THE IMPACT OF CIGARETTE TAXES AND ADVERTISING ON THE DEMAND FOR CIGARETTES IN UKRAINE

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SUMMARY

Background: Cigarette consumption in Ukraine is increasing while the cigarettes are becoming more affordable due to low taxes and raising income. The impact of cigarette prices and taxes on cigarette consumption is unclear due to the limited research evidence using the local data. This study estimates the sensitivity of Ukraine population to cigarette prices and the affordability of cigarettes using the macro level data in order to predict the effectiveness of cigarette tax policy.

Methods: Monthly time-series data available from 1997 to 2006 in Ukraine were used to estimate the generalized least square model with an AR(1) process to investigate the impact of cigarette price/tax, household income, the affordability of cigarettes and the volume of tobacco advertising on Ukraine domestic cigarette sales while controlling for other factors.

Results: Our analyses demonstrate a strong positive association between cigarette sales and household income as well as a strong positive association between cigarette sales and tobacco advertising activity. The population is found to have relatively low sensitivity to cigarette prices and cigarette taxes, but the impact of cigarettes' affordability is statistically significant, even though also of low magnitude.

Conclusion: We speculate that the lower sensitivity to cigarette prices among Ukraine population is caused by wide price variation allowing smokers to avoid a price increase by brand substitution as well as by low costs of cigarettes, high social acceptance of smoking and limited effort to control tobacco use in Ukraine. Narrowing the cigarette price choices and increasing cigarette prices above the level of inflation and income growth by adopting the appropriate tax policy would likely increase the effectiveness of this tool for controlling the smoking rate in Ukraine as well as yield additional budget revenue gains. In addition, imposing advertising restriction may further help reducing the smoking prevalence.

Key words: Ukraine tobacco control, cigarette demand, cigarette tax policy

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INTRODUCTION

Smoking is a serious threat to public health and the leading cause of premature deaths. According to estimates by the World Health Organization, 5 million people throughout the world die each year due to smoking related diseases (1); out of those – 110 thousand are Ukrainians (2). In addition, deterioration of public health due to smoking negatively affects government finances and national economy as a whole. Two obvious consequences are growing health care expenditures (which in Ukraine is primarily financed from the state budget) and reduced productivity of labor force due to chronic diseases and premature deaths (3). Therefore, it is crucial for the government to take actions in order to prevent public health deterioration and the economic losses due to smoking.

Cigarette consumption has been quickly growing in Ukraine. Based on the official data on legal sales (Note: This was calculated based on the official statistics using the formula: domestic production – exports + imports) of cigarettes provided by the State Statistics Committee (Fig. 1), there is nearly two-fold increase in legal cigarettes sales from 1997 to 2005. The evident growing trend in legal sales, especially between year 2000 and year 2005, may reflect rising cigarette consumption in Ukraine. If the existing trend continues, one may predict an increasing number of tobacco related diseases and the tobacco related deaths in the population.

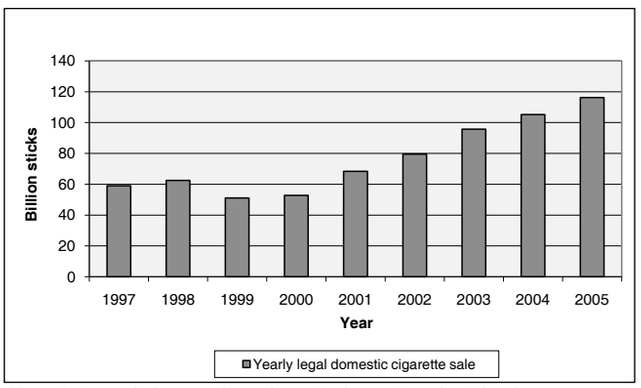


Fig. 1. *Legal domestic sales of cigarettes in Ukraine.*

Government interventions, such as high tobacco tax, have been shown to be effective to control the smoking-related public health and economic problems. The potential benefits include

reduction of tobacco consumption and smoking prevalence as well as increases in budget revenue that could potentially offset additional health care expenditure caused by smoking.

Ukraine currently has low tobacco tax rate, particularly when compared to other European countries. The share of excise tax (i.e. the specific and the ad valorem excise tax) in retail price was only 17.2% for filtered cigarettes (the most popular category in Ukraine) and 28% for non-filtered cigarettes in 2005. The total tax incidences on tobacco products (including VAT) in the same year were as follows: 33.9% of retail price for filtered cigarettes, and 44.7% for non-filtered cigarettes. This is about two times lower share of tax in cigarette retail price compared to EU countries (4). Such low cigarette tax rates in Ukraine promote cigarette consumption, in addition to contributing to smuggling problems from Ukraine to neighboring countries caused by the cigarette price differentials.

Imposing regulations on tobacco advertising is another common government intervention to reduce tobacco consumption, based upon the evidence that total advertising bans reduce smoking prevalence (5). Since late 1990s, Ukraine government has made some positive moves towards tobacco control by the means of restricting tobacco advertising. However, the final version of the law in 2003 banned only prime time tobacco advertising on radio and television and partially restricts tobacco advertisements in the press and outdoors (6). As a result, the outdoor and point of sale advertising has been widely used by the tobacco industry to promote their products.

Cigarette demand in low- and middle-income countries such as Ukraine has been studied primarily by analyzing national-level aggregate consumption data (generally based on tax-paid sales) and individual or household-level survey data. The estimates of the impact of price on cigarette demand fall in a relatively wide range depending on the population studied, the data employed, and the methods used to estimate demand (7, 8). However, the majority of evidence suggests that 10% increase in cigarette prices would result in a 2–10% reduction in cigarette demand (9).

For example, a 1998 study from Brazil (10) used annual data on cigarette consumption for the period 1983–94 and found that a 10% increase in cigarette prices would reduce overall cigarette consumption up to 2% in the short-run, and up to 8% in the long-run. The same study also found that a 10% rise in income would increase cigarette consumption in Brazil up to 3.1% in the short-run and up to 8% in the long-run. A 2002 study from Indonesia (11) used time series data and estimated the impact of cigarette prices and income on the total demand for cigarettes. The authors found that price had a negative and significant impact on cigarette consumption: a 10% increase in real cigarette prices lowered the demand by 3.2 to 5.7%. Higher income also led to higher demand for cigarettes: a 10% increase in real income increased this demand by about 4.7%. The degree of price responsiveness was a bit smaller when monthly data were used. This difference was attributed to the long-time, addicted smokers' need to adjust their behavior to new prices. Research in Sri Lanka (12) evaluated aggregate monthly data on cigarette consumption from 1999 to 2000 and concluded that a 10% increase in cigarette prices would reduce overall consumption by 2.3% to 9.1%. A 10% increase in income would increase overall cigarette consumption by 1.8% to 7.8%. This wide range of estimates was due to the use of various tobacco demand model specifications. However, price and income were significant determinants of tobacco demand in each of the models.

Very few studies of price sensitivity (i.e. the degree of responsiveness to a price change) of cigarette demand exist in the Former Socialist countries in Central and Eastern Europe. A 2002 study (13) estimated the impact of higher cigarette prices on smoking participation and smoking intensity in Russia while controlling for age, wealth, education, household size, and gender using longitudinal data from eight rounds of household surveys (1992–2000). The model predicted that a 10% increase in cigarette prices would reduce overall cigarette consumption by 0.2% to 1.8% and reduce smoking participation by 0.5 to 1%. However, the study did not take into account substitution between cigarettes of different price groups.

In Ukraine, studies of cigarette demand are all based on micro-level survey data. Only one of these studies was published in a peer reviewed literature (14). It used the Global Youth Tobacco Survey (GYTS) collected in Kiev in 1999 and estimated that a 1% increase in cigarette price would decrease smoking participation among youth by 0.5%. No study has analyzed macro-level data to address the issue of price responsiveness of cigarette demand in Ukraine.

In this study we investigate the impact of price/tax of cigarettes, household income, and volume of tobacco advertising, on Ukraine domestic cigarette sales. In addition, we examine how cigarette tax rate influences the cigarette price and eventually plays a role in controlling cigarette consumption. Our analysis provides some useful information for the direction of policy making with the goal of achieving reduction of smoking taking into account the limited resources available to the Ukraine government.

DATA AND METHODS

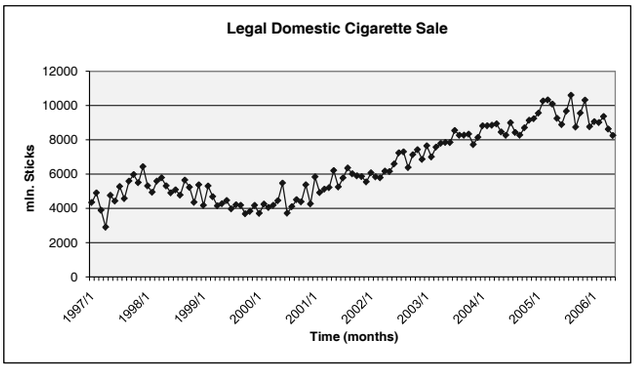
The monthly time-series data for January1997 to May 2006 used in this study contain information on legal domestic sales (mln. Stick), cigarette price per pack (in local currency Hryvnia, UAH), household income (bln. UAH), consumer price index (CPI), exchange rate (UAH for 100 US dollar, USD), volume of outdoor advertising (number of billboards), and cigarette excise rate in Ukraine (UAH/pack).

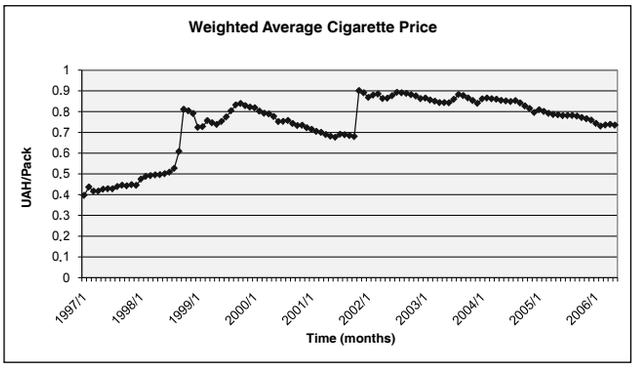
Legal domestic sales of cigarettes were calculated by using domestic production (mln. Stick), imports (mln. Stick), and exports (mln. Stick) data reported by the State Statistics Committee, and applying the formula: sales = domestic production + imports – exports. Monthly sales data were adjusted for seasonality and the resultant variable was recorded as *SADomSale*. Average weighted cigarette price (*WgtPrice*), inflation-adjusted UAH per pack, was used as an overall measure of the cost associated with cigarette consumption. To calculate the average weighted price, we weighted the prices for filtered and non-filtered cigarettes by the shares of filtered and non-filtered cigarettes sale, respectively. Average monthly household income, *SAHincome* (bln. UAH), was used to represent the well-being of Ukrainians. The household income data were recorded as monetary income (e.g. income from salaries) till year 2001 and total income (i.e. monetary earnings plus the value of goods received in barter) afterwards, and were first adjusted by the consumer price index (CPI) and then adjusted seasonally. In addition, we consider exchange rate of Hryvnia

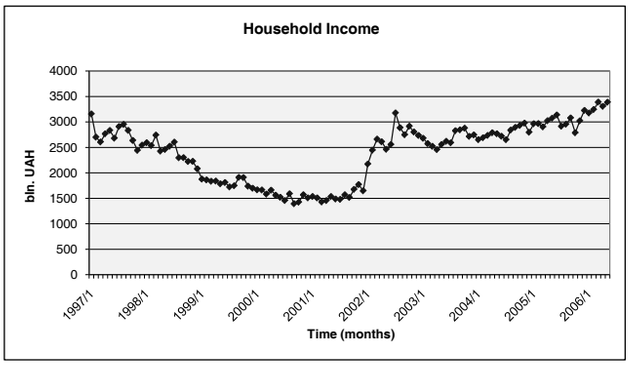
(UAH) with respect to the US dollar (*ExchgRate*) as a proxy for the missing data on the price of raw tobacco used in cigarette production, the majority of which is imported to Ukraine. Seasonally adjusted volumes of outdoor tobacco advertising (*AdOut*) were collected as numbers of billboards in two regional centers of Ukraine, in the cities of Simferopol and Sevastopol. Similar to the calculation of *WgtPrice*, we used shares of filtered and non-filtered cigarettes as weights to calculate inflation-adjusted average cigarette excise rate in Ukraine (*ExcTaxRate*), UAH per pack. Our calculation of cigarette excise tax was based on the Ukraine tax table between 1996 and 2006. When calculating the pension fund tax for year 2000 (= 5% cigarette wholesale price), which is part of the excise tax, we use the wholesale prices of 0.95UAH/pack and 0.32UAH/pack for filtered and non-filtered cigarettes, respectively. The wholesale prices were derived based on the average pack price and the tobacco tax law in force at that time.

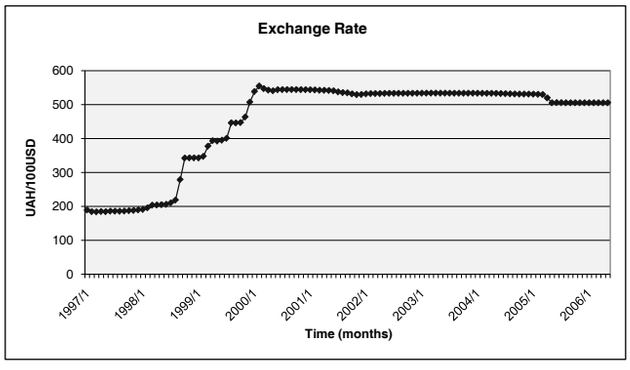
In Figure 2, we plot monthly recorded *SADomSale*, *WgtPrice*, *SAHincome*, *ExchgRate*, *ExcTaxRate*, and *AdOut* versus time. An overall increasing trend over time is observed for domestic cigarette sale and volume of outdoor tobacco advertising. The weighted average real price of cigarette was increasing until 2000, but then it declined until 2002, increased at the beginning of 2002, and then declined again. The exchange rate of UAH started to dramatically increase at the end of year 1998 and became stabilized in 2000. After being adjusted for inflation, the household income appears to decrease before 2002, coinciding with the rapid increase of the exchange rate of UAH during the same time period, and then steadily increase afterwards. For cigarette excise tax, the peak observed in 1999 is related to the switch from quoting cigarette tax rate in ECU (European Currency Unit) to using the local currency and to the increase in the tax rate for non-filtered cigarettes. The excise tax rate declined during years 1999–2003, and then slightly increased with the introduction of the mixed system of tobacco taxation at the beginning of 2004.

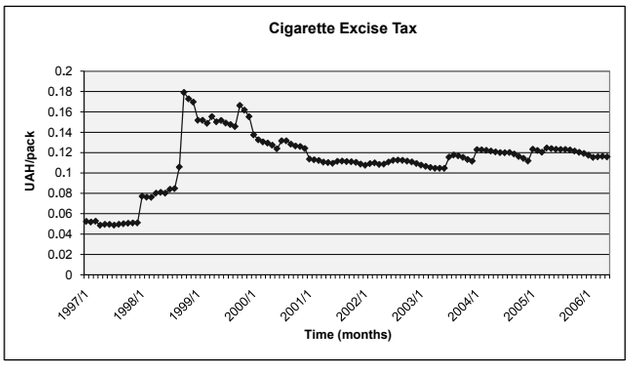
To estimate domestic cigarette sale in Ukraine, we first consider a linear functional model with independent variables including *WgtPrice*, *SAHincome*, and *AdOut*. Natural logarithm transformations are applied to both response, *SADomSale*, and the independent variables stated above, for the purpose of reducing data skewness. In order to take into account the fact that the











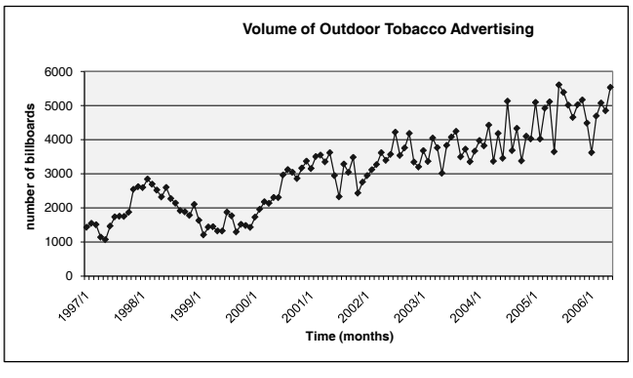


Fig. 2. *Time series plots of domestic cigarette sale, weighted average cigarette price, household income, exchange rate, cigarette excise tax, volume of outdoor tobacco advertising.*

household income data were recorded as monetary income before 2002 and as total income afterwards, we include another dummy variable, *Monetary*, which equals 1 if *SAHincome* corresponds to monetary income and 0 otherwise. In specific, the model can be represented as follows:

$$\log(SADomSale)_t = \alpha + \beta_1 \log(WgtPrice)_t + \beta_2 \log(SAHincome)_t + \beta_3 \log(AdOut)_t + \beta_4 (Monetary)_t + e_t \quad [1]$$

where *t* indicates the time, and α and β_j (j=1,…, 4) are unknown regression coefficients. For model [1], we first perform ordinary least square (OLS) analysis, assuming the independence of residuals, $\{ e_t \}$, across different time points. The results from the OLS analysis are presented in Table 1.

Table 1. *Results from evaluating the effects of cigarette price, household income, volume of outdoor advertising on Ukraine legal domestic sales of cigarettes based on ordinary least square regression*

Variable	Coefficient Estimate (SE*)	p-value
Intercept	2.87 (1.10)	0.01
Log(*WgtPrice*)	0.07 (0.12)	0.56
Log(*SAHincome*)	0.35 (0.12)	<0.01
Log(*AdOut*)	0.38 (0.05)	<0.01
Monetary	0.14 (0.09)	0.14

*: Standard error.

To test the validity of the results in Table 1, we check the assumed stochastic independence of $\{ e_t \}$ by using Durbin-Watson test. The resultant p value is less than 0.001, and thus strongly suggests a positive autocorrelation of residuals. Based on the residuals obtained from the OLS fit of model [1], denoted by $\{ e_t \}$, we obtain estimates of the autocorrelation function (ACF) and partial autocorrelation function (PACF) of the residuals, which are plotted in Figure 3 (a) and (b) respectively. These estimates depict the repeating patterns of $\{ e_t \}$, and thus help choose an appropriate correlation model for the random residuals.

The sinusoidal decay in ACF and one major spike in PACF observed in Figure 3 is suggestive of an AR(1) process for the residuals in model [1], which implies that the strength of the correlation between the two residuals decays exponentially with the time span between them. We use generalized least square (GLS) to fit model [1], assuming $\{ e_t \}$ is an AR(1) process. The estimation of regression coefficients and the associated standard errors is based on maximum likelihood method.

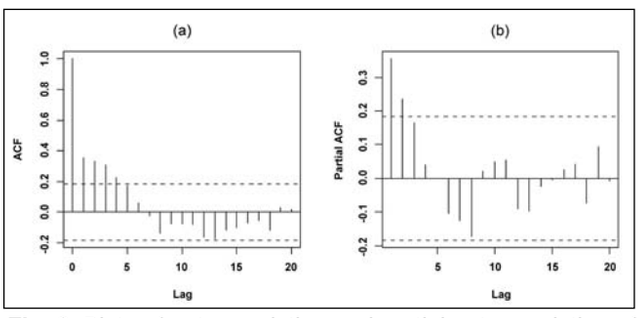


Fig. 3. *Plots of autocorrelation and partial autocorrelation of model [1] residuals.*

In addition to model [1], we consider an alternative model for Ukraine domestic cigarette sales by incorporating a new independent variable, namely *Afford=SAHincome/WgtPrice*. A larger value of *Afford* indicates that tobacco price takes a smaller percentage of household income. Hence the new variable, Afford, may be interpreted as affordability of cigarette. The second model takes the following form:

$$\log(SADomSale)_t = \alpha' + \beta_1' \log(Afford)_t + \beta_2' \log(AdOut)_t + \beta_3' (Monetary)_t + e_t' \quad [2]$$

where *t* indicates time, and α' and β_j' (j=1, 2, 3) are unknown regression coefficients.

Like with model [1], we find that it is appropriate to assume an AR(1) structure for the correlation among residuals in model [2], $\{ e_t' \}$. We fit model [2] using generalized least square with residual process specified as AR(1). Maximum likelihood method is adopted for fitting model [2].

It is noted from the definition of *Afford* that model [2] is essentially a nested model with respect to model [1]. We compare the fit of model [1] and that of model [2] by using F-test. The resultant p-value is less than 0.01, suggesting that model [1] may provide a better fit to the data than model [2].

The second topic addressed by this study is to explore potential determinants of cigarette prices. For this purpose, we build a separate model for *WgtPrice*, which include the variable for cigarette tax rate, *ExcTaxRate*, as a predictor. It is of a particular interest to investigate the impact of tobacco tax on cigarette prices since tax is a potential public policy tool for regulating tobacco consumption. Exchange rate of UAH (*ExchgRate*) and volume of outdoor tobacco advertising (*AdOut*) are also included to the model because both of them are expected to influence the production cost and marketing cost of tobacco products. Another factor under consideration is real household income (*SAHincome*), which can influence pricing strategy of tobacco industry. The variables, *Monetary*, is included in the model to account for the difference between monetary and total household incomes. The model for cigarette price is given by:

$$\log(WgtPrice)_t = \alpha^* + \beta_1^* \log(SAHincome)_t + \beta_2^* \log(ExchgRate)_t + \beta_3^* \log(ExcTaxRate)_t + \beta_4^* (AdOut)_t + \beta_5^* (Monetary)_t + e_t \quad [3]$$

where *t* indicates time, α^* and β_j^* (j=1,…, 5) are unknown regression coefficients. Applying similar procedures for models [1]–[2], we find that an AR(1) process is adequate to model the residual process, $\{ e_t^* \}$, in [3]. The model [3] is estimated based on generalized least square regression, using maximum likelihood method.

RESULTS

The results for model [1] are summarized in Table 2. After adjusting for the residual autocorrelation, the GLS analysis shows that the cigarette price is not significantly associated with legal domestic sale of cigarette. We also directly assess the effect of the inflation adjusted cigarette exercise tax on legal domestic cigarette

Table 2. *Results from evaluating the effects of cigarette price, household income, volume of outdoor advertising on Ukraine legal domestic sales of cigarettes based on generalized least square regression*

Variable	Coefficient Estimate (SE*)	p-value
Intercept	4.36 (1.25)	<0.01
Log(*WgtPrice*)	0.09 (0.15)	0.55
Log(*SAHincome*)	0.30 (0.15)	0.05
Log(*AdOut*)	0.25 (0.06)	<0.01
Monetary	0.23 (0.10)	0.03

*: Standard error.

Table 3. *Results from evaluating the effects of cigarette affordability, volume of outdoor advertising on Ukraine legal domestic sales of cigarettes based on generalized least square regression*

Variable	Coefficient Estimate (SE*)	p-value
Intercept	5.82 (0.68)	<0.01
Log(*Afford*)	0.10 (0.05)	0.06
Log(*AdOut*)	0.24 (0.06)	<0.01
Monetary	0.35 (0.05)	<0.01

*: Standard error.

sale by replacing the *WgtPrice* in model [1] by *ExcTaxRate*, but the effect of excise tax rate on cigarette sale was not statistically significant, either.

Higher household income and more active outdoor advertising have positive and significant impact on cigarette sales ($p=0.05$, $p<0.01$). A 10% increase in income and advertising would increase cigarette sale by 2.9% ($=1.1^{0.30}-1$) and 2.4% ($=1.1^{0.24}-1$), respectively.

The results from generalized least square analysis of model [2] are given in Table 3. It shows a positive relationship between the affordability for cigarette and legal domestic cigarette sales ($p=0.06$). This means that domestic cigarette sales would decrease if cigarette purchases represent higher percentage of household income. The estimated elasticity of affordability is 0.10, meaning that decreasing cigarettes affordability by 10% would result in 1.0% ($=1-0.9^{0.10}$) decline in cigarette sales. Given the standard error for log(*Afford*), 0.05, the elasticity of affordability significantly differs from 1 or -1 ($p<0.01$) based on Wald test, indicating that Ukraine cigarette sales are affordability inelastic.

Based on model [2], again, we find the volume of advertising has a significant effect on the sales of cigarettes in Ukraine and the magnitude of the impact is similar to model [1].

Table 4 gives the coefficient estimates, standard errors, and the corresponding p-values for the cigarette price model [3]. The results suggest that weaker local currency and a higher cigarette excise tax rate is significantly associated with a higher cigarette price ($p<0.01$, $p<0.01$). Weaker UAH causes an increase in the price of imported raw tobacco, thereby resulting in a higher price of cigarette. And higher cigarette excise rate is passed on to the consumers. For example, increasing the cigarette excise tax by

Table 4. *Results from evaluating the effects of household income, exchange rate of UAH, cigarette tax rate, volume of outdoor advertising on Ukraine cigarette price based on generalized least square regression*

Variable	Coefficient Estimate (SE*)	p-value
Intercept	-3.10 (0.92)	<0.01
Log(*SAHincome*)	0.03 (0.06)	0.60
Log(*ExchgRate*)	0.64 (0.11)	<0.01
Log(*ExcTaxRate*)	0.27 (0.05)	<0.01
Log(*AdOut*)	-0.03 (0.02)	0.13
Monetary	-0.02 (0.04)	0.61

*: Standard error.

10% would increase the cigarette price by 3% ($=1.1^{0.27}-1$). This demonstrates that cigarette tax policy can be used to regulate cigarette price in Ukraine. Volume of outdoor tobacco advertising does not have a significant effect on cigarette price.

DISCUSSION AND CONCLUSIONS

Our analysis of Ukraine cigarette time-series data demonstrates a strong positive association between cigarette sales and household income as well as a strong positive association between cigarette sales and tobacco advertising activity. The results reveal that 50% increase in household income would result in 13% ($=1.5^{0.3}-1$) increase in cigarette sales, while 50% less outdoor tobacco advertising may reduce legal cigarette sales by 16% ($=1-0.5^{0.25}$). Our results indicate that imposing further advertising restriction may help reduce smoking prevalence.

The model assessing the impact of affordability offers a valuable perspective to understanding the combined effect of household income and cigarette prices on cigarette sales. It suggests that cigarette sale may decrease if the affordability of cigarettes decreases. In Ukraine, as noted in Fig. 2, the real household income has been increasing while the real cigarette prices stagnate at best since 2001. This may somewhat explain why cigarette price itself is not a significant predictor for cigarette sale under model [1] which also adjusts for household income, while the variable representing affordability demonstrates a pretty good prognostic power under model [2]. Affordability may serve as a valuable proxy for the combined effect of household income and cigarette price on cigarette sales. We found relatively low sensitivity of the population to the average affordability of cigarettes. This can be result of the wide range of cigarette prices on the Ukraine market allowing smokers or potential smokers escaping the impact of a higher price/tax increase by substituting to a cheaper cigarette brand. Other reasons may include low costs of cigarettes, high social acceptance of smoking and limited effort to control tobacco use in Ukraine. Narrowing the cigarette price choices by adopting appropriate tax policy would likely increase the effectiveness of tobacco tax policy in Ukraine. This, however, needs to be confirmed by further research.

The relationship between cigarette taxation and cigarette sales is another subject of interest of this study. We assume in the analysis that cigarette taxation influences the cigarette sales

only through its impact on cigarette price. We find that 50% cigarette excise tax increase may result in 12% (=$1.5^{0.27}$-1) cigarette price increase. According to the cigarette sale model based on affordability, this would incur only 1.1% (=1-$1.12^{-0.1}$) decrease in cigarette sales if the income stays constant. However, such tax increase would result in approximately 48.4% [=1.5×(1-0.011)-1] increase in cigarette tax revenue. This calculation illustrates that higher cigarette taxes would not only improve public health by reducing smoking, but also yield budget revenue gains.

In our estimates, we relied on official statistics that may not sufficiently represent the reality. For example, income data may not capture incomes from the grey economy or income transferred from abroad. The deviation of our dependent variable from the true values does not affect coefficient estimates since any measurement error is captured in the error term of our model. On the other hand, some biases may result from measurement errors in the independent variables. However, to the extent that this measurement error is not random (and it is possible that it is systematic if the State Statistics Committee in Ukraine uses the same method to collect the data over time), our estimates of covariate effects will not be biased.

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