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TOBACCO PRICE ELASTICITY AND TAX PROGRESSIVITY IN MOLDOVA

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Cover photos (clockwise from left): iStock: Children in Moldovan national costumes, Moldavian folklore ensemble 'Orhei Vechi' rock cave monastery in Moldova.

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SUMMARY

Background

Tobacco-use–related diseases are the main cause of mortality in Moldova, where tobacco consumption is widely spread, especially among men. Besides the health concerns, tobacco consumption has economic consequences because households spend substantial resources on tobacco and related out-of-pocket medical costs. Tobacco tax increases are seen as one of the most effective measures to reduce tobacco consumption, but are usually believed to be regressive, taxing the poor proportionally more than the rich.

Methods

The study estimates the tobacco price elasticity of demand for the population of Moldova, and the price elasticity for 10 income groups is obtained. This appears to be the first tobacco price elasticity estimation for income groups in Moldova. The study undertakes an extended cost-benefit analysis to estimate the distributional effect of a rise in tobacco taxes on income distribution. As inputs, it uses tobacco price elasticity, mortality attributed to tobacco, and the medical costs of tobacco-attributed diseases.

Findings

Using three elasticity scenarios, the study finds that a tobacco price increase would generate a rise in expenditure deriving from direct tobacco price increases, but would reduce the costs of out-of-pocket medical expenses. Based on these two factors, the net effect of a tobacco tax increase would be progressive in all of the analyzed cases, and the upper-bound scenario would benefit, in absolute terms, the incomes of the lower-income groups in the population.

Interpretation

The results support the use of a tobacco tax as an effective means to reduce tobacco use, raise government revenue, increase public health, and promote income equality.

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1 INTRODUCTION

Tobacco is one of the major causes of noncommunicable disease in the world. It has been associated with many types of cancers, including lung, oral, laryngeal, pancreatic, kidney, cervical, and acute myeloid.[1] Tobacco consumption is also associated with respiratory problems such as chronic respiratory symptoms, tuberculosis, influenza, pneumonia, other infections, chronic bronchitis, emphysema, and asthma. Furthermore, tobacco consumption has been proven to influence cardiovascular diseases, such as aneurysms, strokes, and coronary heart disease, as well as adverse reproductive and developmental effects, such as low birthweights, congenital malformations in babies, and complications in pregnancy, along with sexual dysfunction among men.[1, 2] In Moldova, the average age of individuals when they start smoking is slightly less than 18 years, and the average smoker spends over 20 years consuming cigarettes. Aside from the health effects, tobacco has significant economic impacts because it accounts for approximately 1 percent of monthly household budgets and is a relevant factor in the expenditures on health treatments. This paper presents estimates of the tobacco price elasticity in Moldova and the distributional effects of a tobacco tax increase across income deciles.

Moldova is a small lower-middle-income country, with a population slightly above 3.5 million people, and a GDP per capita slightly below US$ 2000. It is one of the poorest countries in Europe, with a poverty rate of 9.6 percent measured under the national poverty line with a GINI coefficient of 0.27.[3] The main causes of death in Moldova are diseases of the circulatory system, followed by cancers and diseases of the digestive system. Many of these deaths can be attributed to heavy alcohol and tobacco consumption: 57.6 percent of total male mortality and 62.3 percent of female mortality in 2010 could be attributed to smoking-related causes, while 18.8 percent of male mortality and 13.7 percent of female mortality were related to alcohol consumption.[4] Based on the current level of adult smoking in Moldova, premature deaths attributable to smoking are projected to be as high as 397,000 among the 794,000 smokers alive today.[5] The majority of these deaths are a result of respiratory diseases, strokes, heart disease, and lung cancer. [5] Life expectancy in Moldova is 10 years lower than the European Union (EU) average, and life expectancy is five–six years less among men than women. The health care costs associated with tobacco make up 7.6 percent of the total health expenditures in the Unites States.[2] The negative health and economic impacts of tobacco highlight the importance of tobacco tax policies that could reduce consumption in Moldova.

Tobacco taxation is one of the best ways to control tobacco.[6] This is so because the taxation effectively increases government revenue and decreases consumption, especially among that younger and lower-income groups of the population as these exhibit higher income elasticities. Because there are no estimates of tobacco price elasticities for Moldova in the literature, the study, as a first step, estimated tobacco price elasticity using four cohorts of household surveys. Next, the distributional impact of a rise in tobacco prices caused by a tax increase was estimated. The effect of higher prices on income because of the higher cost of tobacco consumption was evaluated, and, then, the effect of a reduction in medical expenditures because of the reduction in tobacco use was analyzed. The study finds that an increase in tobacco taxes has a progressive impact, benefiting lower-income groups in the population. The paper continues as follows: section 2 analyzes the literature; section 3 describes the estimation model; section 4 shows the results; and section 5 presents a discussion and concludes.

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2 THE LITERATURE

In the last century, about 100 million deaths were related to tobacco use.[7] If current trends were to remain constant, about 1 billion people could die from tobacco-related diseases during this century.[8] In Moldova, over 10,000 children and more than 613,000 adults consume tobacco every day.[2] Globally, antitobacco policies include prohibiting smoking in particular locations to establish completely smoke-free environments, advertising to deter tobacco use, restrictions on tobacco sales by age, smoking cessation programs, prohibitions on tobacco sales close to schools, and taxation. These various policies have produced diverse effects in tobacco use and exposure among populations.

Although media campaigns, tobacco sale prohibitions, and smoking in public places are important policy approaches, tobacco taxation is considered one of the most efficient means of reducing tobacco consumption. As a secondary benefit, it also raises government revenue.[9] Because both effects are desirable from a policy standpoint, the use of taxes is considered economically justified. Additionally, the higher price elasticity of young people makes taxes a good way to fight tobacco use because young people will significantly reduce their consumption in the long run.

The magnitude of price elasticity is central in calibrating the effect of tobacco taxation systems because it determines the sensitivity of demand to a change in tobacco prices. There is extensive research on the price elasticity of tobacco. The Handbook of Cancer Prevention: Tobacco Control, volume 14, reviews the international evidence on the United States and more than 50 other countries. The authors find that price elasticities of demand vary from zero to −0.47 in the United States. In the international literature, results vary: −0.80 in Bulgaria, −0.45 in Canada, −0.53 in China, −0.34 in Estonia, −0.66 in the Republic of Korea, and −0.47 in Ukraine.[10–15] For all 52 countries in the European region, Gallus et al. 2006 estimate a price elasticity of −0.46 using national yearly aggregated data.[16] For the United Kingdom, price elasticity is estimated at −0.5, and, for Hungary, a price elasticity between −0.44 and −0.37.[17,18] For Poland and Turkey, tobacco price elasticities have been estimated at −0.4 and−0.19, respectively, in the short run (−0.7 for long-run elasticity in Poland).[19,20] For India, cigarette price elasticities have been estimated for different income groups, including −0.83 and −0.26 for the lowest and highest income groups, respectively.[21]

Among several factors, there are two important ones involved in determining tobacco price elasticities, namely income and age. People in lower-income groups tend to change

[2] Children refers to individuals under age 18.

consumption behavior more given a change I price (i.e. have more elastic demands) relative to higher-income groups.[8] At the same time, younger groups in populations are more responsive to tobacco price increases because on average they tend to be less nicotine dependent, more affected by peer effects, and possess less disposable income. [8] Studies in the United States have consistently shown that younger groups have higher elasticities relative to older groups.[22–24] Hence the importance of the increase in tobacco prices (through taxes) to reduce tobacco consumption among the younger groups of the population.

The major welfare costs associated with tobacco consumption are direct and indirect. The direct costs include the monetary health care costs (hospitalization, medication, medical supplies, equipment, and so on) and non–health care costs (job replacements for sick smokers, insurance, cleaning up the cigarette ash and stubs, packaging, the smoke residue of smokers, and so on). The indirect costs include the loss of productivity because of lost working days related to smoking illnesses as well as the value of the lives prematurely lost.

Some well-studied and well-documented costs not covered in this paper include days of life lost and working years lost because of early mortality.[25] Secondhand smoke has been proven to be an important societal cost of smoking, affecting the health of adults and children.[26] In the state of Indiana in the United States, the health-related costs of secondhand smoking have been estimated at more than $1.3 billion yearly.[26] There are several potential benefits of tobacco taxation because of the increase in government revenue and the improvement and extension of policies on health expenditures, social welfare, education, and pensions. In this paper, policies are not earmarked as possible benefits because they depend on political considerations that exceed the mere increase in taxes.

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3 THE HEALTH SYSTEM IN MOLDOVA

A System Inherited from the Soviet Union

Moldova was established as an independent state in 1991 following the dissolution of the Soviet Union. This new country continued to rely on the infrastructure, policies, and systems of the previous establishment. Today, Moldova is part of the Commonwealth of Independent States (CIS), which, besides Moldova, is composed of the former Soviet republics of Armenia, Azerbaijan, Belarus, Kazakhstan, the Kyrgyz Republic, the Russian Federation, Tajikistan, and Uzbekistan, as well as two associate states, Turkmenistan and Ukraine. Moldova inherited the Semashko health system, along with relevant staff and infrastructure, characterized by overcapacity, particularly in tertiary hospitalization and specialized institutions.[27]

Several reforms have been introduced since independence, particularly the creation of a mandatory health insurance system (MHI) in 2004 and the National Health Insurance Company (NHIC). The contributions for the MHI come predominantly through a payroll tax of a fixed 7 percent. The nonworking population is covered through transfers from the central government to the NHIC. Voluntary health insurance is limited, accounting for less than 0.4 percent of total health expenditures in 2014.[4] Total health expenditure represented 10.3 percent of gross domestic product (GDP) in 2014. Government expenditure was 51.4 percent of total health expenditure, and the rest came mostly from contributions to the MHI. Of total health expenditure, 3 percent was from the out-of-pocket payments of patients.[28]

Similarities with Neighboring Countries

The health indicators are similar in Moldova and neighboring countries, particularly Russia and Ukraine. In 2009, Moldova had 313 physicians per 100,000 population, similar to the 315 in Ukraine, but less than the 431 in Russia and the CIS average of 377.[4] The number of hospital beds was 583 below the CIS average of 745. While, in Moldova, more than 10 percent of GDP is spent on health services, the corresponding expenditure in the CIS is closer to 6 percent. In absolute numbers, measured in 2009 U.S. dollars, the per capita expenditure on health care was $341 in Moldova, $445 in Ukraine, and $1,037 in Russia; the CIS average was $714. [28]

Results in Health

Health indicators in Moldova are comparable with those in other CIS countries, but far below the EU average. Life expectancy at birth in Moldova is 68.2 years among men and 75.7 years among women, slightly below the CIS average, but well below the average among men in the EU, which is more than 80 years. The infant mortality rate in Moldova is 9.5 deaths per 1,000 live births, higher than the 7.0 deaths per 1,000 in the CIS.

Results in Tobacco

Tobacco prevalence in Moldova is 44.0 percent among men and 5.6 percent among women (table 1). The high rate of tobacco consumption is comparable with other CIS countries, such as Russia and Ukraine, where tobacco consumption rates among men are 51 percent and 46 percent, respectively.[5]

Table 1: Tobacco Prevalence, by Age and Sex, %

Age	Men	Women	Total
18-29	45	7.4	27
30–44	48	6.6	29
45–59	42	4.0	22
60–69	31	1.8	16
18–69	44	5.6	25

Source: World Health Organization, 2014, "Prevalence of Noncommunicable Disease Risk Factors in the Republic of Moldova, STEPS 2013," Regional Office for Europe, World Health Organization, Copenhagen.

Other surveys have been designed to assess tobacco use in Moldova, though their results are not necessarily comparable as they use different questionnaires and sample frames. Nonetheless, results are aligned with the WHO findings. According Krasovsky (2016),[29] the 2005 Moldova Demographic and Health Survey (DHS) indicate that 51.1 percent of men (between 15 and 59 years old) and 7.1 percent of women (between 15 and 49 years old) were current smokers, whereas the 2012 Multiple Indicator Cluster Survey (MICS) showed that 48.5 percent of men (between 15 and 49 years old) and 8.2 percent of women (between 15 and 49 years old) smoked. Finally, a national cross sectional survey on risk factors of noncommunicable diseases conducted between September 2013 and May 2014 showed that among men 15 years and older, 43.6 percent smoked (and 40.6 percent were daily smokers) and 5.6 percent of women smoked (with 4.6 percent being daily smokers).

Deaths Attributable to Tobacco

Several health conditions and causes of death are attributable to tobacco consumption. In the European region of the World Health Organization (WHO), tobacco accounts for 297 age-adjusted deaths per 100,000 population, less than half relative to Moldova. In Moldova, the tobacco-attributed mortality rate narrowed from 763 age-standardized deaths per 100,000 population in 2010 to 613 in 2015, similar to the rate in Ukraine in 2004[28]. Tobacco-attributed deaths represent more than 50 percent of the total age-adjusted deaths in Moldova.

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4 THE MODEL

The study estimates the impact of the tobacco tax in Moldova using an extended cost-benefit analysis, similar to the approach of other studies described in the literature.[25, 30] It estimates how tobacco taxes would change household incomes through an analysis of two factors: (1) the rise in tobacco expenditures because of the tax increase and (2) the reduction in medical expenses because of less tobacco consumption. The aggregated effect of the tax policy is estimated as follows:

$$\text{Income effect} = \text{change in tobacco expenditure (A)} + \text{lower medical expenses (B)} \quad (1)$$

The study baseline scenario is derived from the 2015 household budget survey. The survey is used to measure general consumption and tobacco consumption. Data limitations do not allow a simulation of the exact price increases by brand, but this may be accomplished through the aggregate prices paid by households.

A partial equilibrium model allows the distributional effects of the tobacco tax to be assessed, resulting in an estimation of the first-order effects of these policies. The study then uses a partial equilibrium approach and evaluates the change in prices by relying mainly on household expenditure patterns. This implies that only the first-order response is being assessed and that additional behavioral changes among economic agents, such as the increase in the consumption of other goods, are not included. These assumptions imply that the model uses the share of tobacco consumption in household budgets in relation to price increases. The loss of real income arising from price increases in products i = 1, …, n is obtained by

$$\sum_i^n (\omega_i + \Delta\omega_i) * \frac{\Delta p_i}{p_{i,o}}, \quad (2)$$

where ω_i is the share of product *i* in total household expenditure, and Δp_i is the percent price increase [3] If 10 percent of a total household budget is destined for cigarettes, for example, and the price of cigarettes increases by 10 percent, the real loss of income amounts to 1 percent. $\Delta\omega_i$ is the change in consumption of the taxed good, and it depends on the price elasticity of the product.

Tobacco Expenditures: The study estimates the variation in tobacco consumption after the tax increase by considering the change in prices (ΔP), the tobacco price elasticity, and the tobacco expenditure of decile *i* in period 0 $(Expenditure_{i0})$, as follows.

$$\Delta\, Tobacco\ Expenditure_i = ((1 + \Delta P)(1 + \varepsilon * \Delta P) - 1) * Expenditure_{i0} \quad (3)$$

[3] For a detailed discussion of the methodology, see Coady et al. (2006) and Kpodar and Djiofack (2010).[31, 32]
[4] Another expression might be Δ Expenditure=ΔCΔP+ΔCP_0+ΔPC_0.

The change in tobacco expenditure is divided by the total expenditure for each decile group, ***i***, thereby obtaining a comparable per household measure of the change in tobacco expenditure relative to the total expenditure of each decile group

$$\Delta\ Prop.Tobacco\ Expenditure\ = \frac{((1+\Delta P)(1+\varepsilon*\Delta P)-1)*Expenditure_{i0}}{Total\ Expenditure_i} \quad (4)$$

Medical Expenses: The study estimates the change in medical expenses associated with tobacco-related diseases in equation (5), where the cost of the treatment of tobacco-related diseases by income decile, ***i***, is calculated based on the methodology from Pichon-Riviere et al (2014) and adjusted according to the expenditure survey.[33]

Equation 5 shows the income gains associated with the reduction in medical expenses because of reduced tobacco consumption in the long term. Although the calculation is not realistic in the short term because the effects of tobacco-related diseases are assumed to diminish immediately with the reduction in tobacco consumption, while, in practice, this takes a few years.[5]

$$\Delta\ Prop.Medical\ Exp.= \frac{((1+\varepsilon*\Delta P)-1)*Cost\ Treat.Tobacco\ Related\ Diseases_i}{Total\ Expenditure_i} \quad (5)$$

Elasticity Calculations

The study estimates the price elasticity of demand for tobacco products in Moldova using the 2012 and 2015 household budget surveys of the National Bureau of Statistics of Moldova. National datasets sometimes exhibit endogeneity problems. However, using national surveys to calculate price elasticities does not necessarily lead to this problem because single individuals cannot modify the price of the products they buy. Tobacco price elasticity estimations using national aggregate data on tobacco production and sales could face several problems in Moldova. The latter is mainly due to the fact that it is difficult to differentiate from the number of cigarette sold in Moldova how many were actually consumed and how many were smuggled and sold in other countries. Price differentials between neighboring countries and other EU countries provide incentives for Moldovan cigarettes to be smuggled to countries like Romania, Ukraine, Ireland, Luxembourg and the United Kingdom[29]. Therefore, household surveys could potentially better reflect the total amount consumed and prices effectively paid.

Yet, these surveys present other problems. Surveys are affected by national macroeconomic deterrents of consumption, such as reductions in national production or import, advertisement, or sales restrictions.[10] To control for these problems, the study examined national data on tobacco production, tobacco regulation, inflation, and

[5] Other studies have forecast the pass-through between the decline in tobacco consumption and the effect on medical expenditures. These estimates may also differentiate the effect associated with people who stop consuming tobacco versus people who do not start because of the tax policies. Because of data restrictions, these assumptions cannot be used in this paper.

macroeconomic shocks during the period of analysis. Another advantage of surveys is that one may detect the price paid by consumers and account for promotions and sales. Nonetheless, this estimation of the price paid is tied to certain endogeneity concerns because heavy smokers may consume cheaper brands, buy greater quantities, shop at lower-priced retailers, engage in tax-avoiding behaviors, and take advantage of promotions more regularly than less habitual smokers.[10] Moreover, in household surveys, one household member typically responds to the survey for the household. The accuracy of the survey thus depends on how well informed the individual is about consumption expenditures and quantities purchased by other household members.[10] Despite all the limitations, the use of household surveys to calculate price elasticities is a common practice that has been used in Australia, Canada, India, the United States, and elsewhere. [10,11,34–36]

The study, vigilant to these considerations, calculated the price elasticity of tobacco. It used the inflation rate provided by the National Bureau of Statistics to obtain the real prices paid by consumers (table 2).

Table 2: Inflation Index

Indicator	2012	2013	2014	2015
Consumer price index	100	104.6	109.9	120.6

Source: Data of the National Bureau of Statistics.

Using the inflation and the national budget survey, the study calculated the real prices of cigarettes paid by consumers in Moldova (table 3). In Table 3 shows prices paid for cigarettes by income decile, after eliminating outliers. In line with the literature, we can see an important difference of prices paid for cigarettes in each income decile. This important variance is related to the prices of cigarettes inside the country. For example, in 2015 a package of non-filtered Astru cigarettes could cost 4 MDL, while a package of Marlboro could cost 22 MDL, a pack of Winston 20 MDL and a pack of Montecarlo 15 MDL[29].

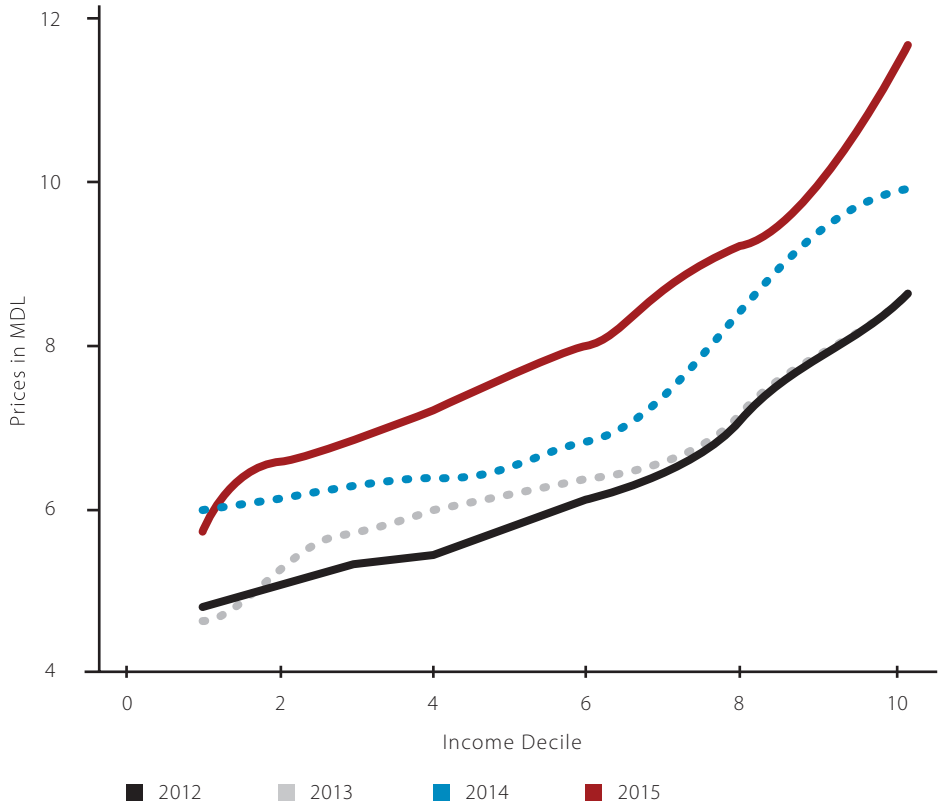
Table 3: Estimated Real Prices Paid per 20 Cigarette Package by Decile

	2012		2013		2014		2015	
Decile	Average	SE	Average	SE	Average	SE	Average	SE
1	4.25	0.17	4.05	0.16	5.95	0.39	5.61	0.25
2	5.00	0.20	4.96	0.25	5.92	0.40	6.43	0.32
3	5.13	0.29	5.62	0.37	6.34	0.31	6.60	0.30
4	5.16	0.25	5.72	0.32	6.29	0.33	7.06	0.34
5	5.10	0.23	6.53	0.38	5.82	0.41	7.68	0.43
6	6.69	0.44	6.15	0.40	7.12	0.42	7.51	0.40
7	6.55	0.42	6.84	0.46	7.22	0.37	8.80	0.45
8	6.79	0.35	7.18	0.35	8.37	0.51	9.09	0.42
9	7.66	0.38	7.49	0.32	9.17	0.38	9.56	0.39
10	9.49	0.32	9.49	0.40	9.93	0.38	11.63	0.35

Source: Household Budget Survey 2012-2015. Eliminating 3SE outliers.

The declared prices paid by households and the declared quantities of cigarettes purchased are applied, thereby rendering possible a measure of the effective price paid for cigarettes that reflects changes in brand and quality. In Moldova, tobacco prices are affected by government action as it affects the specific and ad valorem tax. Tobacco tax policy has had many changes during the last ten years. In 2007 filtered cigarettes had a specific tax of 6.5 Moldovan Lei (MDL), per 1000 cigarettes and a 3% ad valorem excise tax. Between 2008 and 2015 the government of Moldova tested different changes for the specific tax and the ad valorem tax. One problem they faced is that inexpensive cigarettes would pay a very small ad valorem tax. Since 2016, there is a new minimum excise tax per 1000 cigarettes, of 400 MDL, the specific tax was of 300, and the ad valorem was of 12%. In the year 2016, the excise share for cigarettes would vary from 56% to the price to 25% of the cigarette, depending on the price of the cigarette[29]. A detailed analysis of the tobacco taxation policy in Moldova can be found in Krasovsky (2016). Figure 1 shows the estimated average price paid for cigarettes per income decile based on household survey data adjusted for inflation as well as national statistical data.

Figure 1: Tobacco Price Index, by Year and Decile



Source: Author's estimation. Prices of 2012, eliminating 3 SE outliers

After obtaining a measure of the prices paid for cigarettes in Moldova, the study calculates real prices per year and then the elasticity for each income decile of the population (figure 2; table 4).[6] It estimates an average tobacco price elasticity of −0.33, which, in absolute terms, is slightly lower than the elasticities found in the literature on other countries in the region, but within the confidence interval of the estimates of Gallus et al. (2006) on European countries.[37] The Standard error of this estimate is approximately 0.10, generating a 95% Confidence interval of -0.20,+0.20. To show the effect of different scenarios, we simulate a lower bound elasticity and an upper bound elasticity. These estimates have differences of -0.2 and +0.2 with the elasticity previously estimated. The lower-bound elasticity tends to reflect income groups that would not change consumption patterns, such as rural residents or older people.

[6] The use of three different elasticities helps to test the robustness of our results. We tried different specifications with subgroups of tobacco products to calculate elasticities, showing a variety of results, that are represented in the three possible scenarios. As an example: for packages of 20 cigarettes, filtered and not-filtered, sold in authorized establishments, for personal consumption and after eliminating outliers, the estimated elasticity is similar to the lower-bound elasticity presented in this paper.

Figure 2: Cigarette Price Elasticities

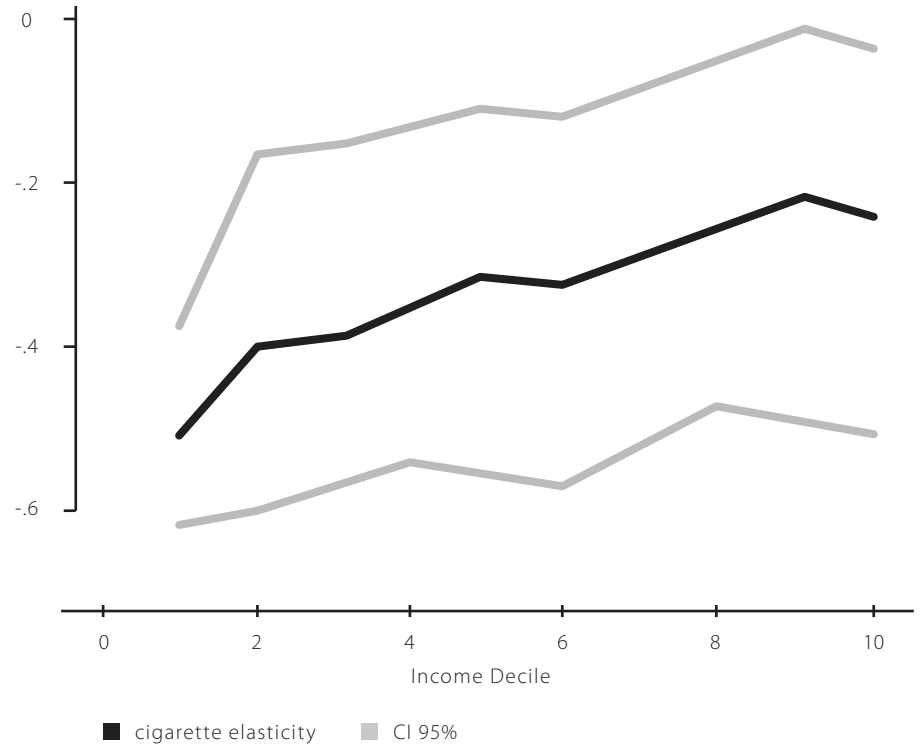


Table 4: Cigarette Price Elasticities and Income Deciles

Price Elasticity	Decile 1	Decile 2	Decile 3	Decile 4	Decile 5	Decile 6	Decile 7	Decile 8	Decile 9	Decile 10	**Average**
Lower bound	-0.31	-0.19	-0.20	-0.14	-0.12	-0.12	-0.12	-0.05	-0.04	-0.06	**-0.13**
Medium bound	-0.51	-0.39	-0.40	-0.34	-0.32	-0.32	-0.32	-0.25	-0.24	-0.26	**-0.33**
Upper bound	-0.71	-0.59	-0.60	-0.54	-0.52	-0.52	-0.52	-0.45	-0.44	-0.46	**-0.53**

Source: Estimates based on data of the household budget surveys 2012-15

Meanwhile, the upper-bound elasticity tends to reflect a longer-term scenario, echoing the effect the tobacco tax would have on younger people. After a few decades, these groups will be the majority of smokers. Thus, the total average effect of the price increase is more accurately approximated by the upper-bound price elasticity. To test the robustness of our calculation, we re-estimate elasticities eliminating different years from the sample. Results of such calculations are presented in Annex I. Annex II presents an assessment of the stability of the survey's calculated deciles. We find that the income deciles are relatively stable in terms of demographic characteristics. In addition, we tested and confirmed that the elasticity estimations do not depend on a specific survey year, as the exclusion of different survey rounds from the estimation yields similar results.

The literature presents different views on the most accurate way to translate the reduction in tobacco consumption into the reduction of medical expenses. One argument is that tobacco price increases reduce consumption on average, but price increase does not necessarily lead to adult tobacco cessation in a similar way[10] as some people may quit, while others may just reduce the number of cigarettes smoked per day. In addition, there are two two important points to underline. First, it has been shown that only quitting – and not smoking less -brings substantial positive effects on medical well-being[2,38-40]. Second, tobacco cessation has a stronger health effect for younger groups of the population[41]. This paper takes the approach that in the medium to long-term, all the reduction in consumption could be directly translated into tobacco cessation among the population. This view considers that tobacco price increase prevents tobacco initiation and induces cessation among younger groups of the population.

Several studies have analyzed the cost of smoking in each country or globally such as WHO has done. To estimate the cost of smoking in Moldova, the present study uses official calculations of the government. In 2001, the Ministry of Health estimated that the amount of health care expenditure associated with tobacco was MDL 360.4 million or $27.6 million.[7] Moreover, the estimated economic costs because of lost productivity associated with premature death, outpatient treatment, and hospitalization was MDL 430 million or $32.9 million. The total yearly cost of tobacco use would thus be $60.5 million.

Public-sector expenditure on health in 2014 was 51.4 percent of total health expenditures. The study assumed that 48.6 percent of this cost—$29.4 million—is covered directly by households[28].

A more conservative option would involve estimating the economic cost of the treatment of tobacco disease by multiplying the value of treatment by the number of deaths attributed to tobacco (assuming that most of the individuals were treated at some point). The major causes of death in Moldova are cardiovascular disease (59 percent), cancers (14 percent), injuries (7 percent), chronic respiratory disease (3 percent), diabetes (1 percent), and other noncommunicable diseases (12 percent) [42]. WHO estimates the number of deaths per 100,000 population in Moldova attributable to tobacco at 613. Because the population of Moldova is 3.52 million (2016 data of the World Bank), it can be inferred that more than 21,600 deaths per year may be attributed to tobacco consumption.

No direct estimates exist of the cost or out-of-pocket expenditures for the treatment of cardiovascular disease, cancer, or respiratory diseases in Moldova. Denisova and Kuznetsova (2012) estimate the treatment costs in Ukraine based on estimates for

[7] The exchange rate on December 1, 2001 was MDL 13.07 = $1

Russia, arguing that the medical systems of the two countries are similar in personnel, infrastructure, and other inputs[43]. The similarity in size, personnel, and inputs between Ukraine and Moldova in medical systems shows that Ukraine may be a good candidate for extrapolating specific costs in Moldova. Following the methodology of Denisova and Kuznetsova, this study calculated the costs in Moldova in this way (table 5). The treatment costs in Ukraine are indexed to the ratio of per capita public health expenditure in Moldova. The total cost and the total cost per household associated with tobacco and selected diseases are estimated at $10.2 million, which is more conservative than previous government estimates.[8]

Table 5: Tobacco Related Medical Cost in Ukraine and Moldova

Disease	Treatment cost, Ukraine	Treatment cost, Moldova	Private sector cost	Number	Total cost, $
Cardiovascular disease	684	524	492	16,760	8,241,911
Cancer	633	485	455	3,977	1,809,887
Chronic respiratory infection	244	187	175	852	149,496
Total				21,589	10,201,295

Source: Denisova and Kutznetzova 2012; WHO 2012.

Note: Per capita national health care expenditure, Moldova: $341; Ukraine: $445. Government expenditure, 51.4 percent. Cardiovascular disease: 59 percent; cancer: 14 percent; chronic respiratory infection: 3 percent at the national level.

In addition, costs of medical treatments of tobacco related diseases in 7 hospitals in Moldova during 2016 were obtained. These costs were identified from Diagnosis Related Group (DRG) database based on the following ICD-10[9] codes:

1. Malignant neoplasms, including lip, oral cavity, pharynx, esophagus, stomach, larynx, trachea, lungs and bronchial tubes, kidneys, bladder and pancreases (C00-C14, C15-C26, C30-C39, C64-C68);
2. Cardiovascular diseases, including ischemic heart disease, other heart diseases, hypertension, cerebrovascular diseases and other CVD (I10-115, I20-125, I30-152, I60-169);
3. Respiratory diseases, including influenza and pneumonia, other acute lower respiratory diseases and chronic obstructive pulmonary disease (J10-J18, J20-J22, J40-J47);

This data is based on costing exercise currently underway, which was completed for seven pilot hospitals and represent approximately 20 percent of total patients treated in Moldova for 2016. Hospitals covered in our case represent tertiary and secondary level of care: Oncology Institute, Emergency Hospital, Neurology Institute, Republican Clinical Hospital, Holly Trinity Hospital, Cahul Raion Hospital).

[8] Medical cost estimation in this paper can be considered as a lower-bound cost. Given the available data, these are the closest estimates that could be calculated. Other papers for countries like Ukraine, Colombia, Chile or the US consider many more diseases and medical problems associated to tobacco consumption [25,44–46]

[9] International Statistical Classification of Diseases and Related Health Problems (ICD), ICD-10, refers to the tenth revision

Table 6: Tobacco Related Medical Cost in Seven Hospitals in Moldova

Disease	Treatment cost, Moldova (USD$)	Number Sample	Tobacco Related Cases	Total Estimated Cost
Cardiovascular disease	762	1525	16,760	12,771,120
Cancer	352	327	3,977	1,399,904
Pneumonia and respiratory diseases	657	169	852	559,764
Total				14,730,788

* ICD-10: Cardiovascular diseases (CVD): including ischemic heart disease, other heart diseases, hypertension, cerebrovascular diseases and other CVD (I10-115, I20-125, I30-152, I60-169); Number of cases survey= 1525

** ICD-10: Malignant neoplasms, including lip, oral cavity, pharynx, esophagus, stomach, larynx, trachea, lungs and bronchial tubes, kidneys, bladder and pancreases (C00-C14, C15-C26, C30-C39, C64-C68); Number of cases survey= 327

*** ICD-10: Respiratory diseases, including influenza and pneumonia, other acute lower respiratory diseases and chronic obstructive pulmonary disease (J10-J18, J20-J22, J40-J47); Number of cases survey= 169

By comparing the estimated treatment costs presented in tables 5 and 6 it is possible to assess that the survey shows higher costs for cardiovascular diseases and pneumonia and respiratory diseases, but lower cost estimates for cancers and malignant neoplasms. The higher cost of pneumonia and respiratory diseases from the survey can be explained due to the fact that these hospitals are tertiary and secondary level care, therefore they attend patients with complex and advanced cases. Therefore, this would be a more appropriate cost measure for diseases associated with tobacco related to mortality. The total cost associated with these estimations if of US$ 14.7 million, higher than the US$10.2 million previously estimated. In the following, analysis will take the upper bound cost estimates, however, the results using the lower bound do not change much and are presented on Annex IV.

Descriptive Statistics

The study used the household budget survey to estimate the cost of an increase in tobacco taxes. Table 7 summarizes the most important indicators, including the total monthly expenditure of households in Moldova.

Table 7: Baseline Descriptive Results, Household Survey 2015

Indicator	Decile 1	Decile 2	Decile 3	Decile 4	Decile 5	Decile 6	Decile 7	Decile 8	Decile 9	Decile 10
Household expenditure, U.S. dollars	185	226	247	247	259	278	319	329	382	568
Proportion tobacco, %*	0.68	0.54	0.62	0.65	0.69	0.78	0.58	0.69	0.68	0.51
Households that smoke, %	19	16	15	16	13	12	13	11	15	19
Woman head, %	29	31	31	34	41	46	42	45	46	48
Average age, head	52	54	57	58	58	58	56	57	54	48
Household size	3.53	3.14	2.84	2.58	2.35	2.22	2.25	2.10	2.04	1.85

* Proportional to total consumption in each decile.

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5 RESULTS

After obtaining the baseline results described in table 7, the study estimated the effect of the tax increase on prices and medical expenditures, aggregating these two effects into a single measure. It used the three scenarios in the tobacco price elasticity, the lower-bound, medium-bound, and upper-bound scenarios presented in table 3. These three scenarios allow an understanding of how results might change under various assumptions.

Tobacco Price Increase

As a first step, the income changes that arise from the increase in tobacco prices are estimated for each income decile based on low-, medium-, and upper-bound elasticity. Using equation (4) and the data illustrated in tables 4 and 7, the study calculated the effects of the tobacco price increase. For example, given the lower-bound elasticity (–0.13) in table 4, the proportion of tobacco expenditure among the first decile (2 percent) in table 7, and a price increase of 25 percent, the increase in expenditure can be gauged at 0.11 percent. This represents a loss in welfare because consumers would devote a higher proportion of their incomes to purchasing the same amount of tobacco, thereby reducing the consumption of other goods. The results among all income deciles and elasticity scenarios are shown in table 8.

Table 8: The Direct Effect of a Price Increase on Taxes, %

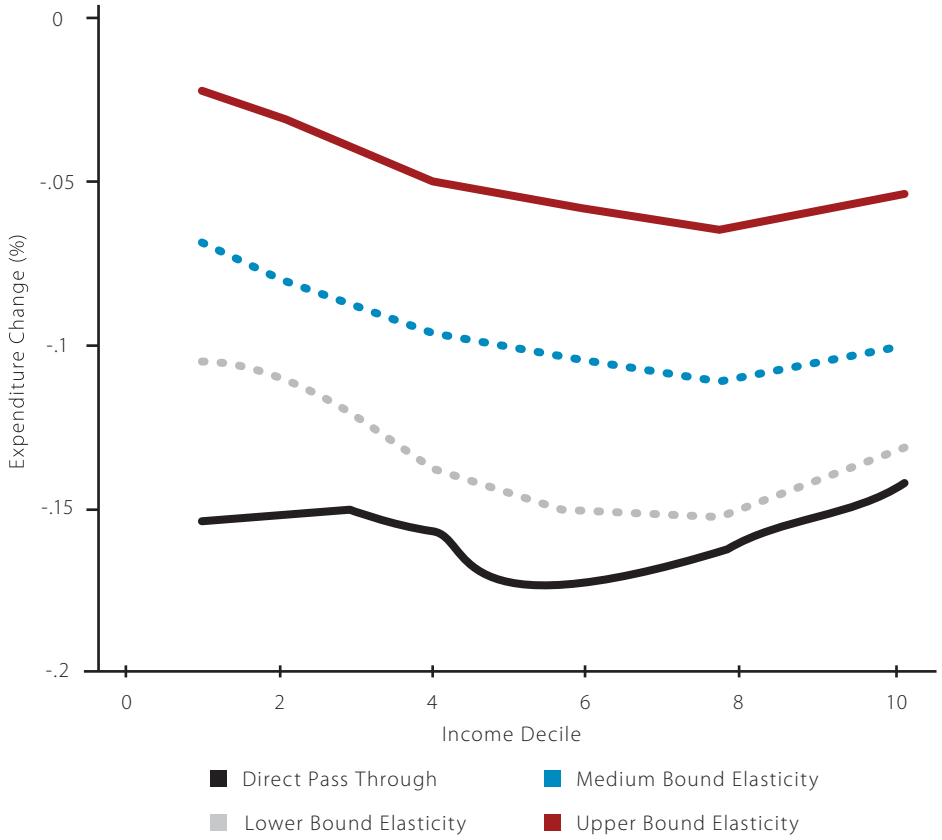
Price shock	Decile 1	Decile 2	Decile 3	Decile 4	Decile 5	Decile 6	Decile 7	Decile 8	Decile 9	Decile 10
Complete Pass-through	-0.17	-0.14	-0.16	-0.16	-0.17	-0.20	-0.15	-0.17	-0.17	-0.13
Low-bound elasticity	-0.11	-0.10	-0.12	-0.13	-0.15	-0.17	-0.13	-0.16	-0.16	-0.12
Medium elasticity	-0.06	-0.07	-0.08	-0.09	-0.10	-0.12	-0.09	-0.12	-0.12	-0.09
Upper-bound elasticity	-0.02	-0.04	-0.04	-0.05	-0.06	-0.07	-0.05	-0.08	-0.08	-0.05

Source: Based on data from the 2015 Household Budget Survey.
Note: The table shows the share of total consumption for each decile. Complete pass-through refers to elasticity equal to zero; consumers pay all the increased prices.

Across the lower- and medium-bound scenarios, the direct effect of the tobacco tax is a welfare loss, but, in none of the cases does the shock seem to be regressive. Meanwhile, in the case of the upper-bound scenario, the tax increase seems to have positive effects on income, as individuals react strongly to price increases by reducing consumption (figure 3). In the lower-, medium-, and upper-bound elasticity scenarios, the effect of the price increases is progressive, affecting the upper-income groups in a larger proportion.

To show the effect of the elasticities on prices, Table 8 includes estimates of a complete pass-through scenario, whereby the increase in prices is completely passed on to consumers without a reduction in consumption. Only in this case is the price shock regressive, affecting the lower-income deciles to a greater degree.

Figure 3: Change in Expenditures due to Tobacco Taxes (direct effect)



Source: Authors' estimation using a price shock of 25%

Medical Expenses

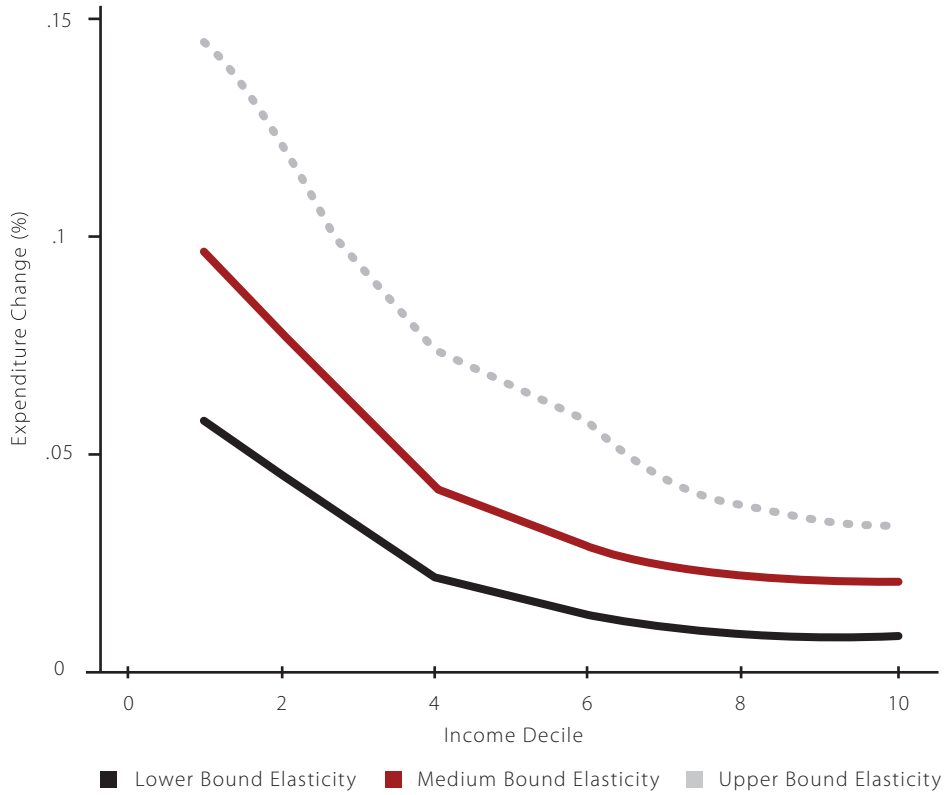
The study estimated annual medical costs associated with tobacco consumption on the assumption that there is a direct medical impact on health. Although the assumption is unrealistic in the short run, the long-run reduction of tobacco consumption would trend according to this pattern, whereby a decline in tobacco consumption would be strongly associated to a reduction in tobacco-related diseases. Health expenditures are estimated using equation (5) and tables 4 and 7 (table 9; figure 4).

Table 9: Reduction in Medical Costs (%)

Price shock	Decile 1	Decile 2	Decile 3	Decile 4	Decile 5	Decile 6	Decile 7	Decile 8	Decile 9	Decile 10
Low-bound elasticity	0.09	0.03	0.03	0.02	0.01	0.01	0.01	0.00	0.00	0.00
Medium elasticity	0.14	0.06	0.06	0.04	0.03	0.02	0.02	0.01	0.01	0.01
Upper-bound elasticity	0.20	0.10	0.09	0.07	0.04	0.04	0.04	0.03	0.03	0.02

Source: Based on data from the 2015 Household Budget Survey.
Note: The table shows the share of total consumption for each decile.

Figure 4: Reduction in Medical Costs due to Tobacco Taxes



Source: Authors' estimation using a price shock of 25%

The medical effects show a highly progressive effect, disproportionally benefiting lower-income groups in the population. This derives from two factors; (1) the higher price elasticity and (2) a lower income base that massively benefits from the reduction in medical costs.

Net Effects: Total Distributional Impacts

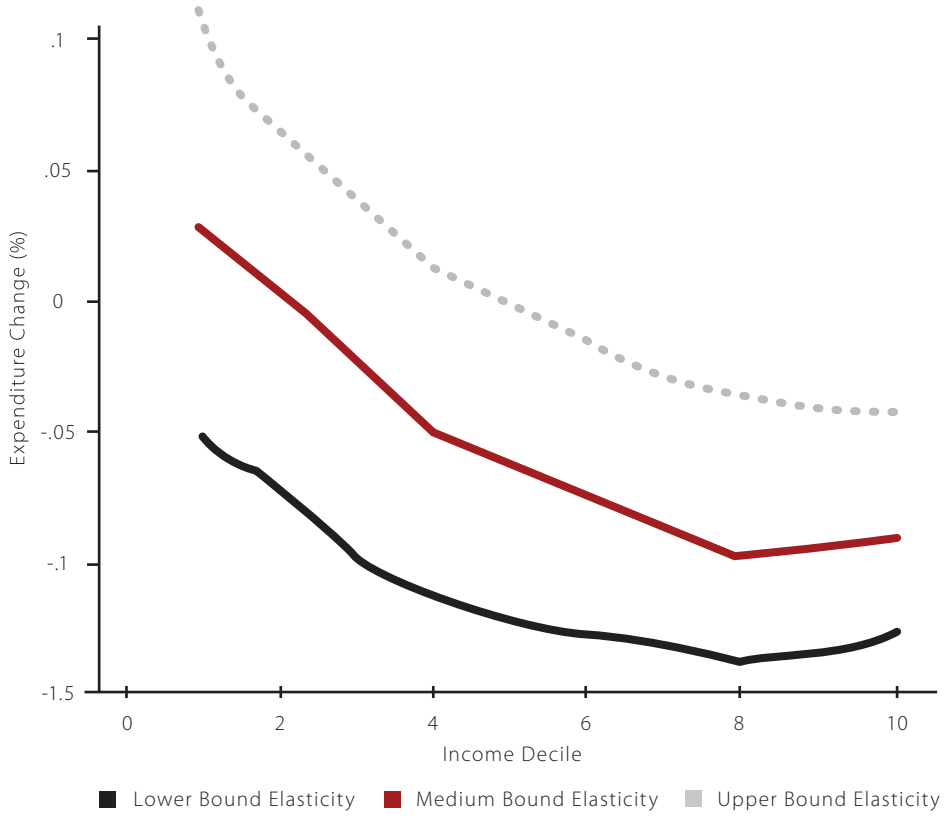
After calculating the effects of the price increase on consumption and medical expenditures, the study estimated both effects jointly. The aggregate effect of the increase in tobacco taxes is progressive, benefiting lower-income groups in the population more in all three scenarios (table 10; figure 5). In the lower-bound the net effect is negative among the all the income groups, affecting less the lower income groups. In the medium and upper-bound scenario, the lower income groups benefited from the policy of raising the tobacco tax, but the higher-income groups see negative effects due to the increase in tobacco prices.

Table 10: Net Effect on Household Expenditures (%)

Price shock	Decile 1	Decile 2	Decile 3	Decile 4	Decile 5	Decile 6	Decile 7	Decile 8	Decile 9	Decile 10
Low-bound elasticity	-0.02	-0.07	-0.09	-0.12	-0.14	-0.16	-0.12	-0.16	-0.16	-0.12
Medium elasticity	0.08	-0.01	-0.02	-0.05	-0.08	-0.09	-0.07	-0.11	-0.11	-0.07
Upper-bound elasticity	0.18	0.06	0.05	0.02	-0.02	-0.03	-0.01	-0.05	-0.05	-0.03

Source: Based on data from the 2015 Household Budget Survey.
Note: The table shows the share of total consumption for each decile.

Figure 5: Net Effect of Tobacco Taxes



Source: Authors' estimation using a price shock of 25%

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6 DISCUSSION

Tobacco-related illness accounts for 6 percent of total health care expenditure in the EU and an important share of health care expenditure in Moldova. The relevance of tobacco consumption in Moldova is not only economic, but social because it is the leading factor in mortality in the country. The negative health and economic impacts of tobacco highlight the relevance of tobacco tax policies that could diminish tobacco consumption.

Tax policies are one of the best instruments to reduce tobacco consumption and increase government revenue, but critics view this approach as regressive. This paper shows that tobacco tax increases are not regressive, but progressive and pro-poor because they could eventually boost incomes among lower-income population groups.

Using four years of household budget surveys, the study calculated the price elasticity of tobacco for the population in Moldova, obtaining an average price elasticity of −0.33 and estimates for the 10 income deciles. The elasticity for the lowest income group is −0.53 and −0.13 for the highest income group. This appears to be the first tobacco price elasticity estimate across income groups ever produced on Moldova.

To extend the analysis, other elasticities were created to simulate the short-term and long-term elasticity scenarios. Using an extended cost-benefit analysis, the study simulated a price increase of 25 percent and obtained the expenditure increases associated with the higher price as well as the reduction in medical expenses caused by the reduction in tobacco consumption. The results show that, in all cases, the tobacco tax increases are progressive, while the reduction in medical expenses outweighs the price increases. Moreover, in the upper-bound elasticity, the net gains of the tobacco tax policy are positive for the lower income groups.

Evidence Before this Study

A search has been undertaken and completed among the PubMed, Embase, and POPLINE databases for related studies published from January 2, 2000, to June 30, 2017, with no language restriction.[10] No previous papers estimating the tobacco price elasticity in Moldova or research related to the inequality effects of tobacco tax increases in this

[10] See Embase (database), Elsevier, Amsterdam, https://www.elsevier.com/solutions/embase-biomedical-research; POPLINE (database), K4Health (Knowledge for Health Project), Johns Hopkins Center for Communication Programs, Johns Hopkins–Bloomberg School of Public Health, Johns Hopkins University, Baltimore, MD, https://www.popline.org/; PubMed (database), National Center for Biotechnology Information, U.S. National Library of Medicine, Bethesda, MD, https://www.ncbi.nlm.nih.gov/pubmed.

country have been discovered. The present study builds on the previous literature on price elasticity estimation and on the health and economic literature on extended cost-benefit analysis.

Added Value of this Study

The value of this study is twofold. First, this study contributes to the estimation of the tobacco price elasticity per income decile in Moldova using household survey data and the prices paid by consumers. Second, this study directly quantifies the potential impact of a tobacco price rise on consumption increases across income groups and estimates the distributional effects of the price rise, including an associated reduction in medical expenses. The analysis provides evidence of the potential distributional impact of tobacco tax policy on consumption in Moldova, but also on broader health care system goals of improving health outcomes and inequality reduction among income groups within the population.

Interpretation of All the Available Evidence

Tobacco taxes are deemed to be regressive by many economists and health researchers who argue that low-income smokers spend a disproportionately greater share of their income on tobacco. We find that, in Moldova, there is a price elasticity of –0.33 and that tobacco taxes benefit the poor because the reduction in medical expenses outweighs the effects of the price increase.

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REFERENCES

1 General S. The health consequences of smoking—50 years of progress: a report of the surgeon general. In: *US Department of Health and Human Services*. Citeseer 2014.

2 Health UD of, Services H, others. *The health consequences of smoking: a report of the Surgeon General*. 2004.

3 The World Bank. The World Bank in Moldova: Country Snapshot. 2017.

4 World Health Organization. European health for all Database. 2012.

5 Eriksen M, Mackay J, Ross H, *et al*. *The tobacco atlas*. American Cancer Society 2013.

6 World Health Organization, others. WHO report on the global tobacco epidemic, 2008: the MPOWER package. 2008.

7 Peto R, Lopez AD. The future worldwide health effects of current smoking patterns. *Tobacco and public health: Science and policy* 2004;:281–286.

8 Jha P, Peto R. Global effects of smoking, of quitting, and of taxing tobacco. *New England Journal of Medicine* 2014;**370**:60–68.

9 The World Bank. Curbing the epidemic: governments and the economics of tobacco control. *Development in Practice Series* 1999;**8**:196.

10 World Health Organization, International Agency for Research on Cancer. *Effectiveness of tax and price policies for tobacco control (IARC)*. World Health Organization, International Agency for Research on Cancer 2011.

11 Gruber J, Sen A, Stabile M. Estimating price elasticities when there is smuggling: the sensitivity of smoking to price in Canada. *Journal of Health Economics* 2003;**22**:821–42.

12 Krasovsky K, Andreeva T, Krisanov D, *et al*. Economics of tobacco control in Ukraine from the public health perspective. *Kiev: Polygraph Center TAT* 2002.

13 Mao Z, Yang GH, Ma H, et al. Adults' demand for cigarettes and its determinants in China. *Soft Science of Health* 2003;**17**:19–23.

14 Sayginsoy O, Yurekli AA, De Beyer J. Cigarette demand, taxation, and the poor: A case study of Bulgaria. Published Online First: 2002

15 Taal A, Kiivet RA, Hu T-W, *et al*. The economics of tobacco in Estonia. Published Online First: 2004.

16 Gallus S, Schiaffino A, La Vecchia C, et al. Price and cigarette consumption in Europe. *Tobacco control* 2006;**15**:114–119.

17 Townsend J, Roderick P, Cooper J. Cigarette smoking by socioeconomic group, sex, and age: effects of price, income, and health publicity. *Bmj* 1994;**309**:923–927.

18 Szilágyi T. Higher cigarette taxes–healthier people, wealthier state: the Hungarian experience. *Central European journal of public health* 2007;**15**.

19 Yürekli A, Önder Z, Elibol M, *et al*. The economics of tobacco and tobacco taxation in Turkey. *Paris: International Union Against Tuberculosis and Lung Disease* 2010;**5**.

20 Ciecierski CC, Cherukupalli R, Weresa MA. The economics of tobacco and tobacco taxation in Poland. *Paris: International Union Against Tuberculosis and Lung Disease* 2011;:8–11.

21 Selvaraj S, Srivastava S, Karan A. Price elasticity of tobacco products among economic classes in India, 2011–2012. *BMJ open* 2015;**5**:e008180.

22 Centers for Disease Control and Prevention (CDC. (1998). Response to increases in cigarette prices by race/ethnicity, income, and age groups--United States, 1976-1993. MMWR. Morbidity and mortality weekly report, 47(29), 605.

23 Chaloupka FJ, Grossman M. Price, tobacco control policies and youth smoking. National Bureau of Economic Research 1996.

24 Lewit EM, Coate D. The potential for using excise taxes to reduce smoking. *Journal of health economics* 1982;**1**:121–145.

25 Fuchs Tarlovsky A, Meneses FJ, others. Are tobacco taxes really regressive? evidence from Chile. The World Bank 2017.

26 Mason J, Wheeler W, Brown MJ. The economic burden of exposure to second-hand smoke for child and adult never smokers residing in US public housing. *Public Health Reports* 2015;**130**:230–244.

27 Turcanu G, Domente S, Buga M, *et al*. Republic of Moldova health system review. *Health Syst Transit* 2012;**14**:1–151.

28 World Health Organization. European health for all Database. 2016.

29 Konstantin Krasovsky. Tobacco Taxation Policy in the Republic of Moldova. 2017.

30 Verguet S, Gauvreau CL, Mishra S, *et al*. The consequences of tobacco tax on household health and finances in rich and poor smokers in China: an extended cost-effectiveness analysis. *The Lancet Global Health* 2015;**3**:e206–e216.

31 Coady DP, El Said M, Gillingham R, *et al*. The magnitude and distribution of fuel subsidies: evidence from Bolivia, Ghana, Jordan, Mali, and Sri Lanka. Published Online First: 2006.

32 Kpodar K, Djiofack C. The Distributional effects of oil price changes on household income: Evidence from Mali. *Journal of African Economies* 2009;**19**:205–236.

33 Pichón Riviere A, Bardach A, Caporale J, *et al*. Carga de Enfermedad atribuible al Tabaquismo en Chile. *Documento Técnico IECS* 2014.

34 Franks P, Jerant AF, Leigh JP, et al. Cigarette prices, smoking, and the poor: implications of recent trends. *American Journal of Public Health* 2007;**97**:1873–1877.

35 Cameron L, Williams J. Cannabis, alcohol and cigarettes: substitutes or complements? *Economic Record* 2001;**77**:19–34.

36 John RM. Price elasticity estimates for tobacco products in India. *Health Policy and Planning* 2008;**23**:200–209.

37 World Health Organization. Tobacco Market Contry Profile: Republic of Moldova. 2012.

38 Gallus S, Schiaffino A, La Vecchia C, et al. Price and cigarette consumption in Europe. *Tobacco control* 2006;**15**:114–119.

39 Pisinger C, Godtfredsen NS. Is there a health benefit of reduced tobacco consumption? A systematic review. *Nicotine & tobacco research* 2007;**9**:631–646.

40 Tverdal A, Bjartveit K. Health consequences of reduced daily cigarette consumption. *Tobacco control* 2006;**15**:472–480.

41 Fact sheet about health benefits of smoking cessation. 2016.

42 Riley L, Cowan M. Noncommunicable diseases country profiles 2014. *Geneva: World Health Organization* 2014.

43 Denisova I, Kuznetsova P. The effects of tobacco taxes on health: An analysis of the effects by income quintile and gender in Kazakhstan, the Russian Federation, and Ukraine. Published Online First: 2014.

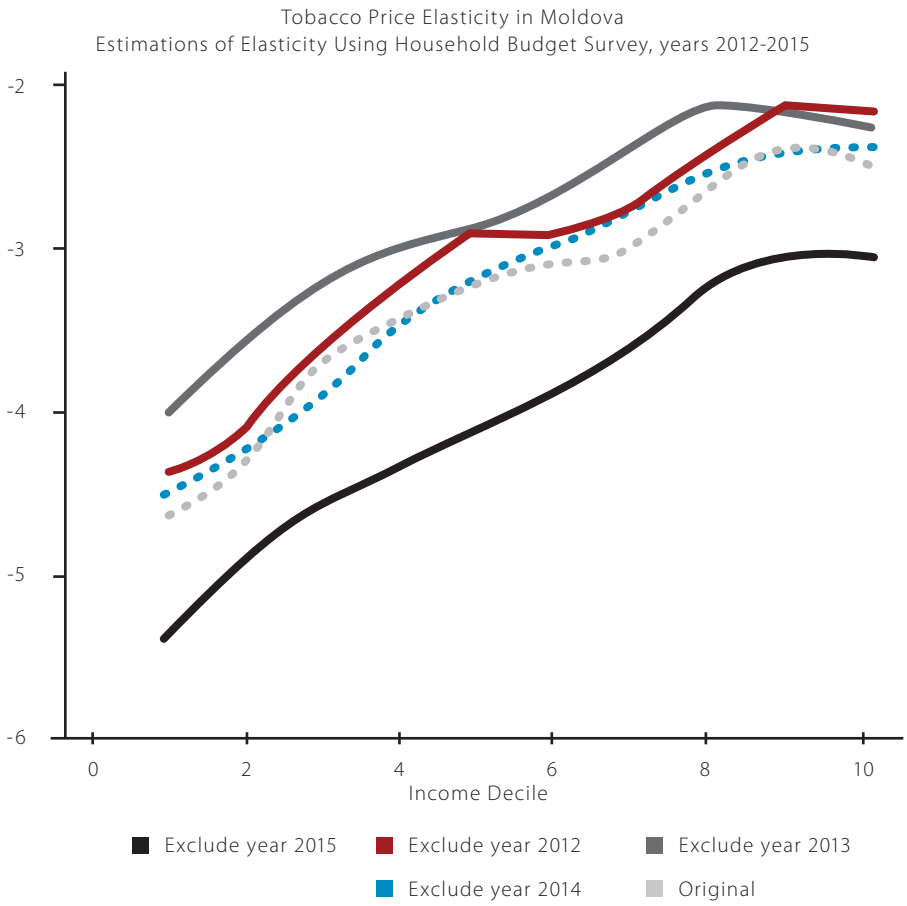
44 James E, Saxena A, Franco Restrepo C, *et al*. The Distributional Consequences of Increasing Tobacco Taxes on Colombia's Health and Finances. 2017.

45 Saywell Jr RM, Zollinger TW, Lewis CK, *et al*. A model for estimating the economic impact of secondhand smoke exposure: a study in Indiana. *Journal of Public Health Management and Practice* 2013;**19**:E10–E19.

46 Fuchs A, Meneses F. Regressive or Progressive? The Effect of Tobacco Taxes in Ukraine. 2017.

ANNEX I

In order to check for the robustness of the elasticity simulation, we eliminate one year of the surveys and estimate the elasticities again. The results are displayed in the graph bellow, where one year is excluded and then the elasticities are re-calculated. The biggest variation is seen with the exclusion of the year 2015, that would generate a higher – in absolute terms – price elasticity. All possible scenarios fall inside the 95% confidence interval of the original estimations. This implies that the elasticities are not prominently affected by the specific years chosen to perform the estimation.



ANNEX II

In order to check for the robustness of the different decile groups used from the household survey we compared specific characteristics such as household size, age and gender of head of household among income deciles. As shown in the following table, only small variations among the decile groups were found.

Table AII: Descriptive Statistics of Income Deciles per year

Household Size

	2012		2013		2014		2015	
Decile	Average	SE	Average	SE	Average	SE	Average	SE
1	3.82	0.09	3.64	0.10	3.56	0.09	3.53	0.08
2	3.17	0.07	2.98	0.07	3.15	0.08	3.15	0.08
3	2.93	0.07	2.77	0.07	2.73	0.07	2.84	0.08
4	2.62	0.06	2.53	0.06	2.62	0.07	2.58	0.06
5	2.50	0.06	2.38	0.07	2.43	0.07	2.35	0.06
6	2.47	0.06	2.22	0.05	2.16	0.05	2.22	0.06
7	2.26	0.06	2.27	0.06	2.17	0.06	2.25	0.06
8	2.28	0.06	2.20	0.06	2.20	0.06	2.10	0.06
9	2.15	0.05	2.16	0.06	2.13	0.06	2.04	0.05
10	1.87	0.05	1.84	0.05	1.79	0.04	1.85	0.05

Household Head Gender

	2012		2013		2014		2015	
Decile	Average	SE	Average	SE	Average	SE	Average	SE
1	1.35	0.03	1.29	0.03	1.30	0.03	1.29	0.02
2	1.35	0.02	1.33	0.02	1.34	0.03	1.31	0.02
3	1.33	0.02	1.36	0.02	1.40	0.03	1.31	0.02
4	1.37	0.02	1.38	0.02	1.38	0.03	1.34	0.02
5	1.42	0.02	1.44	0.03	1.43	0.03	1.41	0.02
6	1.44	0.02	1.44	0.02	1.45	0.02	1.46	0.02
7	1.47	0.02	1.45	0.02	1.45	0.03	1.42	0.02
8	1.42	0.02	1.45	0.03	1.39	0.02	1.45	0.02
9	1.46	0.02	1.45	0.03	1.43	0.03	1.46	0.02
10	1.50	0.02	1.49	0.03	1.47	0.03	1.48	0.03

Household Head Age

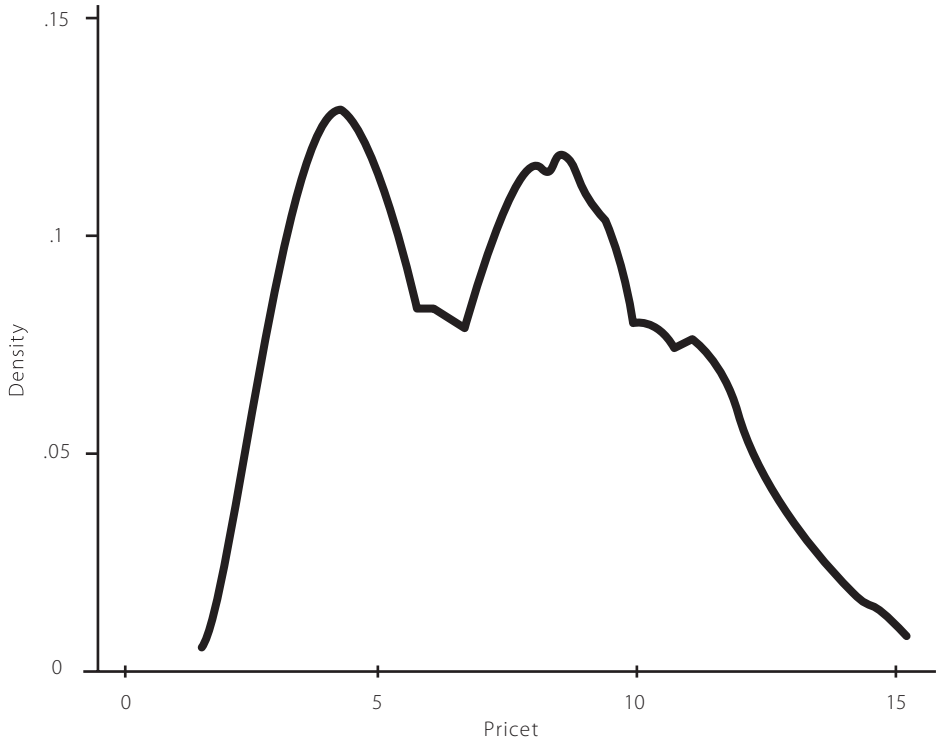
2012			2013		2014		2015	
Decile	Average	SE	Average	SE	Average	SE	Average	SE
1	52.47	0.85	52.39	0.86	52.34	0.85	51.82	0.78
2	55.38	0.81	54.83	0.78	55.19	0.82	54.08	0.82
3	55.41	0.83	56.85	0.72	57.42	0.80	56.92	0.74
4	58.08	0.73	57.27	0.69	57.12	0.72	58.04	0.76
5	57.25	0.70	57.52	0.78	57.19	0.80	58.38	0.71
6	56.00	0.74	57.78	0.66	58.08	0.72	58.30	0.77
7	57.04	0.70	55.95	0.79	56.61	0.78	56.41	0.69
8	53.33	0.69	54.65	0.85	55.34	0.80	56.55	0.75
9	50.63	0.80	51.17	0.81	52.72	0.79	53.64	0.75
10	45.14	0.86	47.67	0.87	47.99	0.80	47.95	0.80

Source: Based on data from the 2015 Household Budget Survey.
Note: The table shows the share of total consumption for each decile.

ANNEX III

We estimate the price elasticity of cigarettes in Moldova for a pack of 20 cigarettes, filtered and not-filtered, sold in authorized establishments, for personal consumption. This extra specification of tobacco products allows us to eliminate variations on demand due to individuals purchasing from non-authorized sellers or buying to sell cigarettes. These purchases could vary because of governmental controls of illegal markets, and other factors not related to price changes. We also eliminated outliers beyond three standard deviations. After eliminating outliers, we look at the obtained prices. In the graph below we can see that the distribution seems to be bimodal, having two distinctive peaks. The prices for the 20 cigarettes a between 2 MDL and 15 MDL, similar to the prices reported by Krasovsky (2016).

Figure AIII-1: Selected Real Cigarette Prices in 2015



kemel = epanechnikov, bandwidth = 0.7280

We proceed to calculate the price elasticity of the pack of 20 cigarettes during the years 2012-2105. The result is show in the graph 2.

ANNEX IV

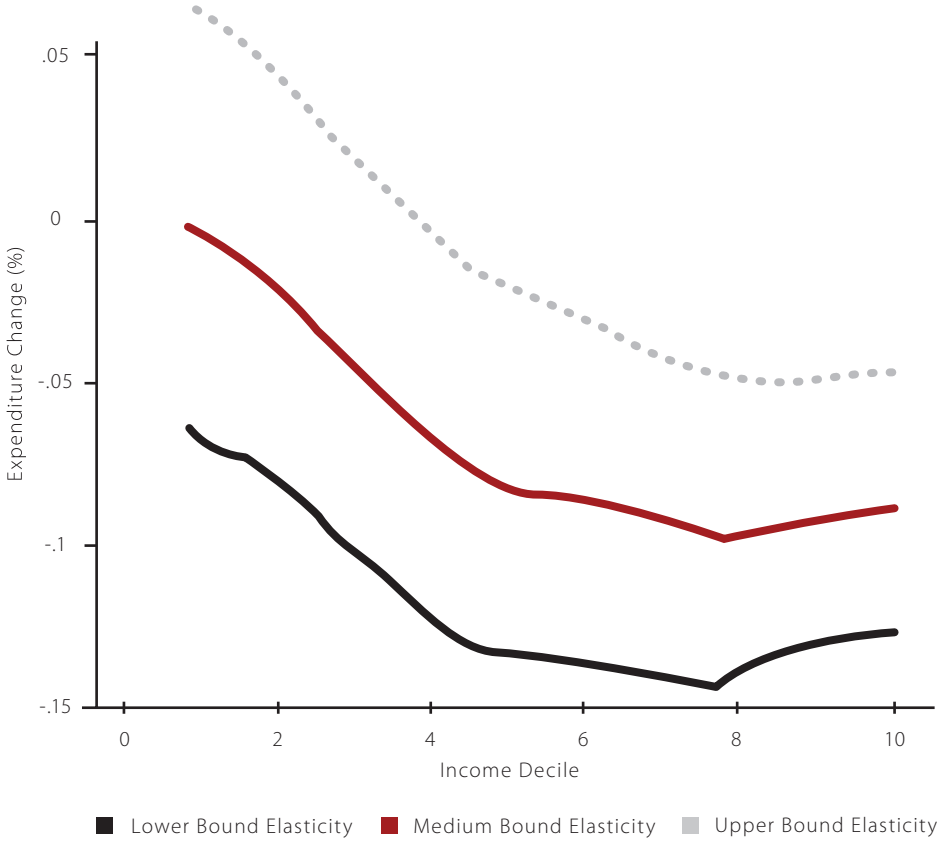
In this annex we present the results obtained by following the same methodology but using the lower bound health costs as indicated in table 5 and referenced in page 11

Table AIV-1: Net Effect on Household Expenditures (%)

Price shock	Decile 1	Decile 2	Decile 3	Decile 4	Decile 5	Decile 6	Decile 7	Decile 8	Decile 9	Decile 10
Lower-bound elasticity	-0.05	-0.08	-0.10	-0.12	-0.14	-0.16	-0.12	-0.16	-0.16	-0.12
Medium elasticity	0.04	-0.03	-0.04	-0.06	-0.09	-0.10	-0.07	-0.11	-0.11	-0.08
Upper-bound elasticity	0.12	0.03	0.02	-0.01	-0.03	-0.04	-0.03	-0.06	-0.06	-0.04

Source: Based on data from the 2015 Household Budget Survey.
Note: The table shows the share of total consumption for each decile.

Figure IV-1: Net Effect of Tobacco Taxes



Source: Authors' estimation using a price shock of 25%