

Error Correction Model Analysis of Tobacco Consumption in Kosovo

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The analysis is part of the national study “Accelerating Progress on Effective Tobacco Tax Policies in Kosovo”

Abstract

Information for cigarette consumption during the time period 2005-2017, was utilized to assess the price and income elasticity effects on smoking intensity in Kosovo. The analysis was conducted by applying the error-correction model to estimate both the long-term and short-term smokers' sensitivity to changes in price and income. The study revealed that the short run price elasticity is -0.33, and -0.68 in the long run. Contrary to the price effect, income showed positive correlation to cigarette consumption in Kosovo. Based on the information revealed, it can be concluded that increasing taxes on cigarette results in lower consumption at the macro level.

Keywords: error correction model, tobacco products, elasticity, cigarette consumption

Introduction

Tobacco smoking is widely recognized as a significant threat to public health leading to more than 7 million deaths per year world-wide. The highest concentration of death is among low and middle-income countries (WHO, 2018). Kosovo has been categorized as a country with a high degree of smoking, based on a number of reports published, prevalence ranges between 16%–28.4% (Kosovo Agency of Statistics, 2018; Gashi et al., 2017). Smoking prevalence is noticeably higher for males in comparison to females. Such risk factor imposes a significant financial burden on the system due to productivity loss and medical expenses in treating conditions that could have been prevented. In the case of Kosovo, number of medical conditions caused by smoking has been on the rise, including here lung cancer, heart disease, stroke, asthma. The records become alarming when considering the young population of the country.

Institutional support in tackling such matter is crucial. The Ministry of Health in cooperation with World Health Organization and non-governmental organizations, drafted the tobacco control law in 2013, which came into force in 2014. The law was among the very first direct initiative against smoking, which banned smoking in public places and a number of other establishments. Parallel to this, in 2015, the Government of Kosovo made a decision to increase the excise tax on tobacco products by €2annually. Yet, there is an overall agreement that more shall be done, and one of the most effective way to combat smoking is through increased taxes. Considering the WHO benchmark, 70% of the retail price of a pack of cigarettes shall be excise tax.

Research within this filed in the context of Kosovo is almost nonexistent. Hence, the error correction model analysis, is among the first initiatives to understand consumption per capita, its trends, and its relation to other economic and social factors. The author estimated the short-run and long-run price elasticity of demand, to provide empirical evidence on the impact of tax

increase on consumption. Such information shall be considered in future policy building that aim to address the issue of tobacco consumption in Kosovo, and comprehend the budgetary impact. The analysis presented, is conducted using the error-correction model, based on the methodology considered by Ross and Al-Sadat (2007), using time-series data from 2005 – 2017.

Methodology

Variables

The study employed annual secondary information for the time period 2005-2017 mainly generated from the Custom Office and Kosovo Agency of Statistics publications. The selection of the time period was done based on the availability of information. Information on the dataset is summarized in Table 1.

To estimate the final price and income elasticities, a number of potential variables were tested within the basic framework, until the preferred control variables were chosen. To begin with, we derived the dependent variable on cigarette per capita consumption for adult population, named as “*consum*”. Information enjoyed in the calculation was based on overall yearly imported net kilograms of tobacco and number of adult population at the national level. Since Kosovo does not produce tobacco products, cigarette consumption is strongly relied on imports; hence, imported kilograms revenue served as a good consumption indicator. Additional advantage is that the total kilogram amount was easily converted into cigarette sticks (1kg=1100 sticks), making it more feasible to understand the number of cigarettes consumed per adult throughout the year. Similar approach was also considered by Ross and Al-Sadat (2007). The mean values of variable “*consum*” is 2,748 cigarettes per adult following a decreasing trend throughout years. The value of 2,748 cigarettes seemed realistic and comparable to other neighboring countries consumption level (Tobacco Atlas, 2016). It is worth mentioning that for year 2007 was linearly interpolated, as the initial value was considered an outlier due to factors beyond price, income or education. The consumption variable served as the dependent variable in both models.

The first variable controlled for was real tobacco consumer price index (CPI) “*rtobcpi*” used to understand price elasticity. The tobacco CPI values obtained from the Agency of Statistics publication in 2017, and converted into real values using the global CPI. The aggregated annual income was captured by the variable “*rincome*” which was measured using annual real GDP growth. Annual percentage growth rate of GDP at market prices was based on constant local currency and measured by World Bank. In order to account for the tobacco control law implemented in 2013, we finally generated a dichotomous variable “*tlaw*” with values 1 and 0. The law Nr.04/L-156 restricted the locations of tobacco consumption and banned advertisement. Further descriptive statistics of the variables in each analysis can be found in Appendix I. Finally, to test the robustness of our results, the tobacco CPI variable was replaced with real cigarette prices (per pack) per one of the most popular brand in the market, the Boss brand.

Table 1: Cigarette consumption, real tobacco CPI, and real income in Kosovo, 2005–2017.

Time	Consumption	Real Income	Real Tobacco CPI	Tobacco Law
2005	2632	6.03323	85.6	0
2006	2870	4.50303	85.57	0
2007	3754	7.28608	83.33	0
2008	3198	2.64482	75.62	0
2009	2641	3.34167	81.02	0
2010	2852	3.30957	80.54	0
2011	2852	4.81256	78.44	0
2012	2686	2.89535	83.43	0
2013	2633	3.43123	89.01	1
2014	2457	1.19807	93.63	1
2015	2382	4.09445	100	1
2016	2524	4.0689	108.47	1
2017	2254	4.4661	112.97	1

Analysis

Initially, the selected variables were tested for stationarity using the Augmented Dickey-Fuller (ADF). The examination was done to avoid spurious regression that can lead to inaccurate estimates of a relationship. The dependent and independent variables were tested for a different number of lags in order to ensure conclusive assumptions on stationarity. The procedure was performed in three steps, initially we regressed the difference of the variable on the lag of the variable, predicting the residuals, and finally regressing the residuals on the lagged residuals. The results confirmed conclusiveness for all the variables. However, the variables were mostly not stationary, widely common in economics, when conducting macro economic analysis. Variable on consumption “*consum*”, real tobacco CPI “*rtobcpi*” and retail cigarette price “*price*” were transformed into stationary after applying the first difference, when trend was added. The variable on real income “*rincome*” appeared to be stationary at 5% critical value. Following, we proceeded to one of the main requirements of the economic theory, a stationary relationship between non-stationary variables, otherwise known as co-integration. Co-integration was tested using the Engle-Granger two stage approach, yielding a t statistic value of -3.581 and -3.670 statistically significant at all levels. The Augmented Dickey-Fuller (ADF) on the residuals was performed using the first difference of consumption variable, the first difference of real tobacco CPI, and real income, afterwards we predicted the residuals and tested the values. The presence of a vector of co-integration allowed us to proceed with the Error Correction Model (ECM). The ECM combines the lagged error term with the difference of the variables employed. The

VIF (Variance Inflation Factors) tests performed on the two models confirmed of no issue with multicollinearity, and the Durbin-Watson d-statistic reported no autocorrelation.

Table 2: Augmented Dickey-Fuller (ADF) Test Statistic

Variables	Augmented Dickey-Fuller (ADF)	
		First Difference (test statistic)
Consumption	-1.545	-3.239**
Real Tobacco CPI	1.246	-4.496***
Real Income	-3.426**	
Prices	0.472	-3.556*

*** p<0.01, ** p<0.05, * p<0.1

Table 3: Engle-Grander two stage approach

	Augmented Dickey-Fuller (ADF) on the residuals
First Model	-3.581***
Second Model	-3.570 ***

*** p<0.01, ** p<0.05, * p<0.1

Having confirmed the variables, the study concentrates on two main analyses. Firstly, the descriptive analysis exploring the data on cigarette consumption and real tobacco CPI over the years. Secondly, the study analysis the long-term and short-term price impact on cigarette consumption. The methodology employed is based on the approach by Ross and Al-Sadat. (2007) studying the case of Malaysia, using two OLS multiple regression models.

Firstly, consumption per capita in Kosovo was regressed on real tobacco CPI and real income. Secondly, we controlled for the new tobacco-control law implemented in 2013 by adding the law control “*tclaw*” to the model.

$$\text{Model 1: } Y(\text{consumption}) = a + \beta_1 (\text{real tobacco price}) + \beta_2 (\text{real income})$$

$$\text{Model 2: } Y(\text{consumption}) = a + \beta_1 (\text{real tobacco price}) + \beta_2 (\text{real income}) + \beta_3 (\text{tclaw})$$

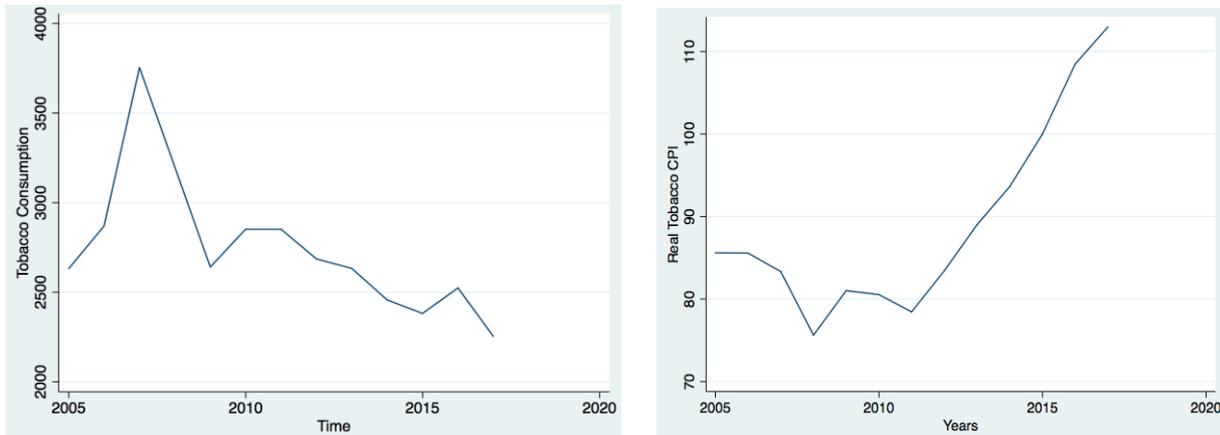
To estimate the short-term effect using error correction model, the regression is transformed into $Y(\Delta \text{consume}) = \beta_0 + \beta_1 \Delta y_t + \beta_2 \varepsilon_{-}(t-1) + \mu_t$ where $\beta_2 \varepsilon_{-}(t-1)$ is the error correction term, showing the speed of adjustment, and μ_t denoted the white noise error term. The $\beta_2 \varepsilon_{-}(t-1)$ is the component that corrects the disequilibrium in the system. All the analysis was carried out using Stata/IC 15.1

Results

Descriptive Analysis

Based on the two-way graph, one observes a decrease trend in overall cigarette consumption over the years, despite a rapid increase from 2005 – 2006. Concerning tobacco CPI trend, an almost exponential trend upwards was observed. The two variables move in opposite direction over the time period 2005 – 2017. The graphical relationship gives indication for the expected negative association between the variables over the time.

Fig. 1: Consumption & real tobacco CPI over the year 2005 – 2017



Statistical Analysis

Following, results from the long-term and short-term model are reported and elaborated.

Table 4: Long-term relationship between the variables of interest

Consumption	Model 1		Model 2	
	Coefficient	t-value	Coefficient	t-value
Real Tobacco CPI	-21.22** (6.608)	-3.21	-25.477 (14.39)	-1.77
Real Income	116.087** (49.892)	2.33	127.56 (0.0154561)	-2.05
Tobacco Control Law			116.59 (427.2783)	-0.34

* $p < 0.05$

* Values in parentheses represent standard errors.

* In parenthesis are presented the standard errors

The results from the two approaches confirm a negative association between tobacco CPI and level of consumption at the aggregate level within a year. The OLS model tells that as tobacco CPI increases by one unit, consumption decreases by 21 cigarettes per person in the long-run, while holding everything else constant. The value is considered statistically significant, put differently, the assumption under the null hypothesis is false. The variable on real income presents a statistically significant and positive association to cigarette consumption, leading to an increase in consumption by 116 cigarettes. One of the reasons behind such increase is expected to be the rightward shift of the budget line, enabling more consumption. The measured long-run price elasticity of demand was -0.68, whilst the income elasticity of demand in 0.169. The interpretation of the results is that increasing cigarette prices by 10%, would lead to a decrease in consumption by 6.8%. The obtained value can be considered relatively comparable to previous

literature on developing countries (Ross and Al-Sadat, 2007). Referring to the study by Jha(1999) and Perucic (2012) on economics of tobacco control and demand for cigarettes, the price elasticity of consumption following a 10% price increase, varies between 4% to 8%. The results were also tested using the bootstrapping method, which confirmed the validity of our estimates and calculated confidence intervals ranging from 0.11 to 0.17 for income and -0.683 to -0.614.

In regards to the second model including the variable on tobacco law implementation, the direction of the relationship remains the same for both variables. The decrease in consumption is by 25.5 cigarettes, however, the value on real tobacco CPI became statistically insignificant, meaning that there is not enough statistical evidence to reject the null hypothesis that the effect is equal to 0. Interestingly, the effect from the introduction of tobacco control law in 2013 did not have any statistically significant effect on consumption. For the second regression, including the implementation of tobacco law, price elasticity of demand increased to -0.82 while income elasticity increased to 0.18. The bootstrapping confirmed identical elasticity results for tobacco CPI and 0.15 for income.

Table 5: Short-term relationship between the variables of interest

Consumption (first difference)	Model 1	Consumption (first difference)	Model 2
	Coef.		Coef.
Real Tobacco CPI (first difference)	-10.383 (13.869)	Real Tobacco CPI (first difference)	-12.467 (14.52)
Real Income	165.53** (43.48)	Real Income	175.127** (43.98)
Lagged residual 1		Tobacco Control Law (first difference)	79.26 (223.21)
L1.	-0.8476*		
		Lagged residual 2	
		L1.	-0.875**

* $p < .05$; ** $p < .01$; *** $p < .001$

* In parenthesis is presented the standard errors

The short-term model explained 79% of the variability. The result for income effect “*real income*” was found to be statistically significant, while price effect was missing statistical significance. The coefficient of the lagged residual exhibited negative results validating the existence of a long-run relationship. The -0.85 value shows the rate it corrects the previous disequilibrium, or said differently, around 85% of the deviation will be corrected. The same interpretation also applies to the lagged residual 2 for the second model. It can be read from the coefficients that increasing real tobacco CPI by one unit, decreases consumption by 10.3 cigarettes, while increase in income is associated with increase in consumption by 165 units. The value in the short run is lower than in the long run, which is consistent with the literature claiming that smoking is not an easy habit to quit on. For the second model the consumption decrease is slightly higher, by 12.46 units, in the short run, after controlling for the tobacco control law. Values on the income effect are statistically significant and positive, while the tobacco control law remains insignificant. The bootstrapping method could not be performed

Subsequently, Table 6 displays the price elasticities of demand using the four above mentioned regressions.

Table 6: Elasticities

	Model I	Model II
Long-run price elasticity	-0.68	-0.82
Short-run price elasticity	-0.33	-0.40
Long-run income elasticity	0.169	0.18
Short-run income elasticity	0.24	0.25

The results were also tested by replacing the real tobacco CPI with the retail price of one of the most popular brand where price elasticity of demand was -0.56, while in the short run it was -0.28. Referring to long-run income elasticity, the value was estimated to be 0.20 and 0.25 in the short-run.

The values obtained are comparable to estimated price and income elasticities of other countries. Based on the WHO publication “The demand for cigarettes and other tobacco products”, the estimates appear to be highly alike to the example of Poland. It shows that price elasticity in the short run is -0.4 and -0.7 in the long-run. Similarly, evidence from Turkey showed that increasing taxes by 10% would lead to a reduction in consumption by 8.7% (Perucic, 2012).

Limitations

A number of caveats within the study should be acknowledged. Initially, the time-period consisting of only 13 years presents a limitation to the ECM employed which could affect the precision of our estimates. Secondly, the threat from omitted variable bias can be present as per other potentially not-included relevant variables. Lastly, the analysis ignores cigarette consumption occurring from illicit trade.

Additional research within the field is necessary to inform the stakeholders involved. Future assessment should also look into additional variables to measure real income beyond real GDP growth rate.

Conclusion

In conclusion, it can be claimed that consumption of cigarettes in Kosovo is inelastic. Roughly looking at the data the increase in the price is relatively modest. The 2-euro yearly price increase policy did not account per inflation, hence the rise in real time was not followed by larger drop in consumption. Results showed that the initial effect from a 10% increase in price, is a 3.3% decrease in cigarette consumption. The effect is larger in the long term, the decrease is estimated to be 6.8%. The income effect could stimulate larger consumption of cigarettes ranging from 116 to 165 additional cigarettes.

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Appendix I

Table 1: Descriptive statistics for the variables employed in the model

Variable	Description	Obs.	Mean	Std. Dev.	Min	Max
Consumption	Continuous	13*	2748.846	387.9289	2254	3754
Tobacco CPI	Continuous	13	89.04846	11.57705	75.62	112.97
Real Income	Continuous	13	4.006544	1.533438	1.198071	7.286083
Tobacco Control Law	Dichotomous =0 no law =1 implemented law	13	.3846154	.5063697	0	1

* The 13 years period covered from 2005 – 2017

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ABOUT THE PROJECT

Commissioned by Bloomberg Philanthropies, the University of Illinois in Chicago (UIC, the leading organization in charge of managing the project Accelerating Progress on Effective Tobacco Tax Policies in Low- and Middle-Income Countries), has contracted the Institute for Economic Studies (IES) in Belgrade, and sub-contracting the Centre for Political Courage (CPC) to conduct economic research on tobacco taxation in Kosovo. UIC is a key partner of the Bloomberg Philanthropies Initiative to reduce tobacco use. The views and opinions expressed in this document cannot be attributed to, nor do they represent the views of the UIC, the Research and Health Policy Institute, or the Bloomberg Philanthropies.