglo xxi generó aumento del poder de compra. Este, al no ir acompañado de un aumento en el impuesto, impulsó el consumo de cigarrillo, con efectos negativos en salud pública, y se desperdició una oportunidad para aumentar el recaudo fiscal.

## Palabras clave

Economía de la salud; hábito de fumar; prevención de enfermedades; impuestos; análisis de regresión; Colombia.