The elasticity of tobacco products in BiH – macro data analysis

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Abstract: Tobacco consumption continues to be behavior engaged in by a large percentage of Bosnia&Herzegovina (BiH) citizens. According to the official statistics, nearly half of the state's adults, that is about 1,200,600 people, consume tobacco product on a daily bases. The state excise policy is one of the main available tool for reducing smoking prevalence because the cigarette prices are under direct impact of this policy. The specific excise on cigarettes introduced in BiH in 2009 and have increased every year so it was the main driver of cigarettes price growth. In order to provide research-based evidence for more effective tobacco taxation policies in BIH, in this paper we estimate price elasticity of demand for cigarettes using the macro level data for the period 2008 to 2017, on a semi-annual basis. The results have shown that increase in prices of cigarettes have statistically significant impact on cigarettes consumption, at significance level of 1%. The estimated price elasticity coefficient is in the range from -0.71 to -0.83, depends on the selected control variables used in the model. It means that increase in real cigarettes prices for 10% led to the decrease in cigarettes consumption in the range from 7.1% to 8.3%.

Keywords: smoking prevalence, price elasticity of demand for cigarettes, specific excise on cigarettes, cigarettes prices.

Introduction

Smoking is an endemic problem in Bosnia and Herzegovina (BiH). Smoking prevalence in BiH is close to 40% with a significant difference between men (46.9%) and women (28.5%), yet, the gender gap has been diminished over time, as the smoking prevalence is increasing among women. Among youth, tobacco use prevalence among girls (9.7%) is significantly lower than among boys (15.5%). BiH is among the top 10 countries in the world for cigarettes consumption (World Atlas, 2018). Level of tolerance towards smoking in BiH, like in the neighboring countries, is relatively high yet with a tendency to decline. Available evidence also suggests that there is growing disparities in cigarette smoking by social classes, and the narrowing of differences in smoking by gender.

Research evidence shows that smoking is among the leading preventable cause of death worldwide. Bosnia and Herzegovina is not an exception. Based on the current percentage of people smoking in BiH, premature deaths attributable to smoking are projected to be as high as 600,000 (World Health Organization, 2016).

The state excise policy is one of the main available tool for reducing smoking prevalence (by reducing smoking initiation and increasing smoking cessation) because the cigarette prices are under direct impact of this policy. The effects of tobacco taxation on smoking prevalence depend on the price elasticity of demand for cigarettes. Research indicates that the price elasticity of demand for cigarettes in high-income countries is, on average, -0.4 among adults (Chaloupka et al., 2000). An even larger effect can be expected among countries and socio-economic groups with lower levels of income, and among youth (Al-Sadat, N., 2005). Previous research, conducted in low and middle-income countries (such as BiH), found that price elasticity of demand for cigarettes is in the range between -0.5 and -1 (Selvaraj et al., 2015). This implies that state excise policy in this countries can be effective in reducing tobacco consumption. Nevertheless, only a few low and middle-income countries have calculated their country-specific estimates of the price responsiveness of the cigarette market. Lack of data or research capacity is often the reason why this information is not available (Ross & Al-Sadat, 2007).

The specific excise on cigarettes introduced in BiH in 2009 and have increased every year. Ad valorem excise, calculated on the retail price of cigarettes, stayed at the same level of 42% retail price. Specific excise increased, from an initial level of 3.83 EUR per 1000 cigarettes stick in the 2009 to 34.5 EUR per 1000 cigarettes stick in 2017. This is the main reason for the increase in the cigarettes prices for about 175%, in the period 2008-2017. However, given the low industry price, retail cigarette prices in BiH are among the lowest in Europe. At the same time, budget revenues from specific and ad valorem excise were constantly increasing, despite a significant drop in consumption of cigarettes. Regardless of observed the positive trends in cigarettes consumption, smoking prevalence and budget revenues since introduction and continuous increasing of specific excise, policy makers are often in a dilemma whether or not to continue with the trend of increasing specific excise tax.

In order to provide research-based evidence for more effective tobacco taxation policies in BIH, it is necessary to estimate prices' elasticity. In this study, we developed the econometrics model of cigarettes demand based on the macro level data. To our best knowledge, this is the first estimate of the price elasticity of cigarettes demand for BiH.

Following this introduction, the second section presents the data related to cigarettes consumption in BiH, the short descriptive analysis and methodology. The third section presents and discusses the results of the regression analysis, while the fifth section concludes the paper.

Data and Method

To estimate the impact of an increase in the price of tobacco product on tobacco consumption, we use data for consumption and price of cigarettes. Consumption of cigarettes accounts for over

97% of total tobacco products in BiH in 2017 (Indirect Taxation Authority of BiH, 2018)[1] and conclusions based on the analysis of consumption of cigarettes are valid and representative.

Data related to cigarettes consumption and prices in BiH are available for the very short period (2008-2017). We have collected data for the last ten years on the semi-annual level, to have sufficient data for implementing time-series analysis. This period of analysis is relevant for BIH, taking into account that specific excise on cigarettes was introduced in 2009.

The time-series data for the period 2008-2017 are summarized in Table 1. The per-capita consumption of domestic and imported cigarettes is calculated based on the semi-annually data of the number of issued excise stamps on tobacco and cigarettes sticks, provided by Indirect tax Authority of BiH and the size of the adult population (aged 15 years or older). The excise stamp is issued for each cigarettes pack, and therefore, the number of issued excise stamps is equal to the number of cigarettes pack. Consumption of cigarettes in the sticks is derived from the number of cigarettes per pack which mainly contain 20 sticks, but there exist packs with 18 and 24 sticks as well[2]. The Indirect Tax Authority of BiH provided us with detail semi-annual data, so we were able to calculate the exact number of cigarette sticks sold.

The real tobacco consumer price index (CPI) we calculated using the average price of cigarettes and general CPI in BIH. Calculation of average price of cigarettes is based on the total value of issued excise stamps for domestic and imported cigarettes and the number of cigarettes (value/quantity), on the semi-annually basis, declared for sale in BiH[3]. Hence, we used official data, provided by Indirect Taxation Authority, on the number of cigarettes and the total value of cigarettes to calculate average prices of cigarettes. Then, based on the average prices of cigarettes, we created nominal tobacco price index. The average price of cigarettes pack in the first period (2008p1) is used as a base value and tobacco CPI index (2008p1=100) for the first period got value 100. For each next period, we calculated index as the ratio between the average price per pack for that period and the average price per pack in the base period, multiplied by 100. To obtain real tobacco CPI, we deflated it using general CPI in BIH[4].

The purchasing power is one of the main determinants of aggregate demand and demand for a particular product. The most often used measure for purchasing power in the country is real income measured by real gross domestic product (GDP) per capita. We have also used real GNI

[1] This estimate is based on only reported consumption. All informal sales, such as of cut tobacco on the street or in the farmers market, is not part of this estimation due to the lack of a reliable and unique assessment of the illicit market.

[2] Until second half of 2014, every cigarette pack contained 20 cigarettes stick. Since then, cigarette packs with either 18 or 24 cigarette sticks accounted on average only 0.66% of all sold cigarettes. Therefore, the difference in number of cigarettes stick in cigarettes pack (two below and four above) has not statistically significant influence on tobacco CPI, during the calculation average price of cigarettes pack.

[3] Indirect Taxation Authority provided us with detailed data of the value and the number of issued excise stamps, number of cigarettes sticks (corresponding to the particular excise stamps) on semi-annual basis.

[4] We calculated semi-annual general CPI (2008p2=100) using monthly inflation rates which are available on http://www.bhas.ba.

per capita as a proxy for real income. BiH has the significant amount of unilateral transfers from abroad, and it means that GNI per capita (GDPpc + unilateral transfers pc) could be a better approximation of income for the estimation demand for cigarettes. The data on real income is available in the online publication of the Agency of Statistics of BiH on a quarterly basis and we recalculate it on semi-annual basis. Data on unilateral transfer is available in the balance of payments statistic in Central Bank of BiH database also on quarterly basis and we recalculate it on semi-annual basis. Also, as a proxy for purchasing power, we used real net average wages, provided by the national statistics agency.

Tobacco control policies other than cigarette taxes can also be an important determinant of demand for cigarettes (Ross & Al-Sadat, 2007). We created two variables related to tobacco control environment in BiH between 2008-2017. First tobacco control variable is "tlaw", which is related to the introduction of Law on Tobacco of Bosnia and Herzegovina in 2010. Law on Tobacco has introduced stricter conditions in the field of tobacco production and trade. Variable tlaw takes the value of 0 for the period 2008p1 – 2010p1 and value of 1 for the period 2010p2-2017p2, because it came into the force in may 2010 [5]. Second tobacco control variable is "aban", and it reflect the adoption of Code on Commercial Communications in december 2015 [6]. This code prohibited all forms of commercial communications related to cigarettes and other tobacco products, guns, firearms and pyrotechnical means, as well as opium drugs. Variable aban takes value of 0 for the period 2008p1 – 2015p1 and value of 1 for the period 2015p2-2017p2. This two variables, "tlaw" and "aban" are summarized in tobacco control index "tcindex". Therefore, "tcindex" is the sum of two dichotomus indicators "tlaw" and "aban" (Ross & Al-Sadat, 2007). Therefore, variable tcindex takes value 0, for the period 2008p1-2010p1, value 0 for the period 2010p1-2015p1 and value 2 for the period 2015p2-2017p2.

Table 1. Cigarette consumption, cigarettes prices and real income in BIH, 2008p1 – 2017p2

Period	Consumption of cigarettes (in EUR)	Number of issued excise stamps (number of cigarettes pack)	Average prices of cigarettes (per pack)	Real tobacco CPI	Consumption (cigarettes per adult)	Real income (GDP pc) in EUR	Real disposable income (GDP pc) in EUR	Real net average wages (in EUR)
2008 p1	212,670,325	261,540,001	0.81	100.00	1663	1789.1	2111.2	2229.0
2008 p2	240,964,705	299,359,999	0.80	99.33	1904	1884.2	2231.6	2378.4
2009 p1	229,652,884	282,960,000	0.81	101.73	1801	1765.0	2057.5	2468.4
2009 p2	244,288,614	251,930,000	0.97	119.66	1604	1792.8	2090.0	2433.6
2010 p1	263,831,212	239,180,000	1.10	134.96	1525	1776.7	2031.2	2421.6
2010 p2	218,533,349	215,344,360	1.01	121.46	1373	1794.2	2081.4	2395.2
2011 p1	294,236,356	232,391,160	1.27	149.20	1493	1827.2	2073.5	2388.6
2011 p2	305,416,626	241,090,000	1.27	147.70	1549	1839.2	2105.9	2382.0
2012 p1	282,548,074	195,360,000	1.45	167.19	1265	1861.6	2099.3	2377.8

[5] Law on Tobacco adopted in Parliament BiH in mid-april 2010, came into the force in may 2010, therefore its possible effect on cigarettes consumption could be expected in second half of 2010.
[6] The Code on Commercial Communication came into force in January 2016.

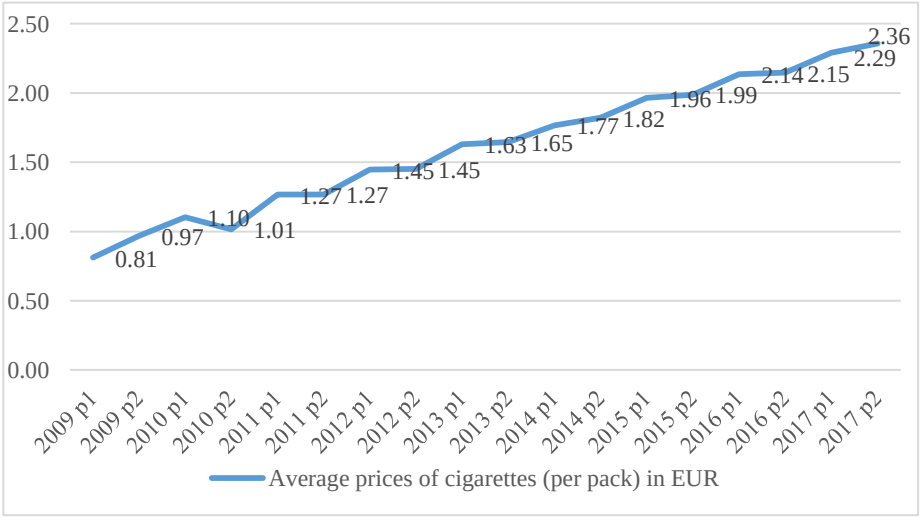
2012 p2	317,968,842	218,854,500	1.45	166.37	1417	1848.1	2133.8	2362.2
2013 p1	293,572,563	180,221,775	1.63	186.88	1175	1878.8	2114.2	2358.0
2013 p2	245,014,137	148,870,000	1.65	191.16	971	1974.4	2289.2	2407.8
2014 p1	251,223,010	142,299,500	1.77	205.45	935	1925.4	2175.6	2406.6
2014 p2	290,028,786	159,298,000	1.82	212.48	1047	1979.7	2305.5	2419.2
2015 p1	290,416,345	147,811,500	1.96	229.96	978	2019.3	2267.3	2423.4
2015 p2	301,082,405	151,360,000	1.99	235.08	1000	2070.3	2339.5	2449.8
2016 p1	271,521,809	127,055,000	2.14	254.04	841	2024.3	2251.9	2473.2
2016 p2	294,837,486	137,330,000	2.15	254.46	909	2224.0	2482.4	2489.4
2017 p1	272,084,486	118,815,000	2.29	269.58	788	2052.8	2299.7	2490.0
2017 p2	293,329,175	124,440,000	2.36	275.89	826	2349.1	2612.3	2493.6

Source: World Bank data; Indirect Taxation Authority of BiH, (2008)

To generate "per person" measures we used a number of inhabitants from the World Bank database, due the poor quality of population data from the national statistics agency. Also, the lack of official population statistics in BiH have prevented us from using other control variables (such as male to female ratio, education, etc.).

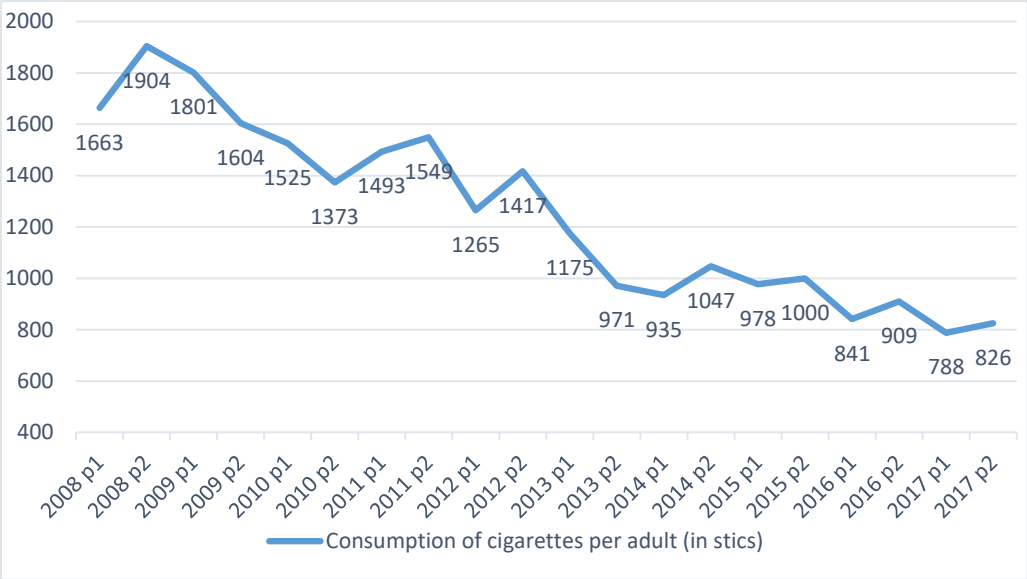
Average nominal price of cigarettes significantly increased in the last ten years (for about 175%). Excise duties (ad valorem) represented 49% of the price (before VAT) until the introduction of specific excise in second half of 2009. By introduction of specific excise, the base for ad valorem excise calculation is changed, from price before VAT, to retail price with VAT. As a consequence, the rate of ad valorem excise changed from 49 % of the price before VAT to 42% of retail price (price with VAT) to keep roughly the same ad valorem excise burden of the retail price . Specific excise duties increased from an initial level of 3.83 EUR per 1000 cigarettes stick in the 2009 to 34.5 EUR per 1000 cigarettes stick in 2017, which is the main reason for the increase in cigarettes prices. This trend is visible in graph 1.

Graph 1. Average nominal prices of cigarettes (per pack)



Along with the rise in the price of cigarettes, caused by the increase in excise duties, consumptions of cigarettes per adult decreased rapidly. The trend is shown on graph 2. Consumption of cigarettes in the half-year period decreased from the value of 1904 per adult in the second half of 2008 to 826 cigarettes per adult in second half of 2017.

Graph 2. Consumption of cigarettes per adult (in sticks)



To estimate the demand for cigarettes, we used the following conventional model in linear functional form:

$$Cons_t = \alpha + \beta 0\ rtcpi_t + \beta 1\ rincom_t + \beta 2\ tcontrol_t + \varepsilon_t$$

Where $Cons_t$ is aggregate consumption of cigarettes per capita, $rtcpi_t$ is real tobacco CPI, and $rincom_t$ is real GDP per capita (alternatively we used also GNI per capita or real wages), tcontrol are tobacco control variables. We used all variables in logarithm (log-log model)[7], except tobacco control variables. Tobacco control variables are dummy variables (tlaw and aban) or the sum of dummy variables (tcindex) and we put them directly in the regression, without logging.

Before testing for unit roots, because we use semi-annually data, we have to test our variables for the seasonal components. Semi-annually, quarterly and monthly data usually tends to have seasonal components in variations. The seasonality becomes an issue in analysis of time series

[7] In many economic situations (particularly price-demand relationships), the marginal effect of one variable on the expected value of another is linear in terms of percentage changes rather than absolute changes. In such cases, applying a natural log to both dependent and independent variables may be appropriate. Relationship where both Y and X are log-transformed, are commonly referred to as elastic in econometrics, and the coefficient of log X is referred to as an elasticity Also, we can directly (from log-log model) obtain standard errors of estimated coefficients without using bootstrap procedure (Wilkins et all, Ruso et all, 2008; Mulugeta et all., 2013).

stationarity, as typical unit root tests do not deal with possibility of seasonal integration. Autocorrelation function is an useful tool for analysis of presence of seasonality in time series. High value of autocorrelation coefficient at season lag *s* indicates presence of additive seasonality, while high and slowly declining autocorrelation coefficients on seasonal lags s, 2s, 3s, etc. indicate multiplicative seasonality. In addition, very high (close to one) and slowly declining autocorrelation coefficients on seasonal lags s, 2s, 3s, etc. of the time series after removing trend component (i.e. using first difference) also indicate high probability of seasonal integration (*Mladenovic et all.,2005*). In order to analyze presence of seasonality, we estimate autocorrelation of up to forth order of logged time series (recommended level is at least 2s lags), both for level and first difference as shown in the table below:

Table 2. Autocorrelation coefficients

	Level				First difference			
	AC(1)	AC(2)	AC(3)	AC(4)	AC(1)	AC(2)	AC(3)	AC(4)
lcons	0.832	0.659	0.515	0.376	-0.371	-0.003	-0.117	-0.057
lrtcpi	0.851	0.707	0.546	0.411	-0.617	0.235	-0.211	0.335
lrincome	0.598	0.688	0.43	0.37	-0.626	0.354	-0.124	0.066
lrdincom	0.466	0.682	0.313	0.39	-0.697	0.536	-0.378	0.324
lrwage	0.44	0.114	0.083	0.025	0.316	-0.144	-0.127	-0.119

The estimated values of the autocorrelation function for the first differences reveals that time series most likely are not seasonally integrated, but lrtcpi, lrincome and lrdincom likely have seasonal component. As type of seasonality is hard to identify solely on the basis of autocorrelation in case of semi-annual data, we run autoregressive regressions up to second order, including also seasonal dummy to identify presence of the additive seasonality and seasonal autoregressive component to identify presence of the multiplicative seasonal component. The results of estimation for seasonal dummy and seasonal autoregressive component (coefficients for constant, trend and common autoregressive components are omitted) shows that logged price index has additive seasonality, while real income and real disposable income have multiplicative seasonality, as shown in the table below.

Table 3. Seasonal dummy and seasonal autoregressive component

original	lcons	lrtcpi	*lrtcpi_sa*	lrincome	*lrincome_sa*	lrdincom	*rdincom_sa*	lrwage
S_2	0.0565	-0.0564**	-0.001	0.0557	-0.000	0.0617	-0.000	0.0014
	(0.0328)	(0.0189)	(0.0110)	(0.0497)	(0.0023)	(0.0397)	(0.0021)	(0.0026)
SAR(2)	-0.0541	-0.4518	-0.454	0.5969***	-0.520*	0.4050**	-0.354	0.1944
	(1.4259)	(0.3080)	(0.3023)	(0.1565)	(0.2786)	(0.1720)	(0.3140)	(0.3318)

We use Tramo/Seats statistical tool, being the only software solution that supports seasonal adjustment of the semi-annual time series, to eliminate seasonality from price index and income variables. Then we rerun autoregressive regressions on the seasonally adjusted data for these three variables (in the table indicated with *sa* suffix). After adjusting, seasonal components have been removed from price index and real disposable income, while seasonality still remained in real income, but statistical significance declined.

Table 4. Seasonally adjusted variables

Period/ Variable	**2008 p1**	**2008 p2**	**2009 p1**	**2009 p2**	**2010 p1**	**2010 p2**	**2011 p1**	**2011 p2**	**2012 p1**	**2012 p2**
rincom	1842.61	1836.41	1800.14	1777.33	1784.55	1796.51	1824.70	1845.69	1855.49	1857.71
rdincom	2187.18	2163.17	2107.86	2060.66	2055.53	2066.30	2086.21	2097.52	2111.85	2114.26
rtcpi	96.43	103.20	98.12	124.33	130.00	126.35	143.96	152.97	162.17	171.39
Period/ Variable	**2013 p1**	**2013 p2**	**2014 p1**	**2014 p2**	**2015 p1**	**2015 p2**	**2016 p1**	**2016 p2**	**2017 p1**	**2017 p2**
rincom	1876.43	1975.24	1931.36	1976.55	2030.42	2043.45	2084.36	2134.18	2160.64	2230.49
rdincom	2160.37	2226.28	2235.58	2263.51	2303.41	2294.52	2327.28	2379.85	2416.93	2484.73
rtcpi	182.26	195.87	201.31	216.94	225.91	239.56	249.93	258.95	265.57	280.53

Having two variables with no seasonal component and three variables with seasonal component, we proceed further analysis with seasonally adjusted data for price index, real and real disposable income to avoid effects of seasonality on results of regression. We applied the Dickey-Fuller test for unit root on a logarithmic data (Ateriou&Hall, 2016, p.361).

Table 5. Unit root test

Variable	Dickey-Fuller test for levels Test statistics	Results
Consumption (lcons)	-4.224	Integrated at zero order I (0)
Real tobacco CPI (lrtcpi), seasonally adjusted	-3.170	Integrated at zero order I (0)
Real GDP pc (lrincom), seasonally adjusted	-2.282	Integrated at first order I (1)
Real GNI pc (lrdincom), seasonally adjusted	-2.898	Integrated at first order I (1)
Real wages (lrwage)	-3.914	Integrated at zero order I (0)

Dickey-Fuller test indicates that real income and real disposable income have unit roots in levels, but not in the first differences, so we can conclude that these three time series are first order integrated.

Regarding to the results of unit root test, which indicate that our variable are integrated at zero order and first order, we can apply two econometrics model:

- The ordinary last squares (OLS) on time series data, when we use variables in levels if they are I(0) and variables in first difference if they are I(1). Due to the fact that variables which are integrated I (1) are logged real GDP and logged real disposable income their first differences (dlrincom and dlrdincom) are real growth rates of GDP and real growth rates of disposable income. Consequently, our differenced variables represent a significant economic variable and can be used in OLS estimation.
- The autoregressive distributed lag (ARDL) model which is preferable when dealing with variables that are integrated of different order, I(0) and I(1). The reparameterized result gives the short-run dynamics and long run relationship of the considered variables.

If we have very short time series, OLS model, if it can be applied, give much more relible results than ARDL (Giles, 2013). In this analysis, we use ordinary last squares (OLS) on time series data, due to the very short time series (10 years and corresponding series of 20 semi-annually data). However, after OLS we will apply ARDL as the second robustness test.

Results

We estimated several versions of our model. As a proxy for real income, we use real GDP, but also real disposable income, due to the significant amount of inward unilateral transfers from abroad, which significantly affect purchasing power in BiH. The results of unit root test suggest us to use income variables in their first difference, which are in the fact real growth rates. Because of the unexpected insignificance of this two proxy for real income, we also used real net average wages to check our results.

We started with only two independent variables, real tobacco CPI (seasonally adjusted) and real income growth rate (proxy by real GDP pc growth rate, seasonally adjusted) in order to estimate the elasticity of demand for cigarettes. Then, we introduced tobacco control variable in the model, one by one. First, we introduced variable tlaw, and then aban. At the end, we estimated the model which is the summary for all tobacco control polices, “tcindex”. The results for different versions of our model are summarized in table 6. Each of our models includes income and prices, but tobacco control policy variables have introduced in the model one by one. As we write above, we used all variables in logarithm except tobacco control variables.

These results suggest that real prices of tobacco products have a negative and statistically significant impact on the consumption of cigarettes, at 1% level of significance. This result is in line with our expectation. The increase in cigarettes prices for 1% led to a decrease in cigarettes consumption by in the range of 0.78% to 0.84%. The regression coefficient of real income growth is positive, which is in line with our expectations, but this coefficient is not statistically significant.

Table 6: Linear demand model for cigarettes – (real income growth is proxied by GDP pc growth rate)

VARIABLES	(1) lcons	(2) lcons	(3) lcons	(4) lcons
lrtcpi	-0.827*** [0.077]	-0.778*** [0.133]	-0.839*** [0.101]	-0.790*** [0.097]
dlrincome	0.250 [1.404]	0.342 [1.454]	0.189 [1.479]	0.215 [1.431]
tcindex		-0.029 [0.064]		
tlaw			0.015 [0.076]	
aban				-0.043 [0.066]
Constant	11.355*** [0.392]	11.131*** [0.635]	11.408*** [0.482]	11.173*** [0.487]
Observations	19	19	19	19
R-squared	0.913	0.914	0.913	0.916
F statistic (prob.)	0.000	0.000	0.000	0.000
D-W d-statistic	2.061	1.928	2.120	2.002
Breusch-Pagan / Cook-Weis. test for heter. (Prob > chi2)	0.809	0.832	0.763	0.769
JB test (Prob.)	0.890	0.921	0.876	0.916
Ramsey RESET test (Prob.)	0.763	0.721	0.741	0.823
Multicolinearity test (vif)	1.50	3.28	2.06	1.83

Standard errors in brackets
*** p<0.01, ** p<0.05, * p<0.1

Our control variables, which represent implemented tobacco control policy in BiH, are not significant. Their introduction in the model did not improve the model, which is shown by adjusted R-square. Including different control variables in our model did not lead to significant changing in the value of price elasticity coefficient and we can conclude that our estimated coefficient of elasticity is stable. The validity of the overall regression was confirmed by F statistics whose probability is 0.000, or less than 0.01, and at the level of 1% of significance, we can say that the estimated model is statistically significant. Independent variables explain more than 91% variance in the dependent variable, which shows adjusted R-squared.

A lot of BIH residents are employed or were employed in western Europe. As a result, unilateral transfers from abroad significantly contribute to the domestic purchasing power of BIH household. In the last ten year, the share of unilateral transfers in real GDP is about 15%, which is visible from the table 1 if we compare GDP pc and GNI pc. Taking into account this fact, we suspected that the insignificance of real income growth rate measured by real GDP pc growth

rate is the result of using the wrong variable for the measuring purchasing power. Therefore, we dropped GDP per capita growth rate from the model (variable dlrincom) and introduced GNI per capita growth rate in the model (first difference of logarithm of real disposable income - dlrdincome), also seasionally adjusted.

Table 7: Linear demand model for cigarettes – (real income growth rate is proxied by GNI pc growth rate, i.e. real disposable income growth rate)

VARIABLES	(1) lcons	(2) lcons	(3) lcons	(4) lcons
lrtcpi	-0.776***	-0.756***	-0.799***	-0.736***
	[0.094]	[0.133]	[0.103]	[0.112]
dlrdincome	-1.200	-1.010	-1.908	-1.279
	[2.001]	[2.223]	[2.350]	[2.037]
tcindex		-0.016		
		[0.068]		
tlaw			0.051	
			[0.083]	
aban				-0.046
				[0.065]
Constant	11.106***	11.012***	11.189***	10.905***
	[0.478]	[0.641]	[0.506]	[0.564]
Observations	19	19	19	19
R-squared	0.915	0.915	0.917	0.918
F statistic (prob.)	0.000	0.000	0.000	0.000
D-W d-statistic	2.039	1.970	2.244	1.993
Breusch-Pagan / Cook-Weis. test for heter. (Prob > chi2)	0.745	0.767	0.615	0.757
JB test (Prob.)	0.868	0.888	0.761	0.934
Ramsey RESET test (Prob.)	0.458	0.477	0.528	0.571
Multicolinearity test (vif)	2.27	3.86	2.82	2.37

Standard errors in brackets; *** p<0.01, ** p<0.05, * p<0.1

Introducing the new variable as a proxy for purchasing power did not result in the significance of these variables in the model. Variables “dlrdincome” is not statistically significant. The regression coefficient of real disposable income is negative, which is not in line with our exaptation, but this coefficient is not statistically significant. Increasing in cigarettes prices for 1% led to a decrease in cigarettes consumption by in the range of 0.74% to 0.80%. The variables, which represent tobacco control polices are not statistically significant.

To check the impact of purchasing power on demand for cigarettes again, we created the model with a new variable which is often used in the literature as a proxy for the purchasing power – real average wages, obtained from National statistics agency. The results of the different version of models are presented in table 8.

Table 8: Linear demand model for cigarettes – (real income is proxied by real wages)

VARIABLES	(1) lcons	(2) lcons	(3) lcons	(4) lcons
lrtcpi	-0.786***	-0.730***	-0.846***	-0.747***
	[0.076]	[0.138]	[0.127]	[0.083]
lrwage	0.194	0.207	0.450	0.637
	[1.012]	[1.036]	[1.121]	[1.086]
tcindex		-0.032		
		[0.066]		
tlaw			0.048	
			[0.082]	
aban				-0.077
				[0.071]
Constant	9.980	9.642	8.714	7.137
	[5.849]	[6.024]	[6.344]	[6.376]
Observations	20	20	20	20
R-squared	0.906	0.907	0.908	0.912
F statistic (prob.)	0.000	0.000	0.000	0.000
D-W d-statistic	1.985	1.858	2.171	1.947
Breusch-Pagan / Cook-Weis. test for heter. (Prob > chi2	0.675	0.694	0.619	0.746
JB test (Prob.)	0.786	0.826	0.7692	0.939
Ramsey RESET test (Prob.)	0.455	0.444	0.486	0.644
Multicolinearity test (vif)	1.54	3.66	2.98	1.88

Standard errors in brackets
*** p<0.01, ** p<0.05, * p<0.1

Once again, variables which represent purchasing power was not statistically significant. The coefficients of the tobacco control variables were again not statistically significant. Impact of real tobacco prices is statistically significant, and estimated coefficients of price elasticity have a wider range of value. Increase in cigarettes prices for 1% led to a decrease in cigarettes consumption in the range of 0.73% to 0.85%.

The reason for the non-significance of real income growth, real disposable income growth and real wages on consumption of cigarettes in our models can be in the fact that BiH has experienced a significant increase in this variable in the observed period. It is possible, that higher income allowed smokers to consume higher-priced brands, without increasing in quantity of consumption (John, 2008).

Adjusted R square in all models is slightly above 90%. We applied the Ramsey regression specification error test for all models. Those tests indicated that we did not exclude any

important variables from our model. Such exclusion would result in biased estimates. The Durbin–Watson test assessed the autocorrelation of OLS model residuals. If residuals are correlated, OLS estimates are unbiased. We found the values of the reported d - statistic to be closer to the value two which implies that the residuals from linear regression are uncorrelated in all estimated models.

The Breusch–Pagan/Cook–Weisberg test showed that residuals of the OLS model have constant variance. Therefore, no heteroscedasticity exists that would reduce the reliability of our hypothesis testing and cause OLS estimators to be inefficient. The assumption about the normality of the residual in our models is satisfied, which has been verified using Jarque – Bera normality test. Value of variance inflation factor suggests that out models don't suffer from the multicollinearity problem.

Robustness test

As the second robustness test, we used the ARDL model to estimate responsiveness of cigarettes consumption to income and price changes.

The estimated models which included consumption of cigarettes per adult (lcons), real tobacco cpi index (lrtcpi), real income (lrincome) and different control policy variables (tcindex, aban, tlaw) confirmed statistically significant and negative impact of the real tobacco CPI on the consumption of cigarettes. The long run estimated price elasticity coefficients were negative and statistically significant with value in the range between -0.58 and -0.77. Other variables were not statistically significant. The error correction coefficient was also statistically significant and negative with value in the range between - 0.91 and - 0.99, which implies that more than 90% deviation from long run relationship between variables are corrected in the current semi-annual period. But this estimations are not reliable because of our model did not pass Jarque – Bera normality test and bound test could not reject null hypothesis of no levels relationship at the 5% of significance.

The estimated model with real disposable income as independent variable also confirmed the existance of long run relationship between price of cigarettes and cigarettes consumption. The estimated coefficients were in range between -0.51 and -0.66 and statistically significant. Also, the estimated model with real wage as independent variable confirmed existence of the long-run impact of the increasing in cigarettes price on the decline in cigarettes consumption, but the estimated coefficients were significantly higher than in other tested models (between -0.76 and -0.99). Due to the similar problems as in the models with real income, results of estimated ARDL models with real disposable income and real wages as dependent variable must be taken with caution. Nevertheless, all ARDL models, regardless of which proxy for income we used, and regardless of the tobacco control variables we used, have confirmed statistically significant impact increase in cigarettes price on decrease in cigarettes consumption. The very short time series is the main cause of the problems that followed our ARDL models.

Conclusion

In this paper, we use macro data to analyze the impact of prices of cigarettes on the demand for cigarettes in BiH. Due to the lack of data to create a sufficiently long data series that is necessary for reliable time series analysis, we collected data for semi-annual level. The period of analysis was 2008p1-2017p2. In this period, average prices of cigarettes increased by about 175%, while consumption of cigarettes decreased for more than 50%. The main reason for an increase in prices of cigarettes was continuous increasing of specific excise duties.

We developed three models, with three different measures of income, and estimated them in several versions. The only variable, which has significant impact on demand for cigarettes, was real tobacco CPI. Value of estimated coefficients was in the range of -0.73 to -0.85, and the estimated coefficient was stable across different models and different versions of a particular model. This implies that an increase in prices of cigarettes for 1% led to a decrease in the consumption of cigarettes in the range of 0.73% to 0.85%.

Results of our analysis suggest that the state excise policy is an effective tool for reducing smoking prevalence in BiH. If policy-makers in BiH continue with the policy of increasing excise taxes, the consumption of cigarettes will decrease.

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