Pan American Journal of Public Health

Original research

Tax increases and the demand for cigarettes in El Salvador*

Alejandro Ramos-Carbajales,[1] *Martín González-Rozada,*[2] *and Hugo Vallarino*[3]

Suggested citation (Original article) Ramos-Carbajales A, González-Rozada M, Vallarino H. La demanda de cigarrillos y el aumento de impuestos en El Salvador. Rev Panam Salud Publica. 2016;40(4):237-42.

ABSTRACT

Objective. *Analyze the short- and long-term elasticities of the demand for cigarettes in El Salvador as a tool for supporting recommendations on tax increases to reduce prevalence and consumption through price increases.*

Methods. *Demand for cigarettes in El Salvador was analyzed through an econometric time-series model using a database from El Salvador's General Directorate of Internal Revenue (DGII) and the General Directorate of Statistics and Census (DIGESTYC). The analysis period was quarterly: 2000Q1-2012Q4. The usual tests were done to prevent a spurious econometric estimation. It was found that the variables of sales volume, actual sales prices, and actual per capita income exhibited first-order cointegration; this result makes it possible to use an error correction model with short- and long-term elasticity estimates.*

Results. *Only long-term elasticities were found to be statistically significant at the 5% level. Results show a long-term price elasticity (5 quarters) of -0.9287 and an income price elasticity of 0.9978.*

Conclusions. *Absolute price elasticity is somewhat high, although it is within the levels estimated in other studies in low per-capita income countries. A tax increase from a base amount of US$1.04 per pack of 20 cigarettes to US$1.66 within three years would reduce demand by between 20% and 31% and would increase tax revenues by between 9% and 22%.*

Key words: Tobacco use; health economics; El Salvador.

As of October 2014, El Salvador was the only country in Central America and one of the few in the world that had not ratified the Framework Convention on Tobacco Control (FCTC), despite having signed it on 18 March 2004. Although the country passed a tobacco control law on 23 June 2011, tax and price increases have never been part of its tobacco control strategies.

For years, increasing tobacco taxes has been considered essential and the most cost-effective strategy in the effort to reduce consumption, as the World Health Organization has recognized (1).

Cigarette tax policies should be based on demand estimates, which El Salvador lacks, in contrast to most other countries in the region.

This demand study is designed to remedy said deficit. To estimate the demand for cigarettes in El Salvador, updated methodological approaches and recent studies in the region where followed (2, 3).

The demand for cigarettes tends to have a price elasticity of less than 1 in absolute value, indicating that demand for cigarettes is relatively rigid: demand falls as a result of cigarettes being a normal good, but less than proportionately to the increases in price. This characteristic is one of the pillars of tax increase policies, since the dual purpose of a price increase via taxation is to reduce consumption and increase tax revenue.

An increase in the income of smokers leads to higher quantities of cigarettes demanded; thus, income elasticity has a positive value; with the majority of studies finding a value of nearly 1. This means that cigarettes are a normal good.

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

[1] Interamerican Heart Foundation, Buenos Aires, Argentina. Direct all correspondence to Alejandro Ramos-Carbajales. E-mail: aleram22@gmail.com

[2] University Torcuato Di Tella, Buenos Aires, Argentina.

[3] University of the Republic of Uruguay, Montevideo, Uruguay.

Essentially, elasticities can be estimated using a cross-sectional econometric model (for example, through data from a prevalence and consumption surveys with data on smokers and nonsmokers) or an aggregate demand model where cigarette sales are used as a proxy for consumption.

MATERIALS AND METHODS

In the case of El Salvador, an aggregate demand model using time series data was used. The period of analysis was quarterly, based on 2000Q1 (first quarter of 2000) to 2012Q4 (fourth quarter of 2012) using sales data from the General Directorate of Internal Revenue (DGII). The basic data consists of cigarette prices, sales volume, and smokers' income. The real cigarette price variable was obtained using nominal price data from the General Directorate of Statistics and Census (DIGESTYC) and deflated by the consumer price index (CPI). The quantity demanded (using sales volume as a proxy) was calculated using DGII data on the value of sales, which were deflated by the cigarette price index to obtain a volume of sales index, which was then disaggregated quarterly. Real income was calculated as the sum of the quarterly gross domestic product (GDP) reported by the Central Reserve Bank. The authors added remittances from abroad (from the same source), which, in the case of El Salvador, are very important.

Figures 1 and 2 show the trends in these three main variables.

The trends in the real price of cigarettes and quantity of cigarettes demanded are inversely related, as tends to occur in demand studies. A sharp drop in cigarette sales is also observed at the end of the period.

The real income series for the Salvadorian population in Figure 2 shows a drop and subsequent recovery in 2009 (4, 5). The 2008 financial crisis in the United States negatively impacted the Salvadorian economy in several ways, reducing exports and, consequently, the income of exporters. This resulted in unemployment and greater emigration, as well as a drop in family remittances. The decline in sales led tobacco companies to substantially increase the real price (as observed in Figure 1), perhaps to offset the lower demand due to the drop in real income through the wholesale price.

Definition of the econometric study variables

Volventas_sapc. These are the seasonally adjusted quarterly cigarette sales by volume, converted to per capita values using the over-15 population projections of the DIGESTYC. It is an index with a Dec 2009 = 100 reference base. It is the dependent variable and a proxy of per capita cigarette consumption.

Realpricetrim. This is the quotient of the cigarette price series taken from DIGESTYC and the consumer price index (CPI). The cigarette prices are taken from a database of market prices collected by DIGESTYC for the CPI in 1992 and 2009.

Ynbreal_sapc. This is an estimated quarterly series of the gross national income available at constant prices. It was constructed using the quarterly GDP from the Central Reserve Bank of El Salvador and remittances from abroad (mainly from emigrants to their families in El Salvador; data also from of the Central Reserve Bank), representing about 10% of GDP. The series was seasonally adjusted and the per capita values were estimated, yielding the ynbreal_sapc variable.

Given the characteristics observed in Figures 1 and 2, both the final and initial quarters of the series were treated as extreme values (outliers) through the creation of the dummy variable "dummy outliers").

To reflect the real income recovery beginning in 2008, a binary variable was used (equal to one from 2008 onward).

Definition of the econometric model

The model is focused on the long- and short-term relationship that determines the demand for cigarettes resulting from changes in price and real income.

The Augmented Dickey-Fuller (ADF) test was used to evaluate the stationarity of each series (6). The results for the seasonally adjusted sales (volventas_sa), real price (realpricetrim), and real

FIGURE 1. Trends in the real price of cigarettes and sales volume in El Salvador, 2000-2012

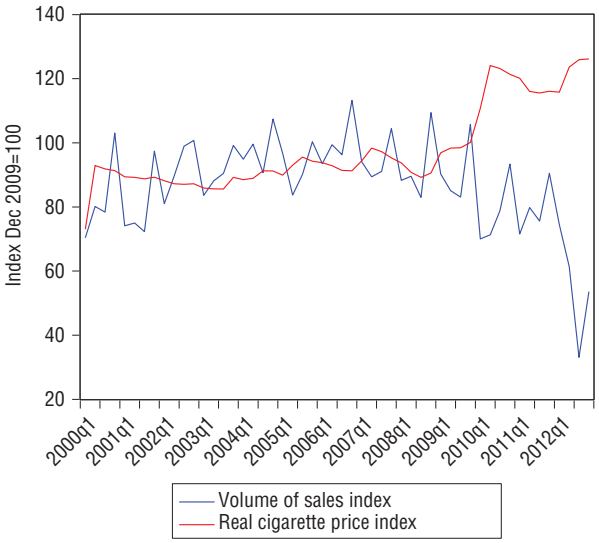

FIGURE 2. Trend in real income in El Salvador, 2000-2012

income (ynbreal) variables show that all are non-stationary and follow a first-order integrated stochastic process.

The result of the ADF analysis for ynbreal_sapc is -1.68, but for the other variables it is equal. The value of the test statistic,-1.68, is not exceeded by the usual critical values (5%); as a result, the hypothesis that the variable has a unit root is not rejected, which is the same as saying that it is I(1) (first-order integrated).

As a result, individually, the variables are non-stationary and contain a stochastic trend.

The real income variable (ynbreal) is a special case, due to a possible structural change since the second quarter of 2008. Thus, the Phillips-Perron test (1989) (7) was used; this test accepts the unit root null hypothesis in the presence of a structural change in the series.

Thus, it is confirmed that the three variables are I(1) and, as a result, should be evaluated to determine whether they are cointegrated. To this end, the Johansen trace test (8) was used, whose results are presented in Table 1. The null hypothesis of a cointegration relationship among the variables is accepted; as a result, the cigarette demand function can be specified through an error correction model.

Given the random trajectories *I*(1) of the model's variables and the fact that they are cointegrated, the best predictor of this trajectory in the short term is the value of the variable in an immediately previous moment, plus its average growth rate, which adds a component of randomness.

Hence, the differences between two consecutive values at the time the variables are proposed as:

$\Delta c_t = g_c + \eta_{1,t}$

$\Delta p_t = g_p + \eta_{2,t}$

$\Delta y_t = g_{y1} + g_{y2} D + \eta_{3,ty}$

where δ it is the finite difference of the first order, which determines the change in c (p, y) between t-1 and t; $\eta_{1,t}$ (η_2, t, $\eta_{3,t}$) is a static process with a zero average; and g_c (g_p, gy_1, gy_2) is the average cigarette consumption growth rate (price and income, respectively). D is a binary variable that adopts a unit value beginning in the second quarter of 2008.

The relationship among these three variables determines that, in equilibrium, the three growth rates are equal.

The variables are cointegrated, which means that this function represents the long-term equilibrium ratio between the variables, measured in natural logarithms:

$C_t = k_1 + \lambda_1 p_1 + \lambda_{2yt} + u_t$

where c_t is the natural logarithm of cigarette consumption (using per capita seasonally adjusted sales, volventas_sapc, as a proxy), p^t is the natural logarithm of the real cigarette sales price index (represented by the variable realpricetrim), yt is the natural logarithm of the real per capita income of the population (ynbreal_sapc) in the period *t*: k_1, λ_1, *and* λ_2 are parameters to estimate and u_t is a stationary error with a zero average.

λ_1 *and* λ_2 are the long-term elasticities of demand for cigarettes to be estimated in relation to price and real income, respectively. In the short term, the variables may not be on the path to equilibrium.

A general model is used with *r* quarters of lag for the short-term dynamic:

See equation in PDF

where, δ, α, β, ϒ, α_1*, β_0, β_j*, Υ_0, Υ_j* and κ_i* are the parameters of the model and ε_t is a static error term . In this model, the dynamic consumption through the difference between period t and the previous period is explained by two components. The first is the difference between consumption in the previous period and the equilibrium ratio (the term in brackets) and is affected by a coefficient that may be either positive or negative.

The term in brackets is equal to u_{t-1}; thus, for the variables to be in equilibrium in the long-term, u_{t-1} must be equal to 0.

All the other components in first differences are the short-term effects.

RESULTS

Table 2 shows the results of the long-term elasticity estimate. It is observed that the model adequately responds to the data and that the long-term ratio yields a statistically significant estimate of price elasticity at the 5% level of -0.9287. This is an absolute value greater than that estimated in other countries in Latin America, where the majority of estimates are less than 0.5 (2). Income elasticity is also statistically significant at the 5% level and is estimated at 0.9978. This estimated value is greater than that observed in the majority of studies in the region, where the estimates hover around 0.5, although there is strong variance in the results outside the region (9).

The short-term elasticities are shown in Table 3 and are not significant, indicating that, since the lag in levels is 5, long-term equilibrium with a change in the real price and income is reached in 5 quarters. This result is similar to that of other countries in the region such as Argentina (4), Peru (10, 11), and Uruguay (3, 7).

Simulated tax policy, based on the estimates

For many years, cigarettes and tobacco products in general in El Salvador have been subject to both excise taxes (tax on tobacco products–ETP) and general taxes (value-added tax–VAT). In 2012, the base year, a mixed type of excise tax was levied on tobacco products (ETP), comprised of an *ad valorem* component with an rate of 39% on the retail sales price (RSP) (the baseline assessment excluded the VAT and the tax itself), which implied 24.83% of the RSP; a specific component of US$0.45 on each pack of 20 cigarettes, which represented 18.99% of the RSP; and

TABLE 1. Econometric model of demand for cigarettes in El Salvador: evaluation of cointegration of the model's variables using the Johansen tracer test

Null hypothesis	Eigen Values	J_{trace} Statistic	Critical value 5%
No cointegration vector	0.41138	32.50454	29.797
At the most, one cointegration vector	0.148907	7.615083	15.495
At the most, two cointegration vectors	0.000789	0.037112	3.841

TABLE 2. Econometric model of the demand for cigarettes in El Salvador: results of the error correction model and long-term elasticities, 2000Q1-2012Q4 [a]

Variable	Coefficient	Standard Error	t Statistics	P Value
Log (realtrim, real sales price)	-0.928672	0.09520	-9.75446	0.0000
Log (ynnbtrim_sapc, real per capita income)	0.997847	0.13183	7.56907	0.0000
Constant	Yes	N/A	N/A	N/A

Source: Authors' own preparation.

[a] Dependent variable: Log (volventas sapc = per capita cigarette consumption). Estimate model: error correction model. N/A=Not applicable.

a VAT of 13%, which represented 11% of the RSP. Column 1 in Table 4 shows the composition of the RSP of the most popular brand in current dollars, based on these percentages, whose percentage as a share of the RSP is shown in column 2.

Two hypotheses based on a specific excise tax are formulated, as WHO currently recommends (12), depending on the potential opposing strategies of tobacco companies and importers related to wholesale prices and the retail sales and distribution margins that they control.

The proposed simulation raises the excise tax from a level of (0.45 + 0.59) = US$1.04 for a pack of 20 cigarettes in the base year to US$1.66 in year 3 (a 60% increase from start to finish).

The system of equations for calculating the RSP has two degrees of freedom:

RSP = tobac + ETP + VAT

VAT = 0.13 × (RSP/1.13) = 11.50% × RSP

RSP = (tobac + ETP/0.8850)

where *tobac* = tobacco companies. Given the VAT rate, when establishing a 3-year projection for the ETP, the RSP depends on the strategic response of tobacco companies. The opposing strategies identified would be to transfer the tax directly to the RSP without altering the wholesale price and other sales margins, or to increase the wholesale price until the gross profit offsets the decline in sales volume. Of course, intermediate strategies would also be valid alternatives to these two identified hypotheses. These opposing hypotheses are analyzed in Tables 4 and 5.

TABLE 3. Econometric model of the demand for cigarettes in El Salvador. Results of the error correction model and short-term elasticities, 2000Q1-2012Q4[a]

Variable	Coefficient	Standard Error	t Statistics
Error correction term	-1.381977	0.43949	-3.14454
Δ (Log [real sales price $_{t-1}$])	0.370364	0.72587	0.51023
Δ (Log [real sales price $_{t-2}$])	0.929489	0.66810	1.39124
Δ (Log [real sales price $_{t-3}$])	1.05813	0.73296	1.44185
Δ (Log [real sales price $_{t-4}$])	0.004293	0.34682	0.01238
Δ (Log [real income p/c $_{t-1}$])	-1.277377	1.22759	-1.04156
Δ (Log [real income p/c $_{t-2}$])	0.517539	1.26453	0.40927
Δ (Log [real income p/c $_{t-3}$])	1.816663	1.39971	1.29788
Δ (Log [real income p/c $_{t-4}$])	0.864719	1.31098	0.65960
Δ (Log [consumption p/c $_{t-1}$])	0.288031	0.42699	0.60430
Δ (Log [consumption p/c $_{t-2}$])	0.193346	0.37020	0.52228
Δ (Log [consumption p/c $_{t-3}$])	0.406434	0.31986	1.27067
Δ (Log [consumption p/c $_{t-4}$])	0.262797	0.23234	1.13110
Constant	0.042032	0.04022	1.57763

Source: Authors' own preparation.

[a] Dependent variable: Log (volventas sa_pc= per capita cigarette consumption). Estimate model: error correction model

TABLE 4. Simulation of a new cigarette tax policy in El Salvador [a]

	Base: most popular brand (2012)		Proposed 1st year		Proposed 2nd year		Proposed 3rd year	
	US$	%	US$	%	US$	%	US$	%
Wholesale/retail margin	1.06	44.68	1.06	38.09	1.06	35.77	1.06	34.38
Selective - specific	0.45	18.99	1.40	50.43	1.56	52.70	1.66	53.90
Selective - AdVal	0.59	24.83	0.00	0.00	0.00	0.00	0.00	0.00
VAT	0.27	11.50	0.32	11.50	0.34	11.50	0.35	11.50
RSP (retail price)	2.37	100.00	2.78	100.00	2.96	100.00	3.08	100.00
Reduction in consumption	N/A	N/A	N/A	N/A	N/A	N/A	N/A	20
Total tax share ETP + VAT	1.31	55.3	1.72	61.90	1.90	64.20	2.01	65.40
Increased collection of ETP	N/A	N/A	N/A	N/A	N/A	N/A	N/A	22

Source: Authors' own preparation.

[a] Hypothesis 1: 60% increase in the ETP in 3 years without changes in the wholesale price or distribution and sales margins.

US$=United States dollars; VAT= value-added tax; ETP=selective tax on tobacco products; N/A= not applicable.

TABLE 5. Simulation of a new cigarette tax policy in El Salvador [a]

	Base: Diplomat (2012)		Proposed 1st year		Proposed 2nd year		Proposed 3rd year	
	US$	%	US$	%	US$	%	US$	%
Wholesale/retail margin	1.06	44.68	1.34	43.27	1.49	43.28	1.53	42.38
Selective - specific	0.45	18.99	1.40	45.22	1.56	45.22	1.66	46.11
Selective - AdVal	0.59	24.83	0.003	0.00	0.00	0.00	0.00	0.00
VAT	0.27	11.50	0.36	11.50	0.40	11.50	0.41	11.50
RSP (retail price)	2.37	100.00	3.10	100.00	3.45	100.00	3.60	100.00
Reduction in consumption	N/A	N/A	N/A	N/A	N/A	N/A	N/A	31
Total tax share ETP + VAT	1.31	55.3	1.76	56.7	1.96	56.7	2.07	57.6
Increased collection of ETP	N/A	N/A	N/A	N/A	N/A	N/A	N/A	9

Source: Authors' own preparation.

[a] Hypothesis 2: 60% increase in the ETP with increases in the wholesale price and/or sales margins to offset the drop in sales volume.

US$=United States dollars; VAT= value-added tax; ETP= selective tax on tobacco products; N/A=not applicable.

In this first hypothesis, with these tax increases, the drop in sales (= consumption) would be 20% in three years, and tax revenue would increase by 22%.

Simulated below is the second hypothesis, in which the tobacco companies and importers would increase wholesale prices and distribution margins until they offset, in terms of value, the drop in sales volume. This strategy has proven effective in Uruguay (7).

In this second hypothesis (Table 5), the reduction in sales (= consumption) in three years would be 31% and the increase in tax revenue, 9%.

DISCUSSION

Considering the two hypotheses, it can be concluded that the reduction in consumption would range from 20% to 31% in three years and that tax revenue increases would range from 9% to 22%, according to the hypotheses of the level of tax increases and the tobacco companies' reaction to these increases.

Based on the simulation conducted, the RSP of the most popular brand of cigarettes would range from US$3.08 to US$3.60 in the third year and the total tax share on RSP levels would range from 57.6% to 65.4%.

Had these policies been implemented in El Salvador in 2012, in three years they would have yielded an RSP for the most popular brand similar to that of Costa Rica (US$2.70) and close to Uruguay (US$3.51), but somewhat lower than Panama (US$3.73) and Chile (US$3.74). The total tax share on the RSP would be similar to that of Panama (56.5%), somewhat lower than Uruguay (68.5%), and substantially lower than Costa Rica (71.5%) and, especially, Chile (81%) (13).

Not having the average price for cigarettes could be a constraint for this ETP simulation, however, the price of the most popular brand, which was used in the analysis, was at an intermediate level between the cheapest and the most expensive brand in 2012.

Finally, it should be noted that a sustainable cigarette tax policy should not have a 3-year horizon.

Furthermore, the impact of the tax and subsequent price increases on the different socioeconomic groups cannot be visualized with the aggregate demand model used here. The impact should be investigated in future research projects using databases with information from specific surveys that contain prevalence and consumption data.

Acknowledgements. The authors would like to thank Liliana Choto, Verónica Villalta, and Luis Morera for the support received in El Salvador.

Funding. The authors would like to thank the International Development Research Center (IDRC) of Canada through the "Raising tobacco taxes in selected countries of Central America" Project, IDRC 106841-001.

Conflicts of interest. None declared.

Disclaimer. Authors hold sole responsibility for the views expressed in the manuscript, which may not necessarily reflect the opinion or policy of the *RPSP/PAJPH* or PAHO.

REFERENCES

1. World Health Organization (WHO). Technical Manual on Tobacco Tax Administration. WHO Press, Geneva. World Health Organization, 2010.
2. Guindon E, Paraje G, Chaloupka F. Impact of Prices and Taxes on the Use of Tobacco Products in Latin America and the Caribbean. American Journal of Public Health. 2015;105(3). Available from: http://www.ncbi.nlm.nih.gov/pmc/issues/249485/ Accessed 16 May 2016.
3. Ramos-Carbajales A, Clemente A, González-Rozada, M. Impuestos al tabaco y políticas de control del tabaco para México, Brasil y Uruguay. Resultados para Uruguay. México D.F: Fundación InterAmericana del Corazón, 2013. Available from: http://ficmexico.org/wp-content/uploads/2014/08/uruguay_web.pdf Accessed 16 May 2016.
4. Ministerio de Hacienda de El Salvador. Efectos de la Crisis y Medidas Implementadas para Enfrentarla. Boletín Presupuestario. 2011(1). Available from: http://www.transparenciafiscal.gob.sv/downloads/pdf/DC4333_Boletin_Presupuestario_Enero-Marzo_2011.pdf Accessed 16 May 2016.
5. Banco Mundial. El Salvador: panorama general. Available from: http://www.bancomundial.org/es/country/elsalvador/overview Accessed 16 May 2016.
6. Dickey DA, Fuller WA. Distribution of the Estimators for Autoregressive Time Series with a Unit Root. J Amer Statistic Assoc. 1979;74(366):427–31.
7. Perron, P. The Great Crash, the Oil Price Shock, and the Unit Root Hypothesis. Econometrica. 1989;57(6):1361–401.
8. Johansen S. Estimation and Hypothesis Testing of Cointegration Vectors in Gaussian Vector Autoregressive Models. Econometrica. 1991;59(6):1551–80.
9. International Agency for Research on Cancer (IARC). Effectiveness of Tax and Price Policies for Tobacco Control. In: Handbooks of Cancer Prevention. Tobacco Control. Lyon: IARC; 2011. Available from: http://www.iarc.fr/en/publications/pdfs-online/prev/handbook14/ Accessed 16 May 2016.
10. Gonzalez-Rozada M, Ramos-Carbajales A. Implications of raising cigarette excise taxes in Peru. Rev Panam Salud Publica. 2016; 40(4):250–5.
11. Ramos-Carbajales A, González-Rozada M, Vallarino H. Tributación sobre los productos del tabaco: panorama general y propuesta de reforma. Lima: Comisión Nacional Permanente de Lucha Antitabáquica (COLAT); 2014.
12. World Health Organization (WHO). Framework Convention on Tobacco Control (FCTC). Convention of the Parties. Guidelines for the application of art. No. 6. Sixth session Moscow, Russian Federation, 13–18 October 2014. Available from: http://www.who.int/fctc/treaty_instruments/Guidelines_Article_6_English.pdf?ua=1 Accessed 16 May 2016.
13. World Health Organization report on the global tobacco epidemic 2013. National taxes and retail price for a pack of 20 cigarettes, 2012. Available from: http://www-who.int/tobacco/global_report/2013/appendix_ix_table_9_1.pdf?ua=1 Accessed 16 May 2016.

Manuscript received on 9 January 2016. Revised version accepted for publication on 20 May 2016.

RESUMEN

La demanda de cigarrillos y el aumento de impuestos en El Salvador

Objetivo. Analizar las elasticidades de corto plazo y de largo plazo de la demanda de cigarrillos en El Salvador como instrumento para apoyar recomendaciones sobre aumentos de impuestos para reducir la prevalencia y el consumo vía aumento de precios.

Métodos. Se analizó la demanda de cigarrillos en El Salvador mediante un modelo econométrico de series de tiempo con una base de datos proveniente de la Dirección General de Impuestos Internos (DGII) y la Dirección General de Estadística y Censos (DIGESTYC) de El Salvador. El período de análisis fue trimestral: 2000Q1-2012T4. Se realizaron las pruebas habituales para evitar que la estimación econométrica fuera espuria. Se halló que las variables ventas en volumen, los precios reales de venta y el ingreso real per cápita estaban cointegradas de primer orden; este resultado permite utilizar un modelo de corrección de error con estimaciones de las elasticidades en el corto plazo y en el largo plazo.

Resultados. Se halló que solo las elasticidades de largo plazo son estadísticamente significativas al 5% de probabilidad. Los resultados señalan una elasticidad precio de largo plazo (cinco trimestres) de -0,9287 e ingreso de 0,9978.

Conclusiones. El nivel del valor absoluto de la elasticidad precio es algo elevada, aunque está dentro de los niveles estimados en otros estudios en los países de menores ingresos per cápita. Un aumento del impuesto de un monto base de USD (dólares estadounidenses) 1,04 por cajetilla de 20 cigarrillos a USD 1,66 en un período de tres años reduciría la demanda entre 20% y 31% y aumentaría los ingresos fiscales entre 9% y 22%.

Palabras clave: Uso de tabaco; economía de la salud; El Salvador.