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Analysis of cigarette demand in Argentina: the impact of price changes on consumption and government revenues

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Abstract

Objective. To estimate cigarette demand and to simulate a tax policy targeted to reduce tobacco consumption. **Materials and methods.** Demand was estimated using a vector error correction model. Simulation exercises present the impact of a tax increase on consumption and revenues. **Results.** Changes in real income and the real price of cigarettes affect the demand for cigarettes in Argentina. The long term price elasticity is 0.279 (a 10% increase in real prices reduces cigarette consumption by 2.79% per quarter) and the long term income elasticity is 0.411 (a 10% increase in real income raises consumption by 4.11% per quarter). Even in a conservative scenario, simulations show that increasing the price of cigarettes by 100% using excise taxes would maximize revenues and reduce cigarette consumption. **Conclusion.** There is sufficient room to increase taxes, reducing cigarette consumption, while still increasing tax revenues.

Keywords: tobacco; taxes; elasticity; health policy; Argentina

Rodríguez-Iglesias G, Schoj V, Chaloupka F, Champagne B, González-Rozada M.
Análisis de la demanda de cigarrillos en Argentina: impacto de variaciones de precios en el consumo y recaudación
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Resumen

Objetivo. Estimar la demanda de cigarrillos y simular una política fiscal dirigida a reducir el consumo de tabaco. **Material y métodos.** Se estima la demanda mediante el modelo de corrección de errores. Se simula el impacto del incremento de los impuestos en el consumo y la recaudación. **Resultados.** Las variaciones en ingreso y precio real de los cigarrillos afectan la demanda. La elasticidad precio de la demanda de largo plazo es de 0.279 (10% de aumento en los precios reales reduce el consumo de cigarrillos en 2.79% en un trimestre) y la elasticidad ingreso de largo plazo es 0.411 (10% de aumento en el ingreso real aumenta el consumo en 4.11% en un trimestre). Aun en un escenario conservador, un incremento del precio de los cigarrillos de 100% vía impuestos maximizaría la recaudación y reduciría el consumo de cigarrillos. **Conclusión.** Es posible incrementar los impuestos reduciendo el consumo de cigarrillos e incrementando la recaudación.

Palabras clave: tabaco; impuestos; elasticidad; política de salud; Argentina

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A growing literature shows that the overall demand for tobacco products is significantly affected by changes in tobacco prices.[1-4] Empirical evidence for high-income countries shows a demand price elasticity in the range of -0.25 to -0.50.[5] In the last years there has been evidence from low and middle-income countries, showing elasticity to be at least as responsive, and often more responsive, to price than it is in high-income countries.[6-11]

According to the National Risk Factor Survey 2013, 25% of the Argentinean population smokes,[12] and cigarette smoking contributes to over 40 000 deaths per year, with an estimated 13.5% of all deaths attributable to tobacco.[13] Argentina did not ratify the World Health Organization's (WHO) Framework Convention on Tobacco Control (FCTC), as a result of tobacco industry influence, mostly through tobacco growers.[14]

In June 2011, a comprehensive National Tobacco Control Law (Act 26687) was passed. However it did not include mention of cigarette taxes or pricing.

Argentina has one of the cheapest cigarettes in the world. Cigarettes have become twice as affordable in 2014 that in 2004.[15]

If the government increases tax rates, prices will increase, and consumption will decrease. Price elasticity allows us to quantify changes in consumption as a result of price variations.

To obtain price elasticity we estimated a cigarette demand function. Using a similar methodology but different data sets, González-Rozada[7] and Martinez, Mejia and Perez-Stable[16] have found Argentina's demand price elasticity ranging from -0.26 to -0.31. The present study updates González-Rozada's analysis and develops simulations to analyze the impact of price changes on consumption and government revenues. This study introduces a cigarette tax structure analysis in the simulation of the impact of a tax increase. Understanding of the tax structure is necessary in the definition of a cigarette tax increase. Findings in elasticity estimations, cigarette tax structure, and simulation estimations can be used in tobacco control policies, as demonstrated in other countries.

Materials and methods

This paper focuses on cigarette consumption because 98.2% of tobacco consumers in Argentina smoke cigarettes.[17] We used monthly data on cigarette sales and average weighted prices published by the Secretary of Agriculture (SAGPyA) from January 1996 to February 2004.[18] From March 2004, these data were published by the Ministry of Agriculture (MINAGRI).[19] The average nominal income of the private sector (computed by the Ministry of Economics, MECON)[20] was used as a proxy for the nominal income of the population. Variables were expressed in real terms, dividing nominal data by the consumer price index (CPI) computed by the National Statistics Agency (Instituto Nacional de Estadísticas y Censos, INDEC)[21] for the period of January 1996 to December 2006 linked with the estimated monthly inflation rate computed by independent private consultants from January 2007 onwards.[15]

To establish the functional form of the demand for cigarettes, it is necessary to determine the statistical properties of the individual series. The order of integration of each series was determined by the augmented Dickey-Fuller (ADF) test.[22]

As seen in table I, consumption and price series do not separately reject the hypothesis of a unit root. Consequently, the price and consumption variables individually have a stochastic trend.

We used the Perron formal procedure to contrast unit root in the presence of a structural break.[23,24] As Perron test statistic (table I) is lower than the critical value, we cannot reject the null hypothesis of unit root in the presence of a structural break, then real income is a non-stationary series.

In sum, cigarettes consumption, real average retail price and real income individually follow a random walk. The only possibility to estimate a demand function for cigarettes was if the three variables were cointegrated.

We tested cointegration using two procedures; Engle-Granger[25] and Johansen tests.[26] Table II presents the Engle-Granger procedure, showing that residuals are stationary. To confirm this result, we applied the Johansen cointegration test[26] that rejects the null hypothesis of no cointegration vector and cannot reject null hypothesis of one cointegration vector.

Empirical evidence suggests cointegration among the variables.

Cigarette demand function

Cointegration implies that the cigarette demand function can be specified with an error correction model (ECM) that takes into account both the short-run dynamics and the long-run relationship between the variables.

The long-run equilibrium function is:

$$c_t = k_i + \lambda_1 p_t + \lambda_2 \gamma_t + \mu_t \quad (1)$$

where c_t is the natural logarithm of cigarettes consumption, p_t is the natural logarithm of real average retail price of cigarettes, and y_t is the natural logarithm of real income of the population at time t. λ_1 and λ_2 are parameters and ut is a stationary error with zero mean. k_i includes coefficients on the control variables, λ_1 can be

Table I
AUGMENTED DICKEY-FULLER AND PERRON UNIT ROOT TESTS. ARGENTINA, 2015

Variable	*ADFτ Statistic*	*P-value*	*Lags*
Log (cigarettes consumption)	-1.511521	0.526	14
Log (average retail price of cigarettes in real terms)	-2.333191	0.1625	0
Variable	*Perron T-Statistic*	*1% Critical Value*	*Lags*
Log (real income)	0.224654	-4.51	15

Source: Authors' estimation using national data.19,21,32 Real price base for January 1996=100
Note: The number of lags was selected according to the Schwarz Information Criterion. The probability of rejection was calculated using the critical values for the test tabulated in.33 log denotes the natural logarithm

Table II
ENGLE-GRANGER AND JOHANSEN COINTEGRATION TESTS. ARGENTINA, 2015

Engle-Granger test	*ADFτ-Statistic*	*P-value*	*Lags*
Variable: Residuals	-5.178634	0	2
Johansen Cointegration test Null Hypothesis	*Eigen values*	J_{trace} *Statistic*	*5% Critical Value*
No cointegrating vectors	0.114406	38.7561	29.79707
At most one cointegrating vectors	0.038812	11.4194	15.49471
At most two cointegrating vectors	0.011105	2.51266	3.841466

Source: Authors' estimation
Note: The number of lags was selected according to the Schwarz Information Criterion. The Engle-Granger Test probability of rejection was calculated using the critical values for the test tabulated in.[33] The Johansen Cointegration test probability of rejection was calculated using the[34] critical values

interpreted as the long-run price elasticity of demand, while λ_2 is the long-run income elasticity of demand.

In the short-run, the variables may not be in the steady state (long-run equilibrium). Outside the steady state, the lag structure of the model cannot be specified with certainty. Therefore, short term is part of a general model with r lags (months),

$$\Delta c_t = \delta + (\alpha - 1)\left\{c_{t-1} - \frac{k_j^*}{1-\alpha} - \frac{\beta}{1-\alpha}\, p_{t-1} - \frac{\gamma}{1-\alpha}\, y_{t-1}\right\} + \sum_{j=1}^{r-1} \alpha_j^* \Delta c_{t-j} + \beta_0 \Delta p_t + \sum \beta_j^* \Delta p_{t-j}^{r-1} + \gamma_0 \Delta y_t + \sum \gamma_j^* \Delta y_{t-j}^{r-1} + \varepsilon_t \quad (2)$$

where β_0 is the short-run price elasticity and γ_0 is the short-run income elasticity of consumption. ε_t is a stationary error term. The term in the curly brackets represents the long-run relation (1), while all variables in first differences measure the short-run dynamics of the model. The long-run equilibrium is reached when the braces term, called error-correction term is equal to zero.

Results

Elasticity estimations

Table III shows the results of the long-run and short-run estimations. The long-run cigarette price elasticity is -0.28, while the long-run cigarette income elasticity is 0.41. Thus, 10% increase in real prices will reduce long-run total cigarette consumption by 2.79%, and 10% increase in real income will raise long-run consumption by 4.11%. The long-run is defined by estimating coefficient *r* in equation (2). The Johansen test states that the value of r-1 is equal to 2. This implies that the long-run is three months (a quarter) (table III).

The short-run price elasticity of demand –β_0– and the short-run income elasticity –γ_0– are not statistically significant. The coefficient associated with the error

Table III
Long-Run and Short-Run Elasticity Estimates. Argentina, 2015

Long-run elasticities			*Short-run elasticities*		
Variable	*Coefficient*	*t-Statistic*	*Variable*	*Coefficient*	*t-Statistic*
Log (Average Real Retail Price)	-0.2796‡	-5.90	Error Correction Term	-0.421‡	-3.784
			Δ (Log(real retail pricet))	-0.208	-1083
Log (Real Income)	0.411‡	6.681	Δ (Log(real incomet))	-0.1186	-0.4027
			Δ (Log(real retail pricet-1))	-0.066	-0.337
D	0.065‡	6.344	Δ (Log(real retail pricet-2))	0.229	1.18
13th Month Pay – June Half	-0.041*	-2.343	Δ (Log(real incomet-1))	-0.265	-0.898
			Δ (Log(real incomet-2))	0.13	0.452
13th Month Pay – December Half	0.177‡	10.08	Δ (Log (total cigarette consumption)t-1)	-0.589‡	-7.501
			Δ (Log (total cigarette consumption)t-2)	-0.372‡	-5.8585
Constant	9.247‡	22.149	Constant	0.0015	0.258
Adjusted R-squared	0.5157		Adjusted R-squared	0.472	
F-statistic	49.337		F-statistic	23.234	
Prob (F-statistic)	0		Prob (F-statistic)	0	

* $p < 0.05$
‡ $p < 0.01$

Source: Authors' estimation using national data.21,32,35 Real price base for January 1996=100
Notes: 13th Month Pay – June Half and 13th Month Pay – December Half are dummy variables that take on the value 1 for June and December, respectively, to capture the effect of the split 13th month pay and any seasonal effects
D captures March 2002 structural break
Short-run lags are determined by the Johansen test. D is the finite difference operator
Log denotes the natural logarithm
Dependent Variable: Log (Total Cigarette Consumption)
Estimation Method: Least Squares
Sample: 1996:01 2014:12

correction term –(α-1)– is negative and statistically significant, which means that the model is stable.

Cigarette tax structure

In December 2014, the average price of a pack of cigarettes was AR$17.42, and the federal tax percentage collected on each pack was 69.25%. Taxes levied on tobacco products are, in general, ad valorem. There is a consumption tax (Value Added Tax (VAT) and three excises taxes: Additional Emergency Tax (AET); Special Tobacco Fund (FET) and Internal tax (IT). The only tax that is not ad valorem is a small component of the FET that is specific. In nominal terms, IT account for 60%, IAE for 7%, VAT for 21% and FET for 8.35%. However, the taxes are applied over different tax bases differing nominal rates from the share of the price that each tax accounts. The total tax burden accounts for 68.18% of the average price of a pack of cigarettes in Argentina (AR$11.88 / AR$17.42 x 100 = 68.18%).Other tobacco products (cigars, roll-your-own, etc.) have significantly lower taxes (VAT 21% and IT from16 to 20%) table IV shows the tobacco tax structure and the percentage of tax as a share of the price.

Table IV
Components of price of a pack of cigarettes. December 2014

Component	*Amount (argentinean pesos)*	*Percentage of overall price*
Taxable tax as share of price	11.876	68.18
AET	1.219	7.00
Taxable FET (Ad valorem)	1.108	6.36
Taxable FET (Specific)	0.388	2.23
VAT	1.125	6.46
Internal tax	8.036	46.13
Non taxable tax as share of price	0.187	1.08
Non taxable FET (Ad valorem)	0.151	0.87
Non taxable FET (Specific)	0.036	0.21
Total tax as share of price	12.063	69.25
Retail price	17.42	100

AET: Additional Emergency Tax
FET: Special Tobacco Fund
VAT: Value Added Tax

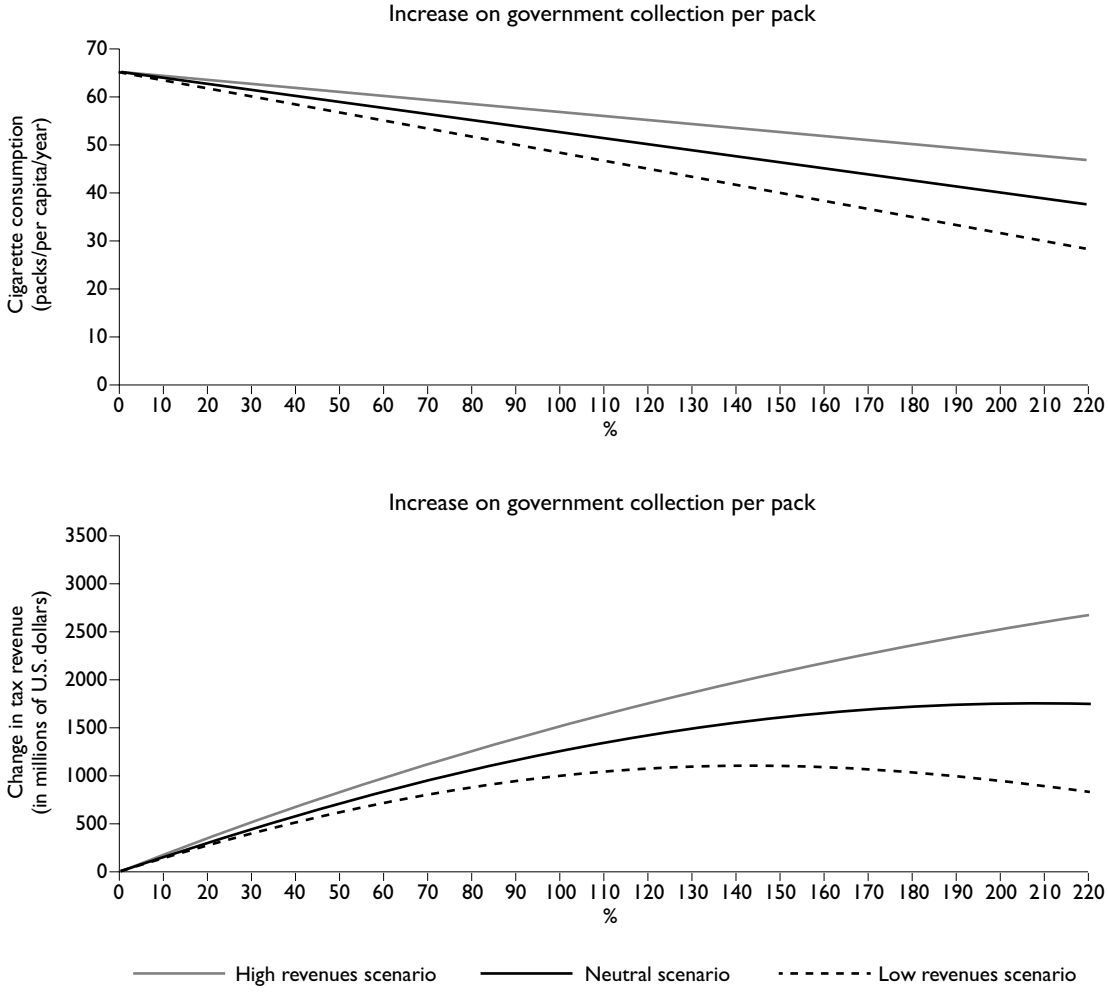
Source: Constructed by the authors using information from the tax laws of Argentina

Simulation of the impact of a cigarette tax increase

Considering December 2014 values [annual cigarette sales 2.1 billion packs; average retail price AR$17.42 per pack; total tax on cigarettes (excise duty plus VAT) AR$11.88; cigarette excise tax AR$10.75 per pack; federal cigarette tax revenue AR$ 27.9 billion (US$ 2 billion); exchange rate: US$1=AR$$13.73; population 42 202 935 (more than 15 years old 31 452 302);[27] per capita consumption 48.53 packs/year and per capita consumption (more than 15 years old) 64.97 packs/year. The simulation exercise was conducted for three different cigarette price elasticities. The "neutral scenario" is based on the -0.28 estimated value; the "high revenues scenario" considered a -0.18 price elasticity obtained from the -0.28 estimated value plus twice its standard error (0.047); the "low revenues scenario" is a -0.37, obtained from the -0.28 estimated value less twice its standard error.

We assume that the tax increase passes through totally to the retail price. This is probably a conservative scenario for public health impact considering that the tobacco industry will likely reduce total profits as tobacco consumption falls.

Figure 1 shows the average annual per capita consumption of cigarette packs under the tax rate increase for the three scenarios defined above. The horizontal axis shows the increase in government collection per pack. The vertical axis shows the average annual per capita consumption for the population over age 15. An increase



Source: Authors' estimations.

Figure 1. Relationship between Increases on government collection per pack, Cigarette Consumption Change in tax revenue.

in the tax rate is interpreted as an increase in the AR$11.88 price, which is the amount that the government collects per pack. In the neutral scenario, a 10% increase in prices, from AR$17.42 to AR$19.16 per pack (resulting from a 14.7% increment in government revenue per pack), causes a 2.8% drop in average annual per capita consumption (from 64.97 to 63.02 packs per year).

Figure 1 also shows the Laffer curves, which represents graphically the relationship between changes in federal tax revenue (vertical axis) and the increase in government collection per pack. A 10% increase in the amount that the government collects per pack represents a retail price increase from AR$17.42 to AR$18.61 per pack. Thus, to obtain a 10% increase in cigarette price, government revenue per pack should rise by 14.7%. This 10% tax increase results in AR$2.21 billion increase in tobacco revenues (a 160 million US dollars increase).

The "Laffer point," i.e., the peak point at which cigarette tax revenue starts to fall as the tax rate rises, is reached in the low-revenue scenario for a 146% increment on government collection per pack, or at AR$34.77 price per pack, that is a 100% real price increment per pack. In the other two scenarios, the Laffer point is only reached after a 212% increase (more than a 145% increase in real prices for the neutral scenario and more than 237% price increase in the favorable scenario).

Discussion

This study updates the results obtained by González-Rozada in 2006[7] and its estimates are consistent with those by previous authors in Argentina.[16] The results of this study had direct bearing on a significant tax increase on cigarettes that was approved in May 2016.

Argentina's elasticities are closer to those observed in high-income countries likely below 5% like other Latin American countries (LAC) such as Chile, Brazil, Uruguay and Mexico.[28] This relatively low elasticity could be attributable to the high affordability of cigarettes in these countries.[29]

This study confirms that the rise in taxes results in a reduction of cigarette consumption as well as an increase in government revenues even in the most conservative scenario analysis. Tax increase simulations support international evidence on the effectiveness of increasing taxes as an tobacco control measure.[3] In absolute value, income elasticity is about 47.1% greater than the price of elasticity of demand. This means that to offset 10% increase in income and bring about a fall in consumption, the real price should be raised by 14.71% in a quarter. Policymakers must ensure periodic tax increases to progressively reduce cigarette affordability. Combining price and income elasticities estimations, policymakers, particularly in rapidly growing economies, may obtain a tax increase benchmark indicator that determines how much tax should increase so that cigarette affordability at least does not increase.[30,31]

The present study has some limitations. Our analysis considers average price and income, and does not allow us to analyze inequalities neither other tobacco products elasticities of certain groups.

This study contributed significantly to a change in fiscal policy in Argentina. In May 2016, the Argentinean federal government enacted a decree that increased the Internal Tax by 15 percentage points (from 60 to 75%) increasing the cigarettes price by 50%. According to our analysis, the total cigarette consumption would be reduced by 15%. This tax increase is an important success for public health, even though the increase in Internal Tax was only applied to cigarettes and it served to strengthen the ad valorem tax structure.

This new tax policy increases opportunities for substitution for cheaper brands and for other tobacco products like "roll-your-own". Tax increase law should include a simpler tax structure via a specific tax and a harmonization of the taxes for all tobacco products to avoid substitution. A single increase is not sufficient and it is essential to implement periodic adjustments to offset the effects of increasing affordability in an inflationary context like Argentina's.

Our study shows that demand analysis is necessary but not sufficient to promote successful tax policies. It is also essential to analyze the tax structure to promote effective and sustainable policies.

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