INSTITUTO DE ESTUDIOS LABORALES Y DEL DESARROLLO ECONÓMICO (ielde)
Facultad de Ciencias Económicas, Jurídicas y Sociales
Universidad Nacional de Salta (UNSa)
Salta
Argentina

Documentos de Trabajo

Elasticity of cigarette demand in Argentina: An empirical analysis using vector error-correction model

Eugenio Martínez
Raul Mejía
Eliseo Pérez Estable

Noviembre de 2008
Nº 1

ielde – **Facultad de Ciencias Económicas, Jurídicas y Sociales - UNSa**
www.economicas.edu.ar/ielde
UNSa: Av. Bolivia 5150, A4408FVY, Salta, Argentina
ISSN 1852-1118 (impreso), ISSN 1852-1223 (en línea)
Editor: Jorge A. Paz ielde@unsa.edu.ar

Elasticity of cigarette demand in Argentina: An empirical analysis using vector error-correction model

Eugenio Martínez
Raul Mejia
Eliseo Pérez Stable

Abstract

Objective: To estimate empirically the short and long-term effects on cigarette demand in Argentina based on changes in cigarette price and income.

Method: We analyzed data from the Ministry of Economy and Production of Argentina. Analysis was based on monthly time-series data between 1994 and 2004. The econometrics specification is a linear double-logarithmic form using cigarettes consumption per person older than 14 y. as dependent variable and real income per person older than 14 y. and the real average price of cigarettes sales as independent variables. Empirical analyses were done in three steps: 1) To verify the order of integration of the variables using the augmented Dickey-Fuller test; 2) To test for co-integration using the Johansen-Juselius maximum likelihood approach to capture the long-term effects; and 3) To utilize the Vector error-correction model to capture the short-run dynamics of the variables.

Results: The empirical results showed that in the long-term period the demand for cigarettes in Argentina is affected by changes in real income and real average price of cigarettes. The value of income elasticity is equal to 0.54 while the value of own-price elasticity is equal to –0.34.

The results using vector error-correction model estimation suggest that the short-term cigarette demand in Argentina is independent of price (not statistically significant). The value of the short-term income elasticity is equal to 0.49.

A simulation exercise show that increasing the prices in a 120% we can obtain a maximum of revenues from cigarette tax and obtain also a big impact in the fall of the total consumption of cigarettes in the country.

Key Words: Price elasticity, cigarette demand, Tobacco control

JEL Classification: D12, I18.

Elasticity of cigarette demand in Argentina:
An empirical analysis using vector error-correction model.[1]

Eugenio Martínez

Instituto de Estudios Laborales y del Desarrollo Económico-(IELDE). Facultad de Ciencias Económicas, Universidad Nacional de Salta, Salta, Argentina

Raul Mejía

Centro de Estudios de Estado y Sociedad and Programa de Medicina Interna General, Universidad de Buenos Aires, Buenos Aires, Argentina

Eliseo J. Pérez Stable

Division of General Internal Medicine, Department of Medicine, Medical Effectiveness Research Center for Diverse Populations, Helen Diller Family Comprehensive Cancer Center, University of California, San Francisco, USA.

Introduction

Empirical studies of cigarette demand have received considerable attention in recent years. Many studies have examined the demand for cigarettes mainly in developed economies and the number of studies focused on low- and middle-income countries is relatively limited. (Jha and Chaloupka, 2000).

This interest is mainly due to the fact that the price and income elasticity of cigarette demand are important for assessing proposals to revise cigarette tax, anti-smoking regulation and for predicting the cigarette demand in future periods.

The issue of analyzing and predicting the evolution of cigarette demand is crucial for an effective tobacco control policy though it is a complex topic. This paper approaches the problem from an economic point of view and it is timely with respect to the new world trends on the evaluation and elaboration of anti-smoking policies. Despite the importance of the

[1] This study was funded by grant Nº TW05935 from the Tobacco Research Network Program, Fogarty International Center, National Institute on Drug Abuse, National Institutes of Health, USA. We thank Teh-wei Hu, PhD for helpful comments on an earlier draft and the data analysis and Cecilia Populus-Eudave for administrative and research support at UCSF. The views expressed in this paper are solely those of the authors and do not necessarily reflect the views of the institutions.

subject in the development of tobacco control policy, only one study has been done on cigarette demand in Argentina.

In order to estimate long and short-run demand equations, the researchers used data with different frequencies (e.g., annual, monthly) (see Agelike and Kostas 2001; Keeler, Hu, Barnett and Manning 1993) for several countries (e.g., Greece, USA and others). Kim and Seldon (2004) used econometric models in order to estimate the cigarette demand in the Republic of Korea, and analyzed various government policies to control cigarette consumption. They estimated the long and short-run price elasticities for the period 1960-1997 with values of -0.35 and -0.27 respectively.

Valdes (1993) used a different approach called the "habit-persistent" model and estimated the main determinants of cigarette demand in Spain from 1946 to 1988. This study employed a partial adjustment model and used annual time series and found that cigarette demand in Spain appeared to have similar values for the price elasticities for the short and long run (–0.60 and –0.69 respectively).

Gallet and Agarwal (1993) applied an alternative method in order to estimate the specific factors that affect cigarette demand in the US such as price and health information. These authors used annual data for the period 1955–1990 to estimate a gradual switching regression model and found that cigarette demand was negatively affected by changes in the price but in a decreasing way throughout the time period. The elasticity price was –2.371 in the first decade of the period under study and –0.140 in the last decade, but cigarette demand was positively affected by the advertising with an elasticity that ranged between +0.65 to +0.008.

Baltagi and Levin (1992) employed panel data from 46 US States over the period 1963 to 1988 in order to capture the "bootlegging effect". In light of the results, their mainly findings are a significant habit persistence effect, "border purchasing" effect and an inelastic own-price effect. Another interesting approach to examine the main determinants of cigarette demand is the "rational addiction model" proposed by Becker and Murphy (1988) which has mainly been used to analyze cigarette consumption by Cameron (1999), Becker, Grossman and Murphy (1994) and Chaloupka (1991), but also has been applied to estimate the demand of other addictive goods such as opium by vanOurs (1995), alcohol by Chaloupka, Saffer and Grossman (1993), cocaine by Grossman and Chaloupka (1998) and coffee by Olekalns and Bardsley (1996). All these studies report negative and significant price effects, positive and significant past and future consumption effects, and larger long run rather than short-run own-price elasticity, (Grossman and Chaloupka,1998).

The study by Tiezzi (2005), estimated tobacco demand in Italy applying the rational addiction framework, using first a pseudo-panel data and second time series data. Their results showed that announcement of future price increases may be effective in curbing cigarette demand.

The only analysis of the cigarette consumption in Argentina was the study of Gonzalez Rozada (2004). This study examined the demand for cigarette consumption in Argentina employing double-log function model and used monthly data to explore the dynamic relationships for cigarette consumption. The main results show a significant long run price elasticity of –0.414. The cigarette consumption in Argentina is elevated and is not uniformed; the tendency was decreasing from 1994 but demonstrated a change of direction during the last year of the analysis. This pattern may be due to the absence of tobacco control policies and to the low level of knowledge about the health risks attributable to smoking in Argentina. Tobacco control advocates are currently attempting to pursue a mixture of reforms and policies that include to reduction in overall consumption, increase in taxes, prohibiting the consumption in public places, prohibiting the sale to minors and restricting tobacco advertising.

The purpose of the paper is to conduct an empirical analysis of cigarette demand in Argentina over the period 1994 – 2004 using monthly data. Income and price elasticity of both the long- and the short-run demand for cigarette use are examined in a multivariate framework. The paper briefly describes the tobacco sector in Argentina, deals with methodological issues and the data used in the empirical analysis, presents the empirical results and the policy implications are discussed.

Stylized facts for the Tobacco Market in Argentina.[2]

Argentina is in the leading 12 tobacco growing countries in the world and second in Latin America after Brazil (Mackay and Eriksen, 2002). Argentina produced about 95,000 tons of tobacco leaves in 1990 and increased to a record volume of 157.300 tons in 2004. This production is concentrated in seven provinces of northern Argentina and of these, three provinces, Salta, Jujuy and Misiones produced 88% of the total of tobacco in the country. The increase in tobacco production was accompanied by an increase in the total harvested area, which changed from 57,750 hectares in 1990 to 77,600 hectares in 2004 or an increase of 34%. The economic activity of tobacco farming and production crops is labor–intensive and generates almost 60.000 jobs as direct work.[3] Argentina is a net exporter of tobacco with 60% of the tobacco produced in the country is exported.

The tobacco industry in Argentina is led by two producers companies subsidiaries of multinationals, Massalin Particulares S.A. of Phillips Morris Co and Nobleza Picardo of British American Tobacco (BAT). Massalin Particulares has 60% of the national cigarette market in Argentina. Given the structure of this market, the cigarette industry can be classified as oligopolic in the output Market and like oligopsonic in the input market, (Gonzalez Rozada, 2004). One characteristic to point out is that the tobacco production in

[2] The data used in this section came from the Secretary of Agriculture, Livestock, Fish and Food-Department of Agricultural Economics.
[3] We calculated this value following the methodology developed by Corradini, et.al. (2005).

Argentina is subsidized.

Figure 1: Avergae monthly consumption of cigarettes

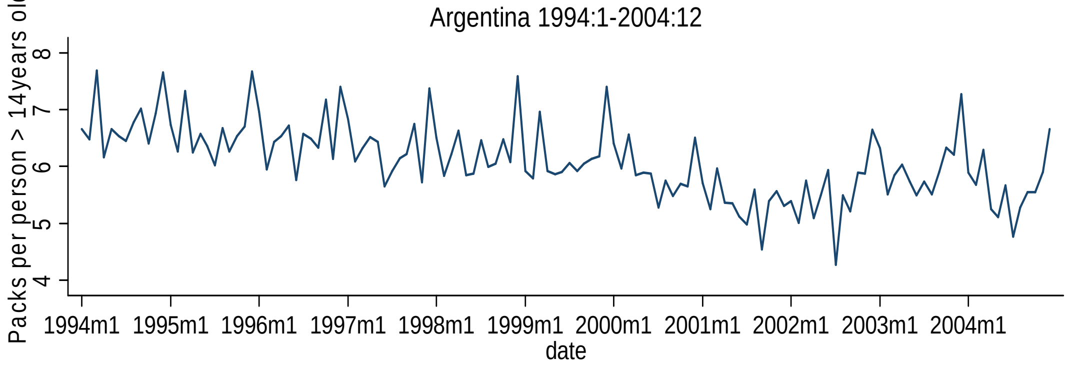
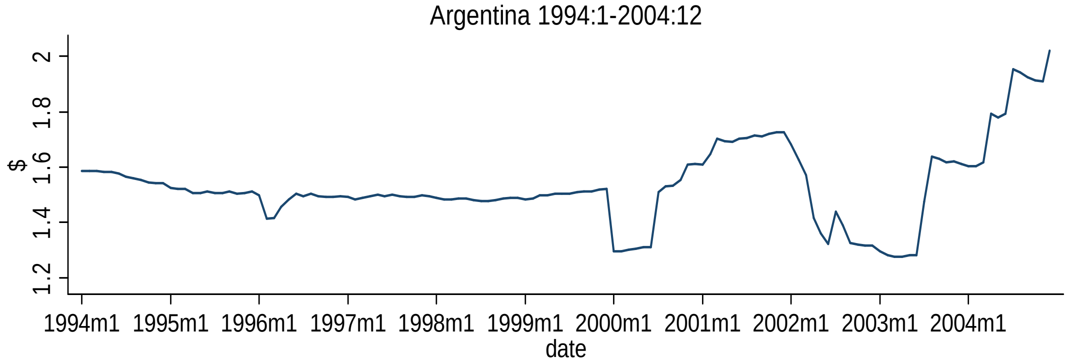


Figure 2: Average monthly real retail price of cigarette packs



This subsidy is paid to the producer as an over-price on the final cost of storing. In order to finance this over-price the National Government collects the Special Tobacco Fund (FET) through a specific tax on consumption of 7%. About 80% of this fund is distributed to the producers trough the subsidy previously described.

The average real retail price per pack of cigarettes was stable between January of 1994 and December of 1999 with a gap between maximum and minimum for that period of $ 0.17. From that date the average real retail price per pack presented wide fluctuations reaching a minimum of $ 1.27 in March of 2003[4].

Since that date the real price had an increasing tendency reaching a maximum in December of

[4] Real retail price in 1993 pesos.

2004 ($2.02). The 69% of retail price is conformed by different type of taxes (indirect taxes, VAT, etc), Ministry of Health and the Environment (2005). The monthly average consumption of cigarettes in Argentina was of 160 million of packages for the period 1994 to 2004 (a monthly average of 6.11 packs by persons older than 14 years of age). Reaching a maximum of approximately 8 packs per person older than 14 years of age in December 1999. As is well known the economic activity previously described and therefore its final product "cigarettes" is highly addictive and its consumption has serious adverse effects on health. In Argentina, the prevalence rate for people of 13 to 64 years old and living in the main urban centers of the country was 32.7% in year 2004, Ministry of Health and the Environment (2005).

The total smoking prevalence in Argentina was 38.3% for men and 24.5% for women in 2001 (Martinez, Kaplan, Guil, Gregorich, Mejia and Perez-Stable, 2006). Conte Grand (2005) estimated for year 2003 that the deaths attributable to the tobacco consumption in Argentina were of 41,280 people older than 35 years old, which generated a cost by lost of future earnings by premature death of $2.315 million (pesos of 2003).

Methodological Framework and Database.

Following the specification of Gonzalez Rozada (2004), a linear double-logarithmic form using income and price as independent variables was used in the empirical analysis. Therefore, in the empirical study the following specification for the long-run demand for cigarette was employed:

$$\ln(Qpc_t) = \alpha_0 + \alpha_1 \ln(RYpc_t) + \alpha_2 \ln(RP_t) + \alpha_3 D_t + \mu_t \qquad (1)$$

where Qpc_t is the per capita consumption for cigarette at time t, $RYpc_t$ is real per capita income at time t in pesos in 1993 prices, RP_t is the real average price of cigarettes, D_t is some seasonal dummy variable and μ_t is an error term. Qpc_t is the quantity of cigarettes consumed and was measured as numbers of cigarettes per person older than 14 years old; $RYpc_t$ is the real income measured as the real gross domestic product (GDP) in real terms per capita.

This analysis was carried out using the available data from Argentina; it was for the period 1994:1– 2004:12. The variables were not seasonally adjusted[5]. All data except population data were obtained from the Ministry of Economics and Production in Argentina. The population data were collected from the INDEC-National Institute of Statistics and Census-(2004). The data corresponding to the GDP were generated on a quarterly frequency but in order to adjust to the model using monthly frequency, the Chow-Lin procedure (1971) was carried out to obtain monthly series from quarterly frequencies[6].

Table1. Descriptive Statistics of Data

Variable	**N**	**Mean**	**Std. Dev.**	**Min**	**Max**
Cigarette per person > 14 years old	132	122.06	12.95	85.45	153.73
Packs per person >14 years old	132	6.11	0.65	4.27	7.69
Real retail price	132	1.53	0.14	1.27	2.02
Real income per capita	132	6,682.50	345.33	5,887.80	7,298.00

On the other hand, the information referring to the population greater than 14 years old was available only on an annual frequency and thus was made into an interpolation in a constant growth rate to obtain monthly series. In the empirical analysis, we tested for the existence of a long-run relationship among the variables (estimation of Eq. (1)) while the utilization of the vector error-correction model captures the short-run dynamics of the variables. The analysis was done in two steps and the initial one is to verify the order of integration of the variables since the various co-integration tests are valid only if the variables have the same order of

[5] Ghysels and Perron (1993) showed that it is better to work with seasonally unadjusted data when the Augmented Dickey-Fuller (ADF) test will be used. Due to the fact that if filtered data are used; the test ADF will be biased toward non rejection of the unit root null hypothesis.

[6] For this procedure was used like a related series: the Monthly Estimator of Economic Activity of Argentina (EMAE) from National Institute of Statistics and Census (INDEC).

integration. Standard test for the presence of a unit root based on the work of Dickey and Fuller (1979, 1981) (ADF) was used to investigate the degree of integration of the variables used in the empirical analysis. The second step involved testing for co-integration (Eq. (1)) using the Johansen maximum likelihood approach, Johansen (1988) and Johansen and Juselius (1990, 1992).

The Johansen–Juselius estimation method is based on the error-correction representation of the Vector Autoregressive (VAR) model with Gaussian errors. The presence of evidence of co-integration rules out the possibility that the estimated relationship is spurious.

Engle and Granger (1987) showed that in the presence of co-integration there always exists a corresponding error correction representation, which implies that changes in the dependent variable are, a function of the level of disequilibrium in the co-integrating relationship, captured by the error-correction term (ect), as well as changes in other explanatory variables to capture all short-term relations among variables.

Results

Campbell and Perron (1991) provide rules of thumb for investigating whether time series contain unit roots. To begin, we estimated the following three forms of the augmented Dickey–Fuller (ADF) test where each form differs in the assumed deterministic component(s) in the series:

$$\Delta x_t = \delta_1 x_{t-1} + \sum_{i=1}^{P} \phi_i \Delta x_{t-i} + \mu_t \qquad (2)$$

$$\Delta x_t = \delta_0 + \delta_1 x_{t-1} + \sum_{i=1}^{P} \phi_i \Delta x_{t-i} + \mu_t \qquad (3)$$

$$\Delta x_t = \delta_0 + \delta_1 x_{t-1} + \delta_2 (Time) + \sum_{i=1}^{P} \phi_i \Delta x_{t-i} + \mu_t \qquad (4)$$

where $x_t = \{Qpc_t, RYpc_t, RP_t\}$. The μ_t is assumed to be a Gaussian white noise random error and *Time*=1,…,*T* (the number of observations in the sample) is a term for trend. In Eq. (2) there is no constant or trend. Eq. (3) contains a constant but no trend. Both a constant and a trend are included in Eq. (4). The number of lagged differences, *P*, is chosen to ensure that the estimated errors are not serially correlated.

The results from the unit root tests are shown in Table 1. The first three rows test the null hypothesis that a series follows a unit root process or random walk. This implies it is non-stationary and (possibly) integrated of order one, *I*(1), rather than *I*(0). The second three rows test the null hypothesis that first difference of a series follows a unit root. If true, the researcher must difference the series twice to obtain a stationary process.

We found that for all series in Table 1 the null hypothesis of a unit root in the level cannot be rejected. There is evidence that cigarette consumption per capita is stationary, *I*(0), for the ADF regression including a constant and a constant plus trend term (Eqs. 3 and 4).

However, further testing suggested that the model without constant or trend was the appropriate choice. The constant term and the slope coefficient of the trend term were insignificant. The tests for unit roots in the second differences are rejected, implying that the series is *I*(1) and stationary in their first differences.

Table 2. ADF statistics testing for a unit root

Variable	**Augmented Dickey-Fuller**		
	Eq-2	**Eq-3**	**Eq-4**
LQpc	-1.62	-3.06*	-4.00*
LRYpc	0.04	-2.00	-2.24
LRP	-0.12	-1.46	-1.70
ΔLQpc	-8.38**	-8.59**	-8.58**
ΔLRYpc	-2.78**	-2.77	-2.76
ΔLRP	-9.13**	-9.12**	-9.23**

All variables are in natural logarithms. The first three rows present the ADF *t*-tests corresponding to tests for unit roots in the levels of the series. The last three rows report the ADF *t*-test results for testing whether the first difference has a unit root. A rejection implies that the first difference of the series is a stationary process. The last three columns refers to Eqs. (2)–(4) in the paper, which are ADF regressions with no constant, a constant and a constant plus trend, respectively. The critical values for the *t*-tests at 5% are y -1.94, -2.88 and -3.44, respectively; at 1% they are -2.58, -3.48 and -4.04, respectively. Rejections at the 5 and 1% critical values are denoted as * and **, respectively. The critical values for this table are calculated from MacKinnon (1991). The lag length structure of ϕ_i of the dependent variable x_t is determined using a recursive procedure in the light of a Lagrange multiplier (LM) autocorrelation test (for orders up to 13), which is asymptotically distributed as chi-squared distribution and the value of t-statistic of the coefficient associated with the last lag in the estimated auto-regression.

Co-integration Analysis and Long-Run Relationship.

Co-integration tests are a multivariate form of integration analysis. Individual series may be $I(1)$, but a linear combination of the series may be $I(0)$. The error correction model is a generalization from the traditional partial adjustment model and permits the estimation of short-run and long run elasticity.

The approach is based on the findings of Nelson and Plosser (1982), in which many macroeconomic and aggregate level series are shown to be well modeled as stochastic trends, i.e. integrated of order one, or $I(1)$. Simple first differentiation of the data will remove the non-stationary problem, but with a loss of generality regarding the long-run 'equilibrium' relationships among the variables. Engle and Granger (1987) solve this filtering problem with the co-integration technique. They suggest that if all, or a subset of, the variables are $I(1)$, there may exist a linear combination of the variables that is stationary, $I(0)$. The linear combination is then taken to express a long-run 'equilibrium' relationship. Series that are co-integrated can always be represented in an error correction model. The error correction model is specified in first differences, which are stationary, and represent the short-run movements in the variables. When the error correction term (ect) is included in the model, the long run, or equilibrium, relations are accounted for. The ect term represents the deviation from the equilibrium relation in the previous period. Lags of the independent and dependent variables would be included to capture additional short- and medium-term dynamics of cigarette consumption.

To determine the lag length of the VAR and co-integration analysis we used Hannan-Quinn (HQIC) and the Bayesian Schwarz Information Criterion (BSIC). These measures compared the fit of the maintained model against reductions in the number of explanatory and predetermined variables. Given the monthly frequency of the data, an initial version of the VAR with 12 lags was estimated. The results indicate an optimum length of 2 lags. The estimated statistics, for the VAR = 2, indicate not only the absence of serial correlation but also support the structural stability of all the estimated regressions.

Specifications of the VAR with smaller number of lags reveal serial correlation in the estimated regressions. Thus, a VAR = 2 is employed in the estimation procedure of co-integration. It was tested whether the estimated regression equations were stable throughout the sample using the CUSUM and CUSUMSQ tests on structural stability of the estimated relations. Finally, a log-likelihood ratio test is used for testing the deletion of three dummy variables from the VAR model. The first dummy variable (Dummy 97) accounts from the moment when was established that the cigarette sale was prohibited for persons under 18 years old (March 1997). The second dummy[7] (D(ACS)) accounts for the increase of cigarette consumption during Christmas holydays and the payment of the annual complementary salary (with a value of 1 for December and 0 in all others months) and the last dummy (Dummy 02) capture the moment when the macroeconomics policies changed (March 2002). All tests reject the null hypothesis of the deletion of the first two dummy variables from the VAR system.

Table 3 contains the results of co-integration analysis among per capita cigarette consumption, real income per capita and real price of cigarettes in order to estimate Eq. (1).

To test for co-integration, we use the Johansen-Joselius maximum likelihood approach employing both the maximum eigenvalue and trace statistic. The results from the co-integration test showed that both maximun eigenvalue and trace test statistics imply that there was one co-integration vector among cigarette consumption, disposable income and price.

Table 3. Johansen-Juselius Cointegration Test

Trace Statistics

Null	**Alternative**	**Trace**	**0.05 Critical Value**	**Prob.**
r=0	r>=1	59.9	35.19	0
r=<1	r>=2	8.88	20.26	0.75
r=<2	r>=3	1.65	9.16	0.84

Maximun Eigenvalue Statistics

Null	**Alternative**	**Eigenvalue**	**0.05 Critical Value**	**Prob.**
r=0	r=1	51.02	22.3	0
r=<1	r=2	7.22	15.89	0.64
r=<2	r=3	1.65	9.16	0.84

r indicates the number of cointegrating relationships.

The estimated lung-run demand is summarized in the equation:

$$\ln(Qpc_t) = 0.10 + 0.54\ln(RYpc_t) - 0.34\ln(RP_t) + 0.27D(ACS) \qquad (5)$$

(4.59) (-4.23) (5.36)

[7] Several seasonal dummies were tried and the unique one that resulted to be statistically significant was the correspondent to December.

where (.) contains t-statistics. All two coefficients have significant correct signs. The long-run elasticity of price and income are respectively

$$\eta_{price}^{LR} = -0.34$$

$$\eta_{income}^{LR} = +0.54$$

VECM and Short-run Relationship.

Having verified that a co-integrating relationship exists between the variables, the VECM can be applied. The error-correction term measures the proportion by which the long-term imbalance in the dependent variable is corrected in each short-run period. The size and the statistical significance of the error-correction term measures the extent to which each dependent variable has the tendency to return to its long-run equilibrium.

Table 4. Short-Run Relationship

Variable	Coefficient	t-value
const	0.04	2.75
$\Delta\ln(RP)_{(-1)}$	0.10	0.65
$\Delta\ln(RP)_{(-2)}$	-0.004	-0.03
$\Delta\ln(Qpc)_{(-1)}$	-0.30	-2.73
$\Delta\ln(Qpc)_{(-2)}$	-0.28	-3.86
$\Delta\ln(RYpc)_{(-1)}$	0.49	5.78
$Dummy97$	-0.09	-4.24
$Dummy(ACS)$	0.19	8.60
ect (error correction term)	-0.78	-5.96
$R^2 = 0.72$		
$F-statistic = 33.70$		
$DW-test = 1.82$		
$ARCH-test = 0.74$		
$White-heteroskedasticity = 0.60$		

In the restricted dynamic cigarette demand presented in Table 4, all the estimated coefficients, including the error-correction term, are statistically significant and have a correct sign.

The error-correction term is equal to 0.78 suggesting that the speed of adjustment is equal to 78%[8]. Growth in cigarettes consumption 2 months before the current consumption has a statistically significant negative effect. The estimated coefficient for the short-run change of real income is positive and significant and its value is equal to 0.49. This value is considerably closer to the long-run value and implies that a 10% increase in the growth of real income will lead to an increase of cigarette consumption by 4.9% in the short run. The estimated coefficient for the short-run effect of the price is not statistically significant.

With respect to the coefficient of the Dummy97 variable; which captures the effect to prohibit the sale of cigarettes to persons under 18 years old, can be observed that the same one is statistically significant and with negative sign.

The demand function for cigarette appears to be well specified since it passes a series of diagnostic tests including the serial correlation, the autoregressive conditional heteroskedasticity test (ARCH test) and the heteroskedasticity test.

Table 5. Summary of the Elasticities.

	Long-Run	**Short-Run**
Price-Elasticity (η_{price})	-0,34	-----
Income-Elasticity (η_{income})	0,54	0,49

Discussion and Policy Implications

This paper examined the demand of cigarette in Argentina employing monthly data over the period 1994–2004. Co-integration techniques were applied to estimate the demand and to examine the issues of stability, income and price sensitivity of both long- and short-run demand of cigarettes. Finally, the importance of short-run deviations was presented using

[8] In table 4, only the restricted error-correction equation for cigarette demand is presented. All other equations are available from the authors upon request.

vector error-correction model estimation.

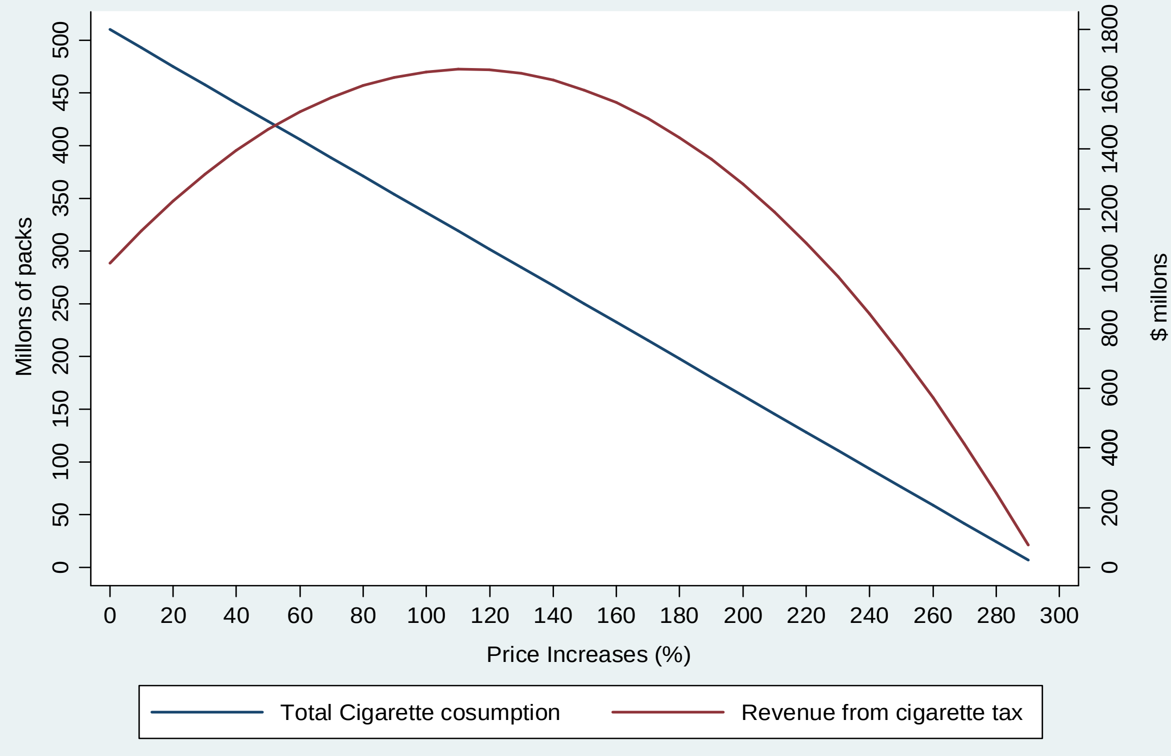
The empirical results suggest that in the long-run period the demand for cigarette is affected by changes in real income and real price. The value of income elasticity was equal to 0,54 while the value of price elasticity was equal to -0,34. The results using error-correction model estimation suggest that the short-run demand of cigarettes in Argentina is independent of price and the value of income elasticity in the short-run is equal to 0,49.

The elasticity values obtained in this study provided valuable information for planning tobacco control policies. Due to this potential utility we developed a simulation exercise following the example by Hsieh (1998) to show the possible impact of increasing the final price of cigarettes on consumption and on revenue from cigarette tax. The initial assumptions or values for the simulation are those that are in the column "Status Quo" in table 6. The values are the corresponding ones to the last quarter of the year 2004[9]. The monetary values are in pesos as of December 2004, the values corresponding to the consumption of cigarettes and the revenue from cigarette tax were from the last quarter of 2004. The tax increases were designed in a way that when the cost was completely transferred to the final retail prices and thus reflects an increase of 10%, 20%, 30%, on this final price.

Table 6 only contains information about seven different increases of the cigarettes final price, but the complete simulation reach until an increase of 290%, which can be observed in figure 2.

[9] We took a quarterly as long run because was captured the short run dynamic in VECM with 2 lags and we are working with monthly data.

Figure 3: Revenue from alternative rates of cigarette tax and total cigarette consumption



From the simulation we can obtain important information for tobacco–control policies. An increase in the final price of 20% can lower the total consumption of cigarettes packs in 34.70 million in a quarter and can also generate an increase in the fiscal revenue from cigarette tax of $ 209,70 millions.

On the other hand a bigger increase of prices, for example of 50% in the final price, generated a fall in the consumption of cigarettes per person > 14 years old of 3,08 packs quarterly and an increase of $447,94 millions in the tax revenues.

If we observed the figure 2, is possible to see that in Argentina a wide margin exists to increase the cigarettes prices without falling in lost of tax revenues. Increasing the prices in a 120% we can obtain a maximum of revenues from cigarette tax and obtain also a big impact in the fall of the total consumption of cigarettes in the country (see the last column in table 6).

Table 6. Simulation of alternatives increase of cigarette retail price (Quarterly data).

	Status Quo	Long-run own price elasticity = -0.34						
		Price increase						
	2004 Q:4	**10%**	**20%**	**30%**	**40%**	**50%**	**60%**	**120%**
A- Average retail price ($)	2.93	3.23	3.52	3.81	4.10	4.40	4.69	5.51
B- Average tax per pack ($)	1.99	2.29	2.58	2.87	3.17	3.46	3.75	6.45
C-Total cigarette consumption (millions of packs)	510.30	492.95	475.60	458.25	440.90	423.55	406.20	302.10
D- Changes in C (decrease)	-----	17.35	34.70	52.05	69.40	86.75	104.10	208.20
E- Cigarette consumption per person >14 years old (packs)	18.12	17.50	16.89	16.27	15.66	15.04	14.42	10.73
F- Changes in E (decrease)	-----	0.62	1.23	1.85	2.46	3.08	3.70	7.39
G- Revenue from cigarette tax ($ millions)	1,017.54	1,127.47	1,227.24	1,316.83	1,396.24	1,465.48	1,524.55	1,665.28
H- Changes in G	-----	109.94	209.70	299.29	378.70	447.94	507.01	647.74

Note: U$S 1 = $ 2.96 in December 2004.

The results and simulation suggest that increases in the cigarette prices (Tax) in Argentina, can be an effective instrument for reduce the tobacco consumption only in the long run while in the short run changes in prices will not alter the quantity of cigarettes consumed. In addition, the high-income elasticity in the long run implies that a substantial higher cigarette consumption pattern is expected as the real income of the Argentinean converges to the real income of the households of the other countries in the developed world. Finally, Argentina is currently working in different antismoking programs and policies and trying to implement the Framework Convention from the WHO. Therefore, policy makers and tobacco control advocates could benefit from the findings of this study that provides useful information on the characteristics of the market for cigarette consumption and may help to plan their strategy.

References

Agelike, N. & Kostas, V., (2001). Estimating the demand for cigarettes in Greece: an error correction model. *Agricultural Economic Review*, Vol. 2(1), p. 20-27.

Baltagi, B. & Levin, D. (1992) Cigarette Taxation: Raising Revenues and Reducing Consumption. *Structural Change and Economic Dynamics*, Vol. 3(2), p. 321-335.

Becker, G. S., Grossman, M. & Murphy, K. M. (1994). An Empirical Analysis of Cigarette Addiction. *American Economic Review*, Vol. 84(3), p. 396-418.

Becker, G. S. & Murphy, K. M. (1988). A Theory of Rational Addiction. *Journal of Political Economy*, Vol. 96(4), p. 675-700.

Cameron,S. (1999). Estimation of the demand of Cigarettes: a review of the literature. *Economic Isuues*, Vol. 3(2), p. 51-71

Campbell, J. & Perron, P., (1991). *Pitfalls and Opportunities: What Macroeconomists Should Know About Unit Roots. NBER Technical Working Papers 0100*. National Bureau of Economic Research, Inc.

Chaloupka, F., (1991). Rational Addictive Behavior and Cigarette Smoking. *Journal of Political Economy*, Vol. 99(4), p. 722-42.

Chaloupka, F., Saffer, H. & Grossman, M., (1993). Alcohol-Control Policies and Motor-Vehicle Fatalities. *Journal of Legal Studies*, Vol. 22(1), p. 161-86.

Chow, G. & Lin, A. (1971) Best linear unbiased interpolation, distribution and extrapolation of time series by related series. *Re. Econ. Stat*, Vol. 53, p. 372-375.

Conte Grand, M., (2005). Reestimación y actualización del costo económico en Argentina de la mortalidad atribuible al tabaco en adultos. *CEMA Working Papers: Serie Documentos de Trabajo*, 305.

Corradini, E., Zilocchi, H., Cuesta, R., Segesso, R., Jiménez, M. & Musco, J. (2005). Caracterización del Sector Productor Tabacalero en la República Argentina. *Serie Documentos de Investigación, Universidad Católica Argentina de Buenos Aires.*

Dickey, D.A. & W.A. Fuller (1979). Distribution of the Estimators for Autoregressive Time Series with a Unit Root. *Journal of the American Statistical Association*, Vol. 74, p. 427–431.

Dickey, D.A. & W.A. Fuller (1981). Likelihood Ratio Statistics for Autoregressive Time Series with Unit Root. *Econometrica*, Vol. 49, p. 1057-1072.

Engle, R. F. & Granger, C. W. J., (1987). Co-integration and Error Correction: Representation, Estimation, and Testing. *Econometrica*, Vol. 55(2), p. 251-76.

Gallet, C. & Agarwal, R. (1993). The gradual Response of cigarette demand to health information. *Bulletin of Economic Research*, Vol. 51(3), p. 259-265.

Ghysels, E. & Perron, P. (1993). Effects of Seasonal Adjustment Filters on Tests for a Unit Root. *Journal of Econometrics,* Vol. 55, p. 57-98.

González Rozada, M. (2004) Un estudio Económico sobre el Impacto en el Consumo de Cigarrillos y en la Recaudación Impositiva del Estado de Cambios en los Impuestos que gravan a los cigarrillos. *Documento de Trabajo, Ministerio de Salud y Medio Ambiente de Argentina*.

Grossman, M. & Chaloupka, F., (1998). The demand for cocaine by young adults: a rational addiction approach. *Journal of Health Economics*, Vol. 17(4), p. 427-474.

Grossman, M., Chaloupka, F. & Sirtalan, I., (1998). An Empirical Analysis of Alcohol Addiction: Results from the Monitoring the Future Panels. *Economic Inquiry*, Vol. 36(1), p. 39-48.

Hsieh,C. R. & Lin,Y. S. (1998).The economics of tobacco control in Taiwan. In *The Economics of Tobacco Control: Towards an Optimal Policy Mix* (ed. I. Abedian, R. van der Merwe, N. Wilkins, and P. Jha), p. 306–29.

INDEC. (2004). *Estimaciones y Proyecciones de Población: Total del País. 1950-2015*. Serie Análisis Demográfico, N° 30.

Jha, P. & Chaloupka, F. (eds), (2000). *Tobacco Control in Developing Countries* . Oxford University Press, Oxford.

Johansen, S., (1988). Statistical analysis of cointegration vectors. *Journal of Economic Dynamics and Control*, Vol. 12(2-3), p. 231-254.

Johansen, S. & Juselius, K., (1990). Maximum Likelihood Estimation and Inference on Cointegration--With Applications to the Demand for Money. *Oxford Bulletin of Economics and Statistics*, Vol. 52(2), p. 169-210.

Johansen, S. & Juselius, K., (1992). Testing structural hypotheses in a multivariate cointegration analysis of the PPP and the UIP for UK. *Journal of Econometrics*, Vol. 53(1-3), p. 211-244.

Keeler, T., Hu, T., Barnett, P. & Manning, W. (1993). Taxation, Regulation and Addiction: a Demand Function for Cigarette Based on Time Series Evidence. *Journal of Health Economics*, Vol. 12(1), p. 1-18.

Kim S. & Seldom, B. (2004). The Demand for Cigarettes in the Republic of Korea and Implications for Government Policy to Lower Cigarette Consumption. *Contemporary Economic policy*, Vol. 22(2), p. 299-308.

Mackay, J. & Eriksen, M. (2002). *The Tobacco Atlas*. World Health Organization, Geneva.

MacKinnon, J.G. (1991), “Critical values for cointegration tests”, in R.F. Engle and C.W.J. Granger (eds.), *Long-Run Economic Relationships*, p. 267-276, Oxford University Press, Oxford.

Martínez, E., Kaplan, C., Guil, V., Gregorich, S., Mejia, R. & Pérez-Stable, E., (2006) . Smoking behavior and demographic risk factors in Argentina: A population-based survey. *Prevention and Control*, Vol. 2(4), p. 187 – 197.

Nelson, C. & Plosser, C. (1982). Trends and Random Walks in Macroeconomics Time Series. *Journal of Monetary Economics*, Vol. (10), p. 139-162.

Olekalns, N. & Bardsley, P. (1996). Rational Addiction to Caffeine: An Analysis of Coffee Consumption. *Journal of Political Economy,* Vol. 104(5), p. 1100-1104.

Tiezzi, M., (2005). An **Empirical Analysis of Tobacco Addiction in Italy.** *European Journal of Health Economics*, Vol. 6, p. 233-242.

Valdés B. (1993). Cigarette consumption in Spain: empirical evidence and implications for public health policy. *Applied Economics* 1993, Vol. 25, p. 149-56.

van Ours, J. C, (1995). The Price Elasticity of Hard Drugs: The Case of Opium in the Dutch East Indies, 1923-1938. *Journal of Political Economy*, Vol. 103(2), p. 261-79.