DISTRIBUTIONAL EFFECTS OF TOBACCO TAXATION

A COMPARATIVE ANALYSIS

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ABSTRACT

Tobacco taxes have positive impacts on health outcomes. However, policy makers often hesitate to use them because of the perception that poorer households are affected disproportionally more than richer households. This study compares the simulated distributional effects of tobacco tax increases in eight low- and middle-income countries. It applies a standardized extended cost-benefit analysis methodology and relies on comparable data sources across countries. The net effect of raising taxes on cigarettes encompasses the direct negative price shock to household budgets and the long-term benefits of improved health outcomes. The distributional incidence is assessed by estimating decile-specific behavioral responses and relative income gains. The comparative results do not support the claim that tobacco taxes are necessarily regressive. Although welfare losses from the first-order price shock disproportionally affect the poor, these negative shocks are attenuated by greater price-responsiveness among lower-income groups and further offset by higher long-term relative gains through reduced medical expenditures and additional years of productive life as taxes dissuade smoking. In several countries, increasing the price of cigarettes is pro-poor and welfare improving for a large share of the population. Along with raising taxes, policy should aim at encouraging responsiveness to price changes and target tobacco-related medical expenses that disproportionally burden the poor.

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Distributional Effects of Tobacco Taxation:

A Comparative Analysis

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1. Introduction

The World Health Organization (WHO 2017) estimates that tobacco kills more than 7 million people worldwide each year. It is the second leading cause of death and disability worldwide (Ng et al. 2014) and is among the major preventable causes of disease and premature death globally (Doll and Hill 1956; Wynder and Graham 1950). Diseases associated with tobacco use include lung cancer, stroke, ischemic heart disease, and respiratory diseases (HHS 2004).

Among tobacco control policies, tobacco taxes are generally considered the most efficient policy intervention to reduce tobacco consumption (World Bank 1999). Evidence suggests that higher taxes are responsible for almost half the decline in smoking (WHO 2014). By increasing prices and reducing the affordability of tobacco, taxes encourage current smokers to quit and discourage potential consumers to initiate. They also contribute to raising government revenues and to reducing the risks of secondhand smoking. Nonetheless, policy makers often hesitate to increase taxes on tobacco because of claims of the potentially regressive impact, that is, as the prices of tobacco increase, the poor could suffer proportionally larger negative effects. However, in addition to health benefits, taxes bring about medium- and long-term economic benefits among households that are often overlooked, including higher labor productivity and fewer medical bills. Analyzing the burden of tobacco across the population and assessing the distribution of these health and economic benefits are essential to assessing the overall welfare effects and distributional impacts of raising the taxes on tobacco.

Most studies on the economic burdens of tobacco have been concentrated in higher-income countries. Yet, nearly 80 percent of the world's smokers live in low- and middle-income countries (WHO 2015a). Developing countries are already burdened by 40 percent of the total economic costs of smoking (Goodchild, Nargis, and Tursan d'Espaignet 2018). This study reports on a comparative analysis of the distributional impact of raising taxes on tobacco products in eight countries: Bangladesh, Bosnia and Herzegovina, Chile, Indonesia, Moldova, South Africa, the Russian Federation, and Ukraine.

This is a first attempt to carry out a cross-country comparative analysis on the distributional welfare effects of tobacco taxation using household consumption microdata and including a sample of eight countries. The study applies a standardized extended cost-benefit analysis (ECBA), and, to aim for methodological consistency, it relies on the same sources of data across the sample.[2] In line with the findings in the literature, the ECBA methodology allows for differentiated behavioral responses to the price changes in tobacco by examining decile-specific price elasticities of demand. It accounts for both the direct price shock on household budgets and the indirect welfare gains of rising cigarette prices, as the improved health outcomes derived from reduced smoking translate into lower medical expenses and fewer premature deaths among workers. Finally, it simulates medium-, upper-, and lower-bound elasticity scenarios to account for shorter- and longer-term consumption changes and welfare effects.

The results show that, in the short run, the direct price shock negatively affects lower-income households more than the more well-off peers. In most countries, this regressive effect is driven

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[2] The World Bank has published country-specific studies on the distributional incidence of tobacco taxation (see Fuchs and Del Carmen 2018; Fuchs, Del Carmen, and Genoni 2018; Fuchs, Del Carmen, and Mukong 2018; Fuchs and Matytsin 2018; Fuchs and Meneses 2017a, 2017b, 2018; Fuchs, Orlic, and Cancho 2019). However, these studies rely on country-specific data sources with some methodological variation.

by higher budget shares allocated to tobacco product purchases among less well-off households. In all countries, however, the effect is moderated by the higher sensitivity of the poor to price changes. Incorporating the reductions in medical expenditures and the additional years of working life because of lower premature mortality partially offsets the negative effects. In sufficiently high price-shocks and elasticity scenarios, incidence becomes progressive, and welfare changes are modest, but positive among most households. The evidence collected on the eight countries supports the view that resolute tax policy, combined with actions to induce behavioral changes among smokers, can generate pro-poor and welfare-improving outcomes in the long term.

The study is structured as follows. Section 2 revisits the well-known negative health effects of tobacco consumption and reviews the literature on the associated economic costs. It also discusses the use of taxes and other tobacco control policies and the role of tobacco price elasticities in determining policy outcomes. Section 3 outlines and describes the extended ECBA methodology to assess the distributional impacts of raising taxes on cigarettes. Section 4 presents an overview of the data and the basic descriptive statistics of tobacco consumption patterns in the eight countries of the sample. Section 5 examines the results for each component of the model, as well as the net distributional income changes after the price of cigarettes has been increased. The final section discusses the policy implications of these findings and concludes.

2. Literature Review

a. Tobacco and health

An extensive body of research has focused on the effects of tobacco consumption on health outcomes. Robust evidence has linked tobacco consumption to health problems, including several types of cancer, strokes, respiratory diseases, and ischemic heart disease (HHS 2004). An estimated 100 million deaths may have been related to tobacco use during the 20th century (Peto and Lopez 2004). Current trends will likely lead to 1 billion deaths from tobacco-related diseases over the next century (Jha and Peto 2014). Secondhand smoke alone is currently associated with 890,000 premature deaths per year (WHO 2017).

Today, 80 percent of the world's smokers live in low- and middle-income countries (WHO 2015a). Furthermore, these countries are experiencing a rise in noncommunicable diseases, contributing to a double burden of disease. Tobacco is a major risk factor associated with several noncommunicable diseases, including lung cancer and other types of cancer (WHO 1999). Because smoking prevalence and the affordability of tobacco are expected to increase, developing countries will likely bear the major health impacts of tobacco in the near future. Blecher and van Walbeek (2008) find that cigarette affordability rose in developing countries between 1997 and 2006, as mean incomes grew at more rapid rates than average tobacco prices. These trends may negatively affect economic development because smoking decreases earnings potential and labor productivity (WHO 2015b), and it hinders human capital accumulation.

b. Tobacco control policies

Tobacco control has become a major public health priority in the 21st century (WHO 1999). Concerns over the health and economic costs of tobacco consumption have triggered an array of policy initiatives across countries and international organizations. Most commonly, antitobacco policies include smoking bans or smoke-free environments, advertising campaigns to deter consumption, smoking cessation programs, prohibitions on tobacco sales to specific populations, and taxes. The results of such policies on tobacco use and availability and on secondhand exposure remain heterogenous (Fuchs and Meneses 2017a).

Mass media advertising campaigns are the most common policy intervention to combat tobacco use, reaching over 50 percent of the world's population in 2016. However, exposure to advertising campaigns is less extensive in lower-income countries, and evidence supporting the cost-effectiveness of these campaigns remains limited (WHO 2015b). The impact depends on the campaign's duration and specific communication; warnings on the adverse health risks of smoking are among the most effective messages (Durkin, Brennan, and Wakefield 2012). Warning labels printed on tobacco packages to deter consumption reach 45 percent of the global population. Despite wide popular support and the mostly minimum public costs of these policies (WHO 2015a), they only account for marginal reductions in smoking prevalence (Borland 1997; Fathelrahman et al. 2009; Levy, de Almeida, and Szklo 2012).

Smoking-cessation support programs are accessible to 1.1 billion people (WHO 2015b). These programs are highly effective in helping individuals seeking to quit smoking (Fiore and the Guideline Panel 2008). However, smoking-cessation programs are mostly concentrated in high-income countries and do not help addicts who do not wish to be treated. Smoke-free laws reach one-fifth of the world's population (WHO 2017). They are popular because of their claims of improvement in health outcomes and the mitigation of secondhand smoking without affecting business (WHO 2015a). In practice, their effectiveness depends on the breadth of country-specific legislation and implementation (IARC 2009).

c. Tobacco taxation

Taxes on tobacco are generally considered the most efficient policy intervention to reduce tobacco consumption (World Bank 1999). They constitute a central policy of the Framework Convention on Tobacco Control. Governments can potentially use taxes to manage tobacco consumption, raise revenues, and promote public health (WHO 2011a). Evidence suggests that higher taxes are responsible for almost half the decline in smoking (WHO 2014). A growing body of research also supports the effectiveness of price interventions to achieve tobacco control in developing settings. Levy, de Almeida, and Szklo (2012) estimate that higher tobacco prices accounted for 46 percent of the reduction in tobacco use in Brazil compared with the 14 percent reduction associated with smoke-free policies.

Ranson et al. (2002) find that price increases are the most cost-effective among an array of antismoking interventions, including nicotine replacement therapy and other nonprice interventions (bans on advertising and promotion, information campaigns, and smoke-free laws). Raising the prices on tobacco is the lowest cost intervention per disability-adjusted life year saved globally, resulting in impressive reductions in mortality. Tobacco tax policies are cost-effective even relative to other public health interventions traditionally financed by governments

(Ranson et al. 2002). However, analyses of cost-effectiveness tend to focus on the perspective of the public sector provider or financing entity and leave aside the costs borne by individual households.

A recurrent policy concern is the potentially regressive effects of tobacco taxes. Lower-income households usually allocate larger shares of their budgets to purchasing tobacco products. Hence, relative to wealthier households, low-income households face larger negative shocks to budgets when taxes translate into higher tobacco prices. However, this presents only a partial picture of the more complex effects of raising taxes on tobacco. Several benefits of tobacco taxes arise via improvements in people's medical condition and productivity. Such gains may contribute to offsetting the direct negative price shock. The net impact on household welfare of raising taxes on tobacco involves the aggregation of these costs and benefits. Furthermore, it is mediated by the degree of pass-through of the tax burden to consumer prices, the responsiveness of consumers to the price shock, and the initial distribution of tobacco consumption across population groups. The medium- and long-term effects will likely differ from the immediate short-term outcomes if the benefits and behavioral responses take time to kick in.

While the net effect remains an empirical question, a growing body of research within countries supports the conclusion that the benefits of raising taxes on tobacco offset the costs. Denisova and Kuznetsova (2014) and Verguet et al. (2015) find that, across the population and, specifically, among low-income groups, the future benefits of nonsmoking outweigh the losses attributed to tobacco taxes. Other country-specific studies based on household microdata find that the distributional incidence of raising taxes on tobacco can be progressive, most often because of the benefits derived from averted medical expenses (Fuchs and Del Carmen 2018; Fuchs, Del Carmen, and Genoni 2018; Fuchs, Del Carmen, and Mukong 2018; Fuchs, and Matytsin 2018; Fuchs and Meneses 2017a, 2017b, 2018; Fuchs, Orlic, and Cancho 2019).

d. The price elasticity of tobacco consumption

Ultimately, the distributional impact of raising taxes on tobacco—whether the poor are more heavily burdened or see the greatest benefits—depends on the responsiveness of low- and high-income consumers to the price changes in tobacco (WHO 2011a). An extensive body of evidence consists of estimates of the relationship between tobacco prices and consumption. The price elasticities of demand express the sensitivity of consumers to changes in tobacco prices and therefore become crucial in calibrating the welfare and distributional effects of tobacco tax systems. Such relationships, however, are not homogeneous across countries and income groups. In high-income countries, raising the price of cigarettes by 10 percent leads to an estimated reduction of 4 percent in the demand for cigarettes (World Bank 1999). An equivalent price change in low- and middle-income countries would likely result in a 6 percent average fall in demand (IARC 2011). Regional and country-specific estimates are also extensive. Meta-studies on the United States estimate tobacco price elasticity at between zero and −0.47 (Chaloupka and Grossman 1996; Lewit and Coate 1982). Gallus et al. (2006) find an average elasticity of −0.46 in European countries. Empirical results on Latin America conclude that both short- and long-term price elasticities of cigarettes fall below unity (in absolute value), and below −0.50 for higher-income countries in the region (Guindon, Paraje, and Chaloupka 2015).

Age and income are key factors in determining the price elasticities of tobacco. It is often argued that younger individuals and low-income groups are more responsive to price changes relative

to their peers. Lower dependence on nicotine, larger peer effects, and limited disposable income may cause younger people to be more responsive to tobacco price shocks (Jha and Peto 2014). Some evidence supports this claim. Chaloupka and Grossman (1996) and Lewit and Coate (1982) find that, in the United States, individuals ages under 18 exhibit much larger tobacco price elasticities (between −1.44 and −1.31) than adults (between −0.27 and −0.42).

Lower-income households tend to show higher price elasticity of demand relative to medium- and higher-income groups (World Bank 1999). Empirical research in a variety of countries, including Bangladesh, Canada, China, Indonesia, the United Kingdom, and the United States, suggests that the sensitivity of smoking prevalence to changes in cigarette pricing is greater among lower socioeconomic strata. However, the evidence is still mixed in other cases, including the Arab Republic of Egypt, Bulgaria, and Turkey (IARC 2011). Tobacco elasticities can be expected to increase in the future as more-responsive young generations become the largest consumer group (Fuchs and Del Carmen 2018). In the long term, tax policy may become more effective at influencing behavioral changes and reducing tobacco consumption.

e. Costs of tobacco: Life, work, and medical expenditures

Several studies have quantified the economic cost of smoking, though most have focused on high-income countries. Goodchild, Nargis, and Tursan d'Espaignet (2018) find that tobacco-related diseases accounted for 5.7 percent of global health expenditure in 2012 and that the total economic costs of smoking, including health expenditures and productivity losses, were equivalent to 1.8 percent of the world's gross domestic product (GDP) (US$1.85 trillion in purchasing power parity [PPP] U.S. dollars). The highest share, according to these authors, was in high-income countries (US$1.12 trillion in PPP dollars), where the tobacco epidemic is most advanced.[3] The earlier estimates of Lightwood et al. (2000) indicate that the gross health cost of tobacco in high-income countries is between 0.1 percent and 1.0 percent of GDP. However, nearly 40 percent of the health and productivity costs related to tobacco are already concentrated in developing countries (Goodchild, Nargis, and Tursan d'Espaignet 2018).

Public and private health care accounts for the major share of the costs of tobacco use, beyond the price of household consumption. Tobacco-related health care costs can be either direct or indirect. Direct costs include the monetary value of the consumption of goods and services that is motivated or compelled because of tobacco use. These include health care costs (hospitalization, pharmaceuticals and supplies, medical equipment, and so on) and non–health care costs (insurance, job replacements for sick smokers, cleaning up cigarette residues and packaging, and so on). For example, in the United States, tobacco-related diseases are associated with direct health care costs of 1.1 percent of GDP or 8.7 percent of annual health care spending (Xu et al. 2015). Some medical cost estimates are available for the countries in the sample. Pichón-Riviere et al. (2014) estimate the annual direct cost of tobacco-related disease in the Chilean health system at approximately 0.6 percent of GDP. In Indonesia, annual direct health care costs attributable to tobacco consumption amounted to 2.5 percent of GDP in 2015 (Kristina et al. 2018). The total economic cost of tobacco use in Bangladesh was estimated at 3 percent of GDP in 2004 (WHO 2007).

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[3] Goodchild, Nargis, and Tursan d'Espaignet (2018) estimate the economic cost of smoking-attributable diseases at US$15 billion in low-income countries, US$359 billion in lower-middle-income countries, and US$354 billion in upper-middle-income countries, all in PPP U.S. dollars.

The indirect costs of smoking on household welfare may include losses in labor incomes because of lower productivity or working days forgone because of illness, as well as the value of lives prematurely lost because of tobacco (WHO 2011b). Hence, raising the prices of tobacco may expand the years of productive life. Verguet et al. (2015) analyze the health effects of a price increase in China and conclude that a 50 percent rise in prices would result in 231 million life years gained over 50 years and would have a significant impact among the poor. In contrast, Pichón-Riviere et al. (2014) estimate that tobacco use in Chile would reduce life expectancy by nearly 4.0 years among women and 4.3 years among men. Ahsan et al. (2013) estimate that, if taxes were raised to 57 percent of the retail price of tobacco products, 1.96 million tobacco-related deaths would be averted in Indonesia. Similarly, if taxes were raised even more, to 70 percent, more than 5 million deaths would be averted.

Other indirect and second-round effects may also be significant. Raising taxes on cigarettes may reduce exposure to secondhand smoke, with significant health and economic benefits.[4] Households may likewise benefit from increased public expenditure because governments have typically earmarked tax revenues from tobacco sales for health care and social programs.

3. Model

The empirical model of this study relies on an adaptation of the extended ECBA methodology developed by Pichón-Riviere et al. (2014) and Verguet et al. (2015) to assess the medium- and long-run effects of raising taxes on cigarettes. Lower-income households tend to allocate larger shares of their budgets to purchase tobacco products (see above). Hence, relative to wealthier households, low-income families tend to face larger direct negative shocks to their budgets as taxes translate into higher prices for tobacco. Nonetheless, by discouraging consumption, taxes reduce adverse tobacco-related health outcomes, as well as the associated medical and human capital costs to households and societies. Medical treatment of tobacco-related chronic diseases swells annual health care costs among public health care systems and households (Marquez and Moreno-Dodson 2017). Smoking reduces household earnings potential and labor productivity, negatively affecting human capital accumulation and development (WHO 2015b).

Hence, the ECBA methodology incorporates three effects of rising tobacco prices: (a) the direct price shock on household budgets, (b) the reduction in direct medical expenses because of less widespread tobacco-related illness, and (c) the gains from preventing premature tobacco-related deaths among the working population.

An important assumption of the model is that the health effects of tobacco-related diseases will immediately diminish with the reduction in tobacco consumption. Even though this assumption is implausible in the short term because changes in the effects of tobacco-related diseases take some time to materialize, it provides a medium- and long-term estimate of the effects of tax increases.

The aggregate effect of a tax policy is estimated as indicated in figure 1.

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[4] Exposure to secondhand smoke is associated with a variety of respiratory diseases (HHS 2004). In the United States, the annual costs associated with such exposure are estimated at US$5 billion in direct medical bills and over US$5 billion in indirect medical costs (disability and forgone wages) (Behan, Eriksen, and Lin 2005).

Figure 1. Conceptual Framework of the Extended Cost-Benefit Analysis

| Net Income Effect | = | Change in tobacco expenditure (A) | + | Change in medical expenses (B) | + | Change in years of productive life lost (C) |

In addition to this more comprehensive understanding of the costs and benefits of reducing the medical burden of smoking, the ECBA methodology allows the various behavioral responses to the tax shock to be taken into account. The stylized finding in the literature suggests that households in lower-income countries and lower-income groups may be more responsive to tobacco price changes (see above). Decile-specific elasticities of demand for tobacco allow the heterogeneity in the sensitivity to price changes to be taken into account and the distributional impact of various price shock scenarios to be estimated. For further methodological details, see annex A or refer to Fuchs and Meneses (2017a).

4. Data Sources and Descriptive Statistics

a. Household expenditures and tobacco consumption

Data on household expenditures and tobacco consumption are taken from national household budget surveys. If available, surveys with nationally representative data for 2016 have been used. In case of data limitations, the most recent data sets have been used; a 2014 survey in South Africa is the oldest survey that has been used. See annex A on the specific sources, variable definitions, and data limitations in each country.

Table 1 summarizes the most relevant indicators for each country in the sample. Indonesia, followed by Ukraine and Russia, has the largest share of smokers in the sample. Indonesian households spend the largest share of their budgets on tobacco across all income groups. In terms of distribution, the richest households in Moldova and the middle class in Bangladesh, Indonesia, and Ukraine smoke the most among households that purchase cigarettes. In South Africa, the top decile exhibits the greatest probability of smoking, though these households allocate only a small share of their consumption expenditures to purchase tobacco relative to lower-income households. Poorer households allocate higher shares of their budgets to the purchase of cigarettes. This negative relationship between income level and the share of tobacco in household budgets is monotonic only in Chile and Ukraine. Except for Moldova, the richest 10 percent of the population consistently allocates the smallest share of their consumption expenditures to tobacco.

b. Tobacco price elasticities

Price elasticities of demand by decile follow the methodology from previous country studies published by the World Bank. In each country, several models have been tested on household microdata on tobacco expenditures; in general, a fixed effects model with controls has been preferred. (See annex A for details.)

Table 2 and figure 2 show the estimated average price elasticity of cigarette products for each decile and country. Consistent with previous empirical results, elasticities are higher in the lower-income deciles of the eight countries. Demand responses remain inelastic in all countries, that is, with absolute values of elasticities below 1. Responsiveness diminishes with income level. Only the lowest income group in Bosnia and Herzegovina has an elastic response to changes in the price of cigarettes.

Table 1. Baseline Descriptive Statistics

Country	Decile	1	2	3	4	5	6	7	8	9	10	All
Bangladesh	Population	15,929,225	15,905,656	15,917,423	15,920,079	15,915,789	15,919,919	15,913,543	15,917,825	15,918,451	15,914,336	159,172,245
	Household size	4.7	4.5	4.4	4.3	4.2	4.0	4.0	3.8	3.6	3.4	4.1
	Consumption per capita (US$)*	543	726	849	961	1,081	1,217	1,386	1,615	2,008	3,524	1,391
	Share of tobacco expenditures**	4.5%	4.5%	4.4%	5.0%	4.2%	4.2%	4.4%	4.0%	4.4%	3.4%	4.4%
	Share of smoker households***	18.5%	25.7%	27.3%	28.5%	31.3%	32.1%	29.2%	32.2%	30.9%	27.9%	28.6%
Bosnia and Herzegovina	Population	300,264	298,894	299,681	299,885	299,177	299,639	299,491	299,586	299,486	299,499	2,995,603
	Household size	3.9	3.8	3.6	3.2	3.1	2.9	2.7	2.6	2.4	2.0	2.9
	Consumption per capita (US$)*	2,472	3,769	4,626	5,397	6,262	7,235	8,454	10,030	12,468	20,169	8,087
	Share of tobacco expenditures**	8.1%	8.0%	7.8%	7.9%	7.9%	7.8%	8.3%	7.3%	7.2%	7.0%	7.6%
	Share of smoker households***	20.5%	25.3%	27.4%	30.6%	36.5%	33.2%	34.5%	38.0%	39.1%	44.2%	34.2%
Chile	Population	1,112,614	1,106,809	1,109,320	1,112,715	1,107,394	1,110,438	1,108,304	1,109,456	1,110,799	1,107,617	11,095,466
	Household size	4.0	3.8	3.8	3.6	3.5	3.5	3.2	3.1	2.8	2.4	3.3
	Consumption per capita (US$)*	1,538	2,540	3,320	3,990	4,799	5,698	6,861	8,824	12,149	22,289	7,198
	Share of tobacco expenditures**	4.7%	4.1%	3.9%	3.2%	2.8%	3.2%	2.8%	2.4%	1.9%	1.5%	2.9%
	Share of smoker households***	21.9%	26.6%	29.2%	27.9%	33.2%	33.0%	32.6%	29.8%	27.5%	23.4%	28.4%
Indonesia	Population	25,789,505	25,797,193	25,782,690	25,786,895	25,789,046	25,794,001	25,786,176	25,787,870	25,788,261	25,788,684	257,890,321
	Household size	4.4	4.2	4.1	4.0	3.9	3.8	3.7	3.6	3.4	3.1	3.8
	Consumption per capita (US$)*	650	887	1,062	1,278	1,532	1,803	2,179	2,704	3,537	7,062	2,269
	Share of tobacco expenditures**	11.6%	12.7%	12.8%	13.0%	13.1%	13.2%	12.7%	11.9%	10.9%	8.8%	12.1%
	Share of smoker households***	56.2%	63.5%	65.6%	68.8%	69.3%	69.3%	67.8%	65.6%	62.2%	52.9%	63.9%
Moldova	Population	336,024	336,103	336,748	334,646	336,338	335,660	335,970	336,762	334,191	335,566	3,358,009
	Household size	3.1	2.8	2.7	2.6	2.5	2.4	2.2	2.1	2.0	1.7	2.3
	Consumption per capita (US$)*	1,434	1,916	2,209	2,460	2,710	2,973	3,309	3,764	4,402	6,496	3,166
	Share of tobacco expenditures**	5.4%	5.3%	4.9%	5.1%	4.7%	4.5%	5.9%	4.8%	5.3%	4.9%	5.1%
	Share of smoker households***	12.9%	13.5%	18.3%	15.2%	11.6%	15.8%	17.7%	17.2%	14.7%	17.8%	15.7%
Russian Federation	Population	14,684,116	14,700,576	14,577,382	14,671,621	14,616,341	14,694,883	14,642,140	14,640,598	14,650,698	14,621,629	146,499,985
	Household size	4.0	4.0	4.1	3.5	3.6	3.4	3.5	3.3	3.0	2.8	3.5
	Consumption per capita (US$)*	2,124	3,506	4,436	5,384	6,415	7,682	9,260	11,217	14,925	32,099	9,698
	Share of tobacco expenditures**	1.7%	1.2%	0.9%	1.0%	0.8%	0.8%	0.8%	0.6%	0.7%	0.5%	0.9%
	Share of smoker households***	30.4%	38.8%	35.0%	40.8%	38.6%	46.5%	43.3%	43.0%	42.9%	40.7%	40.3%
South Africa	Population	5,791,693	5,791,742	5,797,492	5,785,215	5,790,442	5,791,336	5,793,315	5,791,618	5,790,950	5,789,259	57,913,059
	Household size	5.9	5.2	4.7	4.3	3.8	3.4	3.0	2.7	2.6	2.4	3.5
	Consumption per capita (US$)*	365	641	886	1,140	1,456	1,904	2,544	3,692	6,248	16,689	3,556
	Share of tobacco expenditures**	4.5%	4.1%	4.2%	3.8%	4.6%	4.5%	5.1%	4.4%	3.3%	1.8%	3.8%
	Share of smoker households***	5.9%	7.7%	8.8%	11.8%	13.4%	14.7%	14.5%	16.4%	16.0%	17.1%	13.6%
Ukraine	Population	3,889,447	3,879,872	3,884,554	3,885,933	3,896,620	3,890,316	3,882,851	3,885,145	3,871,535	3,875,590	38,841,863
	Household size	3.5	3.2	3.1	2.8	2.8	2.6	2.5	2.4	2.2	1.8	2.6
	Consumption per capita (US$)*	1,934	2,583	3,022	3,436	3,816	4,227	4,720	5,350	6,252	9,534	4,485
	Share of tobacco expenditures**	7.4%	5.5%	5.0%	5.2%	5.5%	4.9%	4.1%	3.8%	4.2%	3.8%	4.8%
	Share of smoker households***	34.5%	32.5%	38.9%	31.6%	41.7%	41.6%	40.5%	35.3%	41.3%	34.0%	37.3%

Source: Based on national household budget surveys of most recent date (generally 2016).

Note: Deciles are based on household per capita consumption. * Average household per capita consumption in 2016 PPP U.S. dollars; excludes identifiable rents and lumpy expenses. ** Average share of tobacco in household consumption, conditional on the household reporting positive tobacco expenditures. *** Share of households reporting positive expenditures on tobacco.

Table 2. Price Elasticity of Tobacco Consumption, Medium-Bound Estimate, by Decile

Country	Decile									
	1	2	3	4	5	6	7	8	9	10
Bangladesh	-0.71	-0.52	-0.50	-0.42	-0.32	-0.30	-0.29	-0.22	-0.19	-0.17
Bosnia and Herzegovina	-1.08	-0.87	-0.69	-0.70	-0.60	-0.58	-0.53	-0.46	-0.46	-0.34
Chile	-0.64	-0.58	-0.52	-0.47	-0.41	-0.35	-0.29	-0.24	-0.18	-0.12
Indonesia	-0.64	-0.59	-0.55	-0.53	-0.52	-0.50	-0.49	-0.48	-0.47	-0.46
Moldova	-0.51	-0.39	-0.40	-0.34	-0.32	-0.32	-0.32	-0.25	-0.24	-0.26
Russian Federation	-0.68	-0.61	-0.58	-0.54	-0.52	-0.51	-0.49	-0.46	-0.45	-0.41
South Africa	-0.36	-0.26	-0.24	-0.31	-0.34	-0.17	-0.24	-0.21	-0.13	-0.22
Ukraine	-0.59	-0.51	-0.52	-0.46	-0.44	-0.43	-0.42	-0.41	-0.36	-0.33

Source: Estimates based on national socioeconomic surveys.
Note: In most cases, a multiple time cross-section model with time fixed effects is used. Demographic controls include the age, education, and gender of the household head, the share of individuals by age-group in each household, and urban status. Deciles have been created using per capita household expenditure.

Figure 2. Price Elasticity of Tobacco Consumption, Medium-Bound Estimate, by Decile
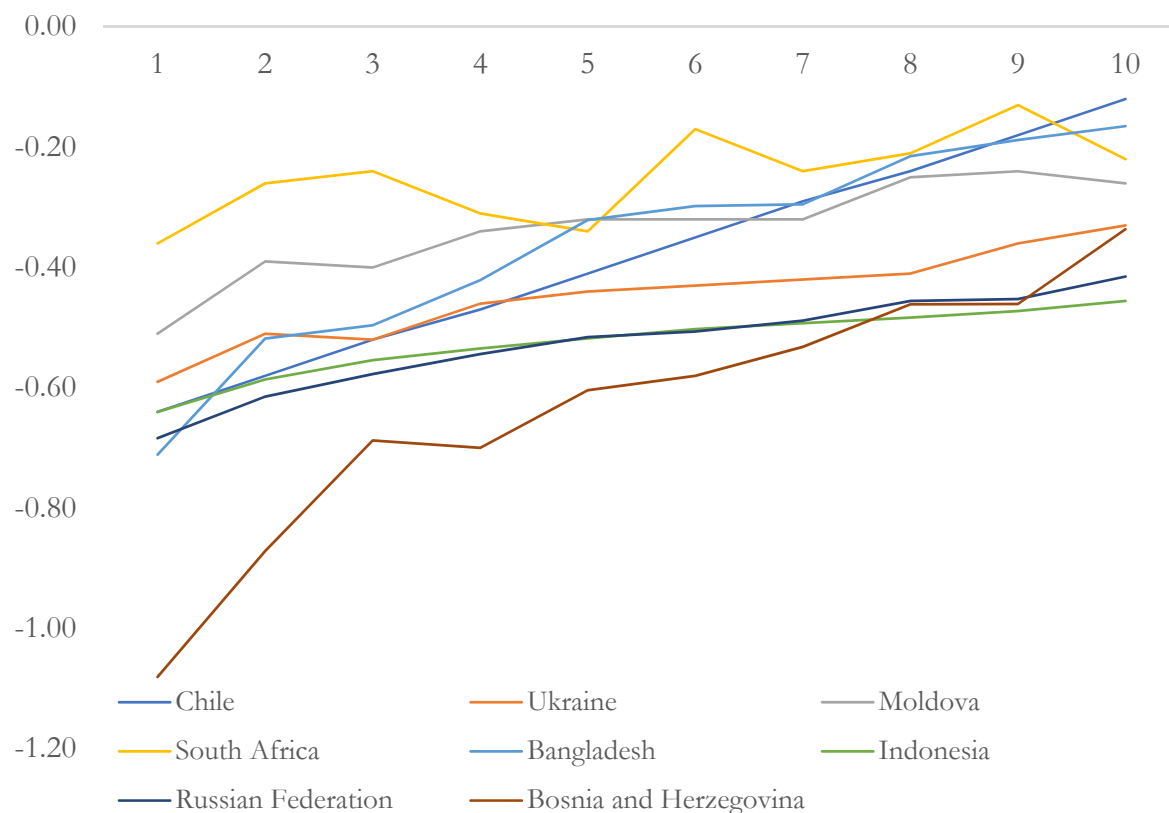
Source: Estimates based on national socioeconomic surveys.
Note: In most cases, a multiple time cross-section model with time fixed effects is used. Deciles have been created using per capita household expenditure.

c. Mortality and morbidity

Data on mortality, years of life lost, and morbidity have been derived from the Global Burden of Disease (GBD) Project as of 2016. For each country, the years of life lost have been calculated as the total number of years lost because of premature deaths attributable to smoking among the working-age population of women and men below age 65 (table 3).

Table 3. Years of Life Lost, 2016

Country	Smoking-related years of productive life lost		
	Males	Females	Total
Bangladesh	346,044	5,340	351,514
Bosnia and Herzegovina	15,656	5,805	21,591
Chile	21,925	12,148	34,203
Indonesia	1,124,484	83,549	1,208,163
Moldova	29,075	2,661	31,866
Russian Federation	1,260,265	196,823	1,457,218
South Africa	66,823	33,915	100,863
Ukraine	517,300	64,192	581,622

Source: GBD Results Tool (database), Global Burden of Disease Study 2016, Global Health Data Exchange, Institute for Health Metrics and Evaluation, Seattle, http://ghdx.healthdata.org/gbd-results-tool.
Note: Smoking-related years of productive life lost are calculated based on Global Burden of Disease Study data by age-group among men and women below the minimum value of age 65 or life expectancy at birth..

d. Tobacco-related medical costs

To maintain methodological consistency across countries, direct medical expenditures have been adapted from the calculations of Goodchild, Nargis, and Tursan d'Espaignet (2018). As part of their broader calculation of the global economic costs of smoking, these authors use the cost of illness approach to estimate the direct medical costs of smoking-attributable diseases in 2012. They apply their method to 152 countries, representing 97 percent of the world's smokers.

Table 4 presents these estimates in national current units and PPP adjustments for the eight countries in this study. It is assumed that the values calculated by Goodchild, Nargis, and Tursan d'Espaignet (2018) hold for 2016 in real terms. This assumption results in a conservative scenario for most countries in the sample, given the middle-income status of these countries.

Table 4. Smoking-Attributable Direct Medical Expenditures, 2016

Country	National aggregate		Per adult (+15 yr)		Per smoker (+15 yr)	
	NCU (Million)	PPP (Million)	NCU	PPP	NCU	PPP
Bangladesh	28,105	881	243	8	1,055	33
Bosnia and Herzegovina	188	236	62	78	160	201
Chile	271,209	596	19,061	42	50,427	111
Indonesia	18,794,853	3,769	99,491	20	252,515	51
Moldova	896	131	299	44	1,237	181
Russian Federation	403,028	16,202	3,376	136	8,590	345
South Africa	20,207	3,218	509	81	2,509	400
Ukraine	16,296	2,757	427	72	1,478	250

Sources: Adapted from Goodchild, Nargis, and Tursan d'Espaignet 2018 and Fuchs and Matytsin 2018. Population, smoking rates, consumer price index and PPP conversion factors are taken from WDI (World Development Indicators) (database), World Bank, Washington, DC, http://data.worldbank.org/products/wdi.
Note: PPP = purchasing power parity exchange rate. NCU = national currency units. The consumer price index is used to account for national price changes, 2012–16.

5. Results

To analyze the distributional effects of an increase in tobacco taxes, each component of the model is estimated separately under three different price shock scenarios—price rises of 25 percent, 50 percent, and 100 percent—and elasticity assumptions. The results, based on a medium-bound elasticity scenario, are discussed in the sections below. The lower- and upper-bound scenarios are simulated as 0.2 below and above the base (medium-bound) scenario; the results under these assumptions are available upon request.
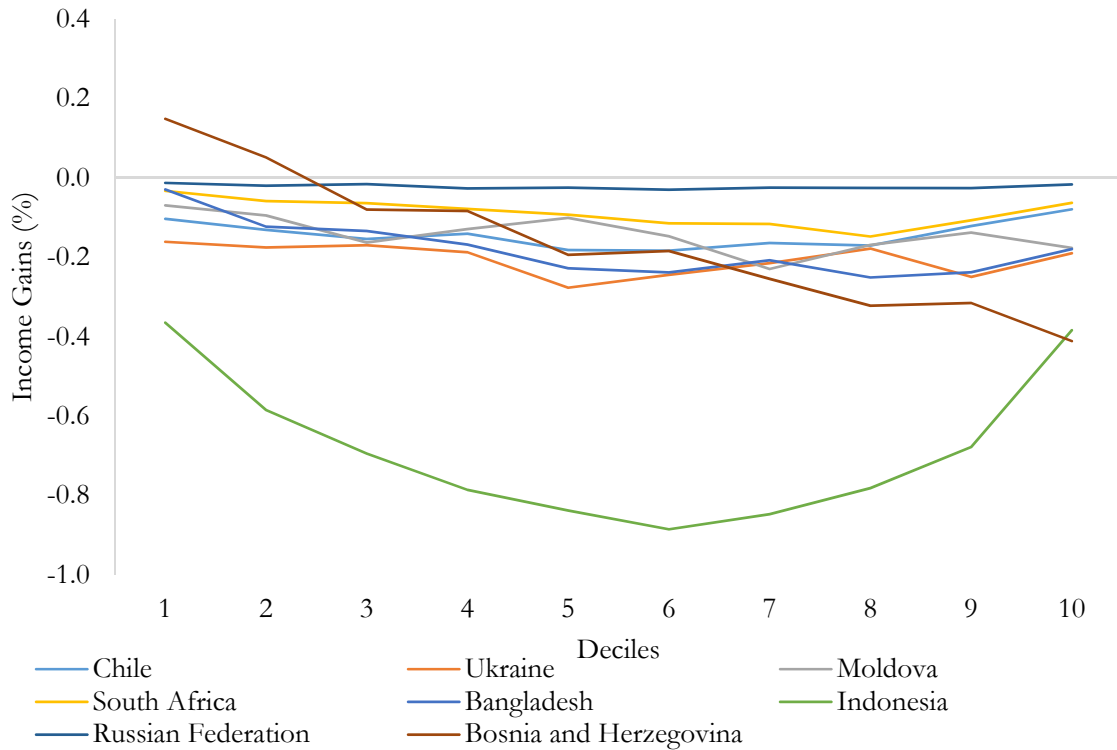
a. Tobacco price increase

Figure 3 shows the effects of the different price shocks on cigarettes for each country and income group in the sample. As prices rise, consumers must allocate greater shares of their budgets to continue to purchase the same quantity of tobacco. Allocating larger shares of their consumption expenditures to tobacco would be particularly difficult among lower-income households. Hence, the direct price effect constitutes a welfare loss, and it is often expected to be regressive. The results in the eight countries analyzed, however, show that substantial responsiveness to price changes mediates a complete pass-through scenario.
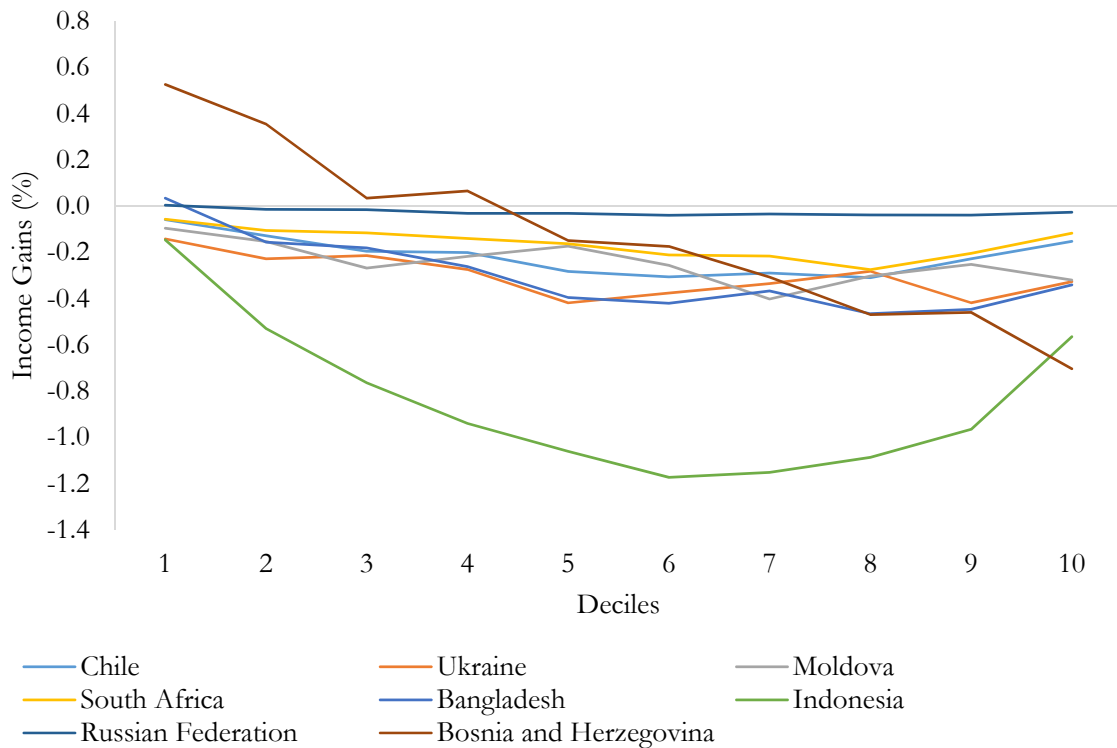
While the effect is an income loss under most scenarios and for most households, the distribution is not necessarily regressive. In the case of large price shocks (100 percent), some lower-income groups effectively stop consuming cigarettes and free up resources for other consumption needs. In some case, such as Indonesia, mainly the middle class is affected by the direct price effect.

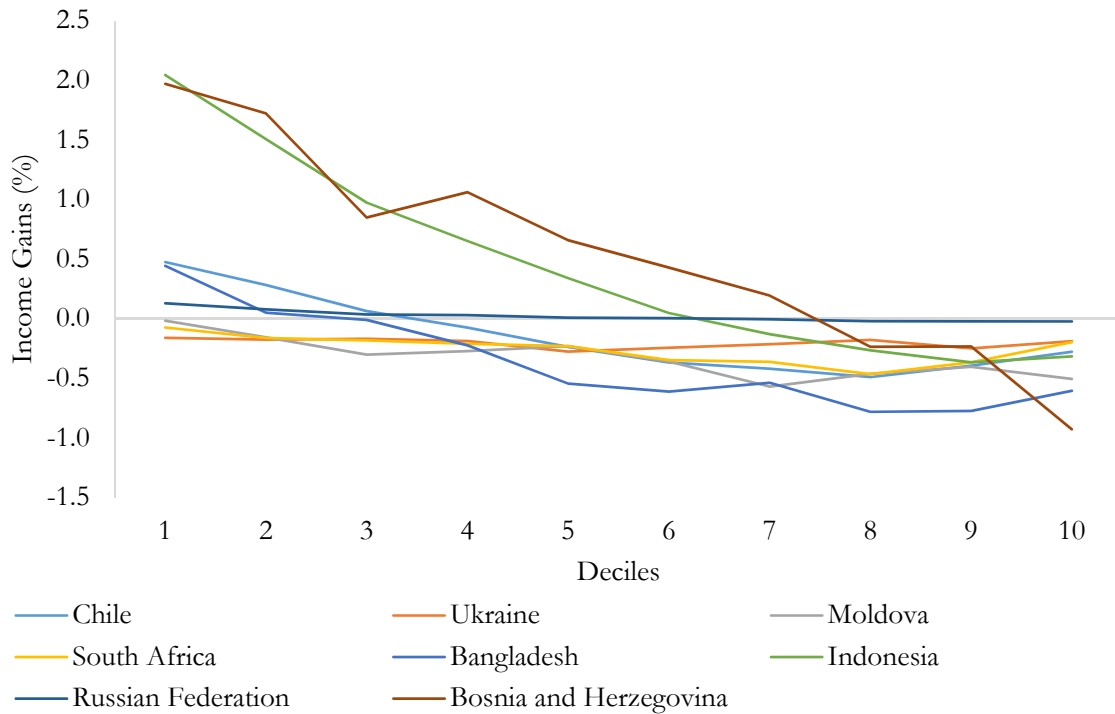# Figure 3. Direct Expenditure Effect of Higher Tobacco Prices

a.   25% price increase, medium-bound elasticity

Chile | Ukraine | Moldova
South Africa | Bangladesh | Indonesia
Russian Federation | Bosnia and Herzegovina

b.   50% price increase, medium-bound elasticity

Chile | Ukraine | Moldova
South Africa | Bangladesh | Indonesia
Russian Federation | Bosnia and Herzegovina

Source: Based on national household budget surveys.
Note: Deciles are calculated based on household per capita consumption, excluding identifiable rent and lumpy expenditures.

b. Medical expenditures

Figure 4 reports the income effect of a reduction in medical expenditures by the magnitude of the price shock. Income changes derived from the reduction in medical expenditures are naturally positive for all deciles and countries, regardless of the price shock. All countries and scenarios show clear progressive patterns because medical expenditures to treat smoking-related diseases more than proportionally burden the poor, and these expenditures tend to be reduced in association with higher tobacco prices.

In line with previous findings on these countries (Fuchs and Del Carmen 2018; Fuchs and Meneses 2017a, 2017b, 2018), reducing medical expenditures disproportionally benefits lower-income households, and this channel seems the most relevant to improving welfare and equity through tobacco price interventions.

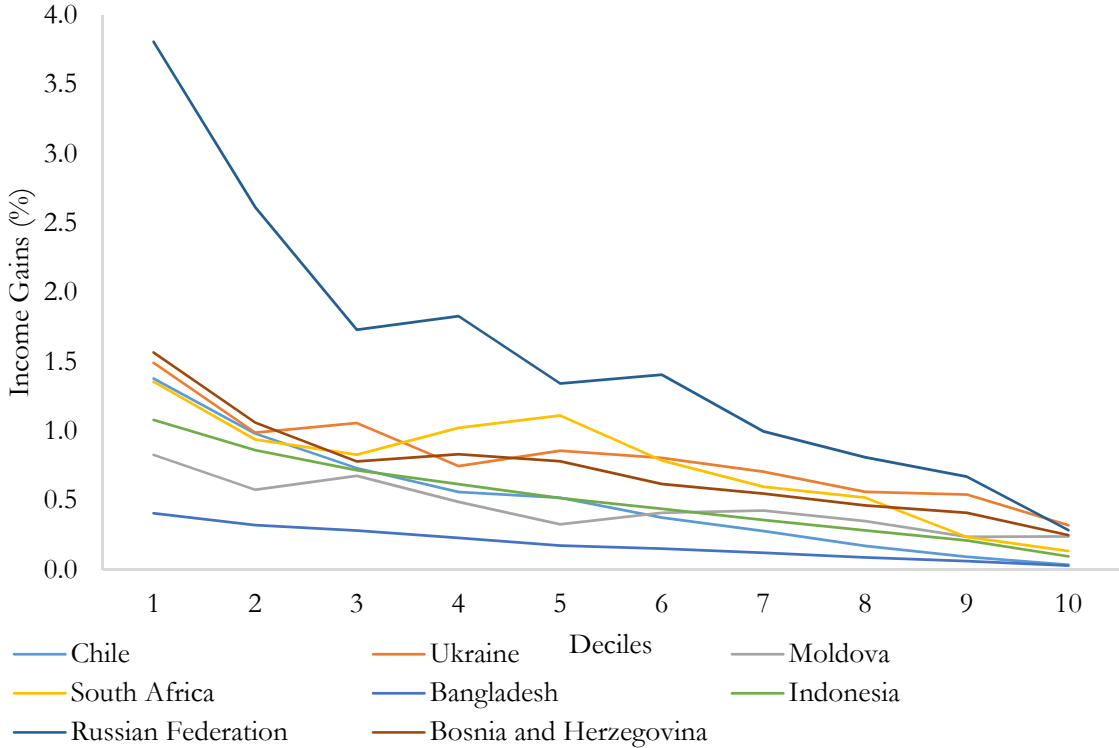Figure 4. The Effect of Changes in Medical Expenditures

a. 25% price increase, medium-bound elasticity
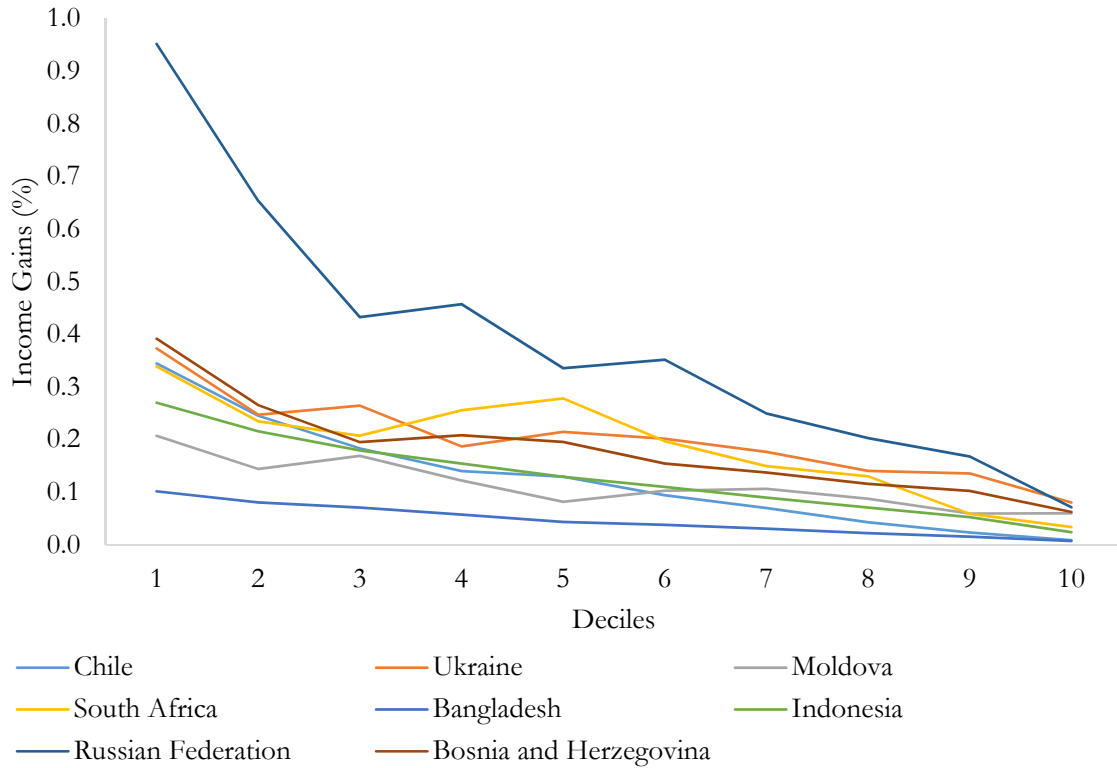
b. 50% price increase, medium-bound elasticity
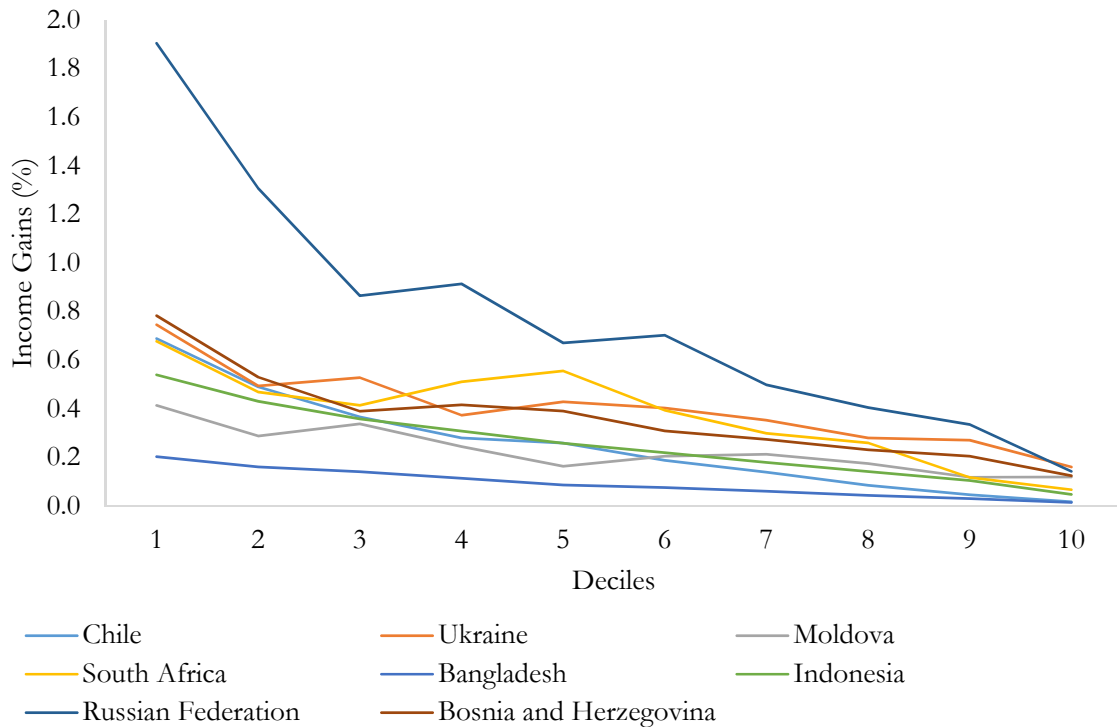
c. 100% price increase, medium-bound elasticity

Source: Based on national household budget surveys and estimates of Goodchild, Nargis, and Tursan d'Espaignet 2018.
Note: Deciles are calculated based on household per capita consumption, excluding rent and lumpy expenditures.

c. Income gains deriving from an increase in years of working life

The cost of working life lost because of tobacco consumption has been estimated in the analysis based in the assumption that the impact of lower tobacco use on health and work-generated income is direct. The deaths attributed to tobacco consumption are distributed using the profile of the occurrence of mortality. For each death, the years of working life lost are divided across deciles proportionately to the number of households that consume tobacco in each income group.

The results, illustrated in figure 5, confirm that rising tobacco prices are linked with positive welfare gains associated with reductions in mortality among workers in all deciles and countries. However, the effects are modest, and no clear distributional pattern emerges. Ukraine, where 16 percent of all premature death events can be attributed to smoking, exhibits the largest effects in magnitude. While poor households—characterized by greater responsiveness to price changes—may benefit the most in the number of averted deaths because of changes in consumption, lower expected earnings among these households and the distribution of smoking prevalence across the population seem to prevent a progressive effect (in terms of income) through this mechanism.

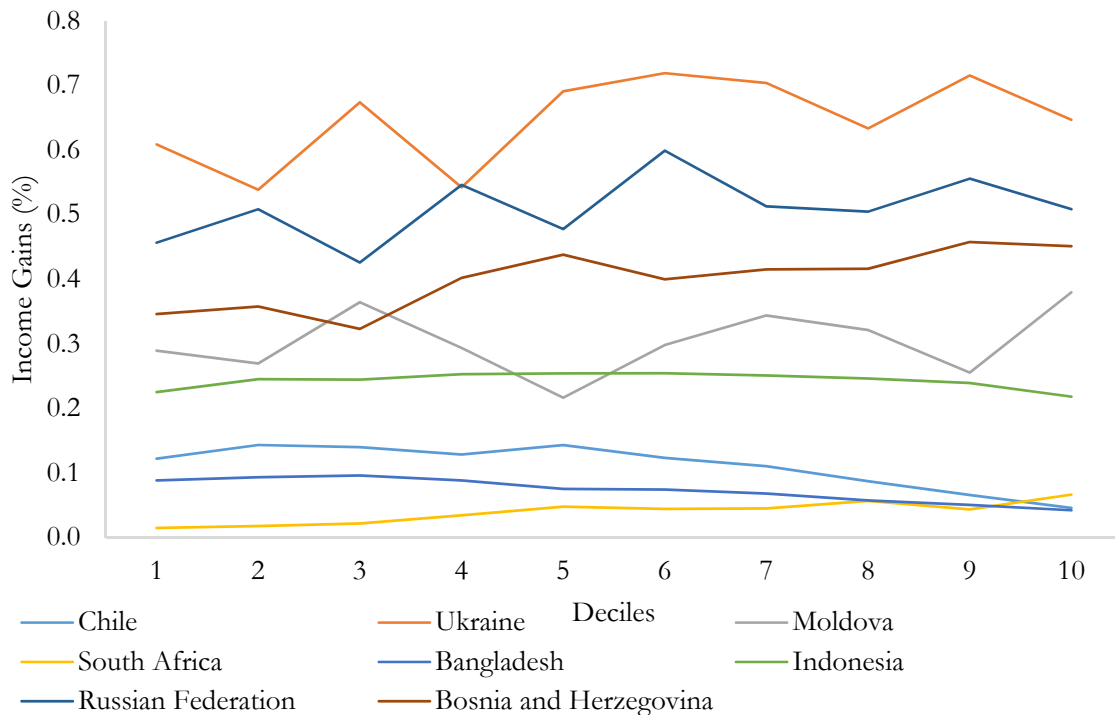## Figure 5. The Effect of Changes in the Years of Working Life Lost

a. 25% price increase, medium-bound elasticity
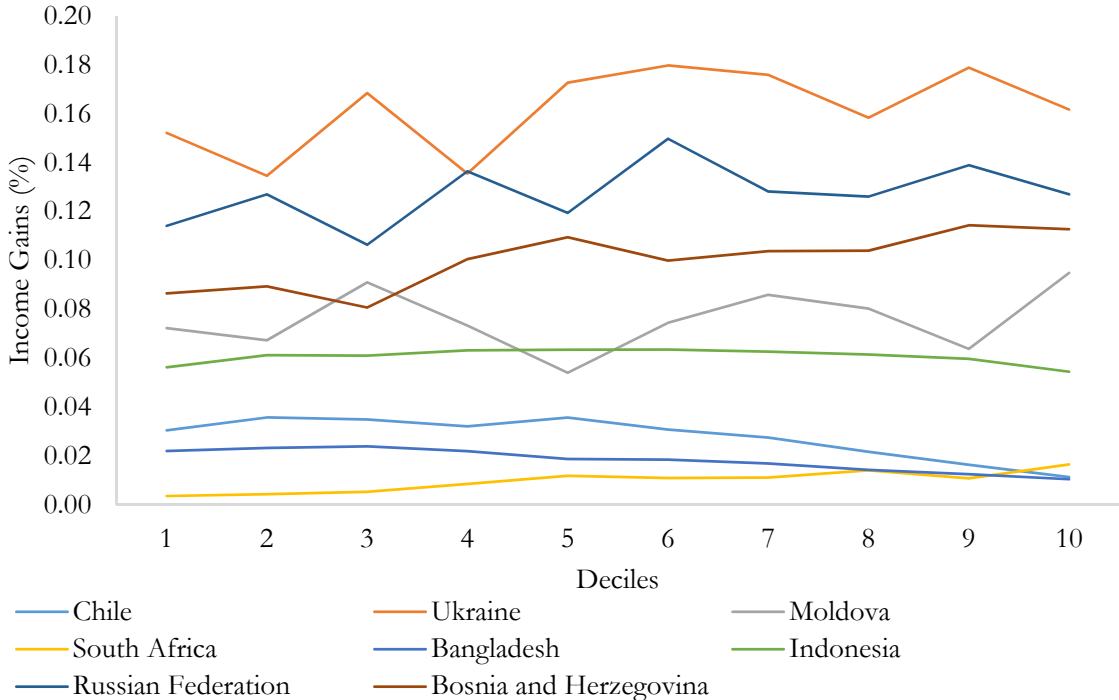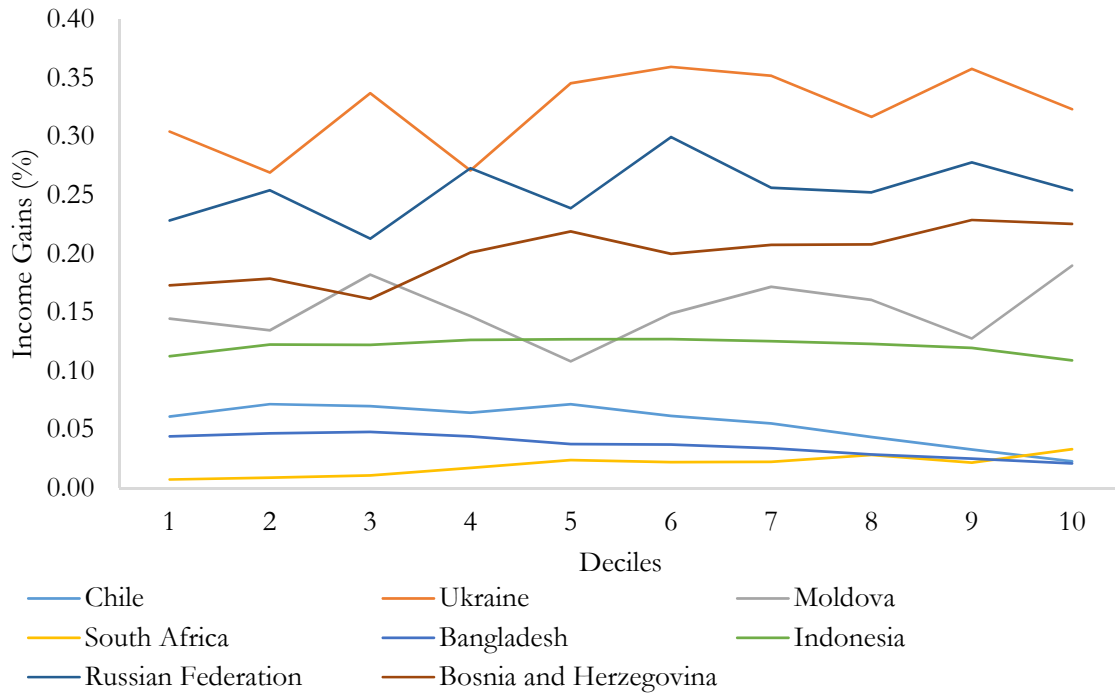
b. 50% price increase, medium-bound elasticity

c. 100% price increase, medium-bound elasticity

Source: Based on national household budget surveys; GBD Results Tool (database), Global Burden of Disease Study 2016, Global Health Data Exchange, Institute for Health Metrics and Evaluation, Seattle, http://ghdx.healthdata.org/gbd-results-tool.

Note: Deciles are calculated based on household per capita consumption, excluding identifiable rent and lumpy expenditures. Years of life lost are calculated are based on death events related to the risk of smoking tobacco.
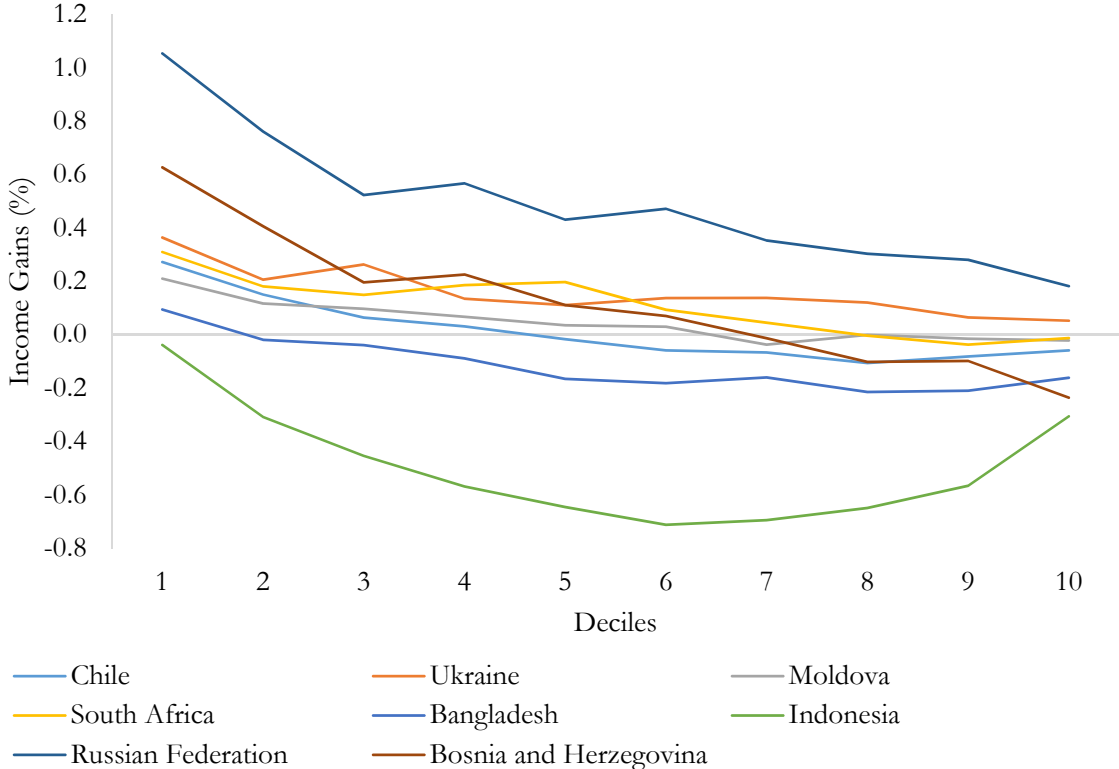
d. Net effects: Total distributional impact

In the analysis, the effects of tobacco tax policy on prices, medical expenditures, and gains in working years are first separately calculated and the components of the model on each country are then added to facilitate an estimate of the net distributional effect of raising taxes on tobacco.

Lower medical expenditures and additional working years help offset the negative direct income effect of an increase in tobacco prices. The total income effect associated with a 25 percent price shock (panel a, figure 6) is positive in the case of several income groups, especially at the lower end of the income distribution. However, most households in Bangladesh and Indonesia, and between 30 and 50 percent of the population in Bosnia and Herzegovina, Chile, and South Africa, continue to be negatively affected. In the particular case of Indonesia, the distribution continues to be U-shaped.

The net effect becomes positive and more progressive with higher price shocks, as the lack of affordability allows the health and economic benefits of the taxes on tobacco to kick in. In a 100 percent price shock scenario, only the 40 percent richest households in Chile, and the top 60 percent in Bangladesh—where medical expenses have lowest incidence—are negatively affected. The results are generally progressive in all eight countries.

Figure 6. Net Income Effects: Direct and Indirect Effects of Rising Tobacco Prices

a. 25% price increase, medium-bound elasticity

b. 50% price increase, medium-bound elasticity

Y-axis: Income Gains (%), range -1.0 to 2.5
X-axis: Deciles, 1 to 10

Legend:
- Chile
- Ukraine
- Moldova
- South Africa
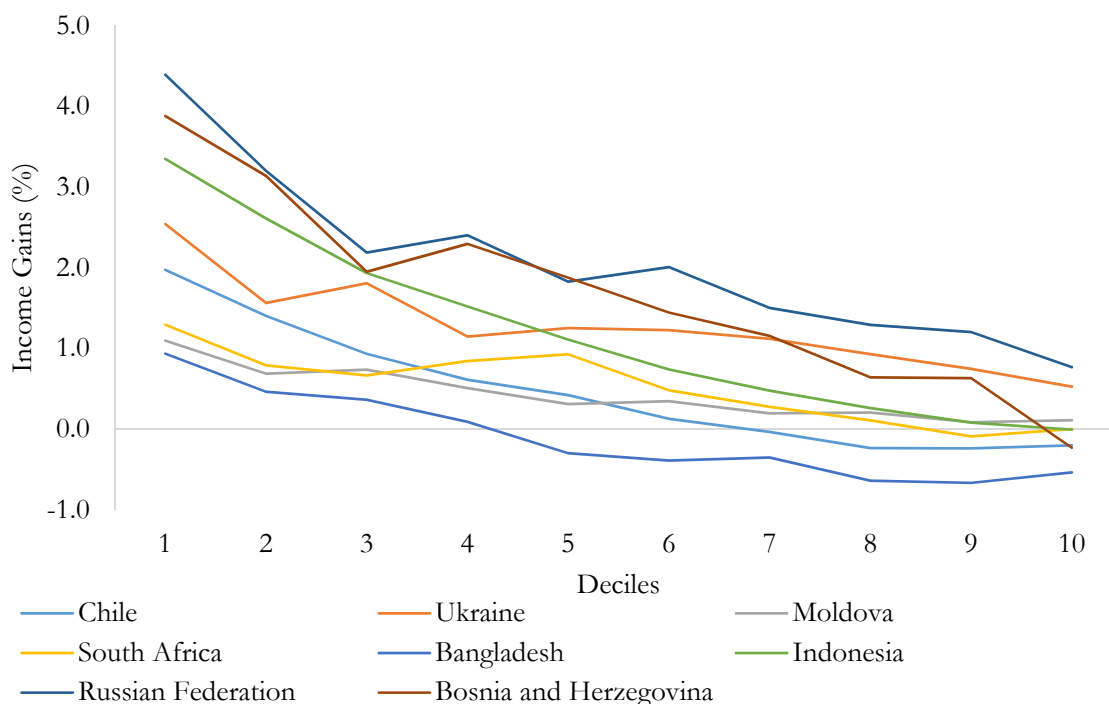- Bangladesh
- Indonesia
- Russian Federation
- Bosnia and Herzegovina

c. 100% price increase, medium-bound elasticity

Y-axis: Income Gains (%), range -1.0 to 5.0
X-axis: Deciles, 1 to 10

Legend:
- Chile
- Ukraine
- Moldova
- South Africa
- Bangladesh
- Indonesia
- Russian Federation
- Bosnia and Herzegovina
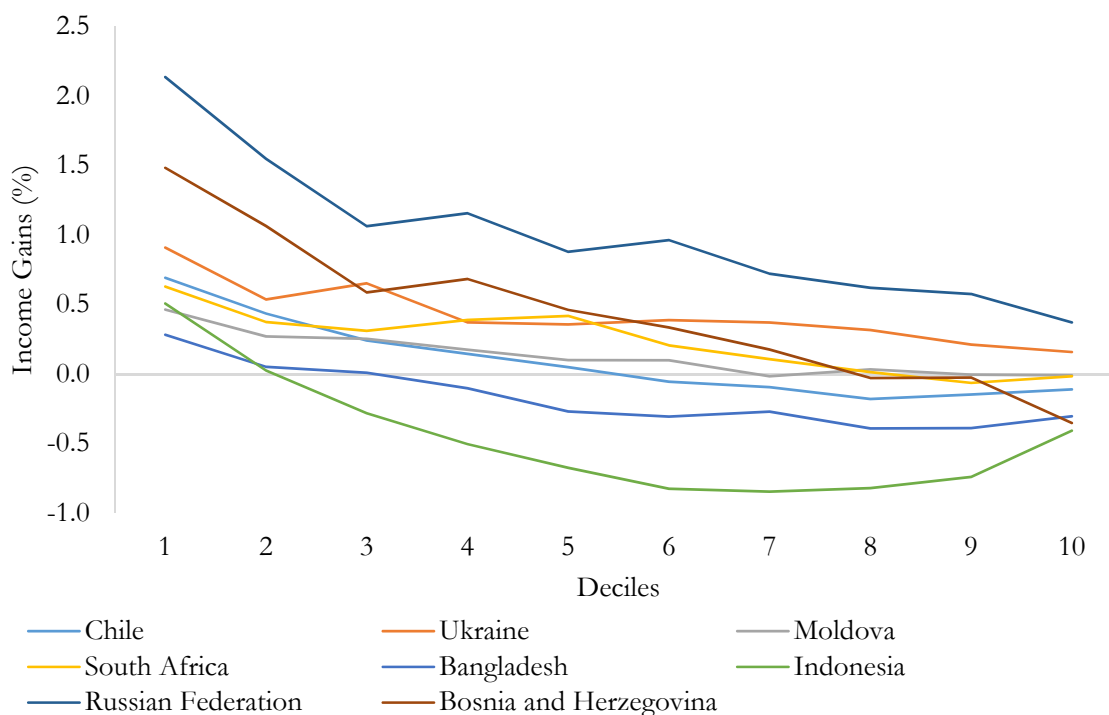
Source: Based on national household budget surveys; Goodchild, Nargis, and Tursan d'Espaignet 2018; GBD Results Tool (database), Global Burden of Disease Study 2016, Global Health Data Exchange, Institute for Health Metrics and Evaluation, Seattle, http://ghdx.healthdata.org/gbd-results-tool.
Note: Deciles calculated from household per capita consumption (excluding identifiable rent and lumpy expenses). Years of life lost calculated form death events related to the risk of smoking tobacco.

6. Discussion

Despite the wealth of research on the negative effects of tobacco consumption and on the benefits of various public policy mechanisms aimed at reducing tobacco use, questions remain about the progressivity or regressivity that these entail. To assess the net welfare gains generated by such a policy, one must look beyond the direct impact on household incomes and consider other benefits of lower tobacco consumption, including the reduction in medical costs and the increase in the potential working years associated with good health.

Applying this comprehensive approach to a sample of eight middle-income countries, the analysis shows that indirect benefits can offset the direct income losses caused by the taxes on tobacco. Considered by itself, a price increase in tobacco through higher taxes generates negative welfare shocks. However, behavioral responses in the form of price elasticities mediate these results and can encourage higher quitting rates among poorer households. As individuals cut down tobacco consumption, reductions in medical expenditures and gains in potential working years also work to offset direct negative income shocks. In the case of large price shocks, the aggregate benefits of tobacco taxes far exceed the greater tax liabilities and produce progressive effects. These results are in line with findings in the literature, highlighting that the critical benefits of reducing tobacco use may emerge through diverse policy mechanisms. In the long term, the benefits of nonsmoking outweigh the losses attributed to tobacco taxes across a population and, specifically, among lower-income groups.

The eight countries under study—Bangladesh, Bosnia and Herzegovina, Chile, Indonesia, Moldova, Russia, South Africa, and Ukraine—account for 700 million people, close to a 10th of the global population. They range from lower-middle-income countries (Bangladesh, which has the lowest GDP per capita in the sample) to upper-middle-income countries (Russia and Chile, which lead in GDP per capita). They also represent 15 percent of the smoking prevalence in the world.[5] Almost three adult men in five ages above 15 living in these countries report that they smoke. One woman in 10 in these countries smokes. On average, health expenditures account for 6.7 percent of GDP in these countries, which collect only 17 percent of GDP as tax revenue.[6]

A back-of-the-envelope estimation under the medium-bound elasticity scenario suggests that raising the price of cigarettes by 50 percent would allow around 350 million people (50 percent of the population in these eight countries) to capture positive household income gains on top of other potential social benefits from the greater public revenue. In some countries, the entire population could potentially see modest positive income effects. Higher elasticities in the longer term and more decisive price shocks would boost the number of beneficiaries. However, some heterogeneity in the results under the lower price shocks and the lower-bound elasticity scenarios and in some countries (especially Indonesia and South Africa) call for caution and careful analysis in implementing policy interventions.

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[5] 2016 data of WDI (World Development Indicators) (database), World Bank, Washington, DC, http://data.worldbank.org/products/wdi.
[6] 2016 data of WDI (World Development Indicators) (database), World Bank, Washington, DC, http://data.worldbank.org/products/wdi.

This report examines a partial equilibrium analysis. Tobacco taxes could unleash economy-wide reactions with potentially large impacts that are difficult to predict. For example, reductions in employment and production in the tobacco industry have been a concern in some local contexts following cigarette tax reforms (Marquez and Moreno-Dodson 2017). More accurate data and additional research should address these indirect effects and general equilibrium interactions.

Taxes on tobacco can be progressive and welfare enhancing. However, the variables affecting tobacco consumption behavior across population groups must be understood clearly for the sake of proper policy. Ultimately, the effectiveness and distributional impacts of tobacco taxes depend on the initial distribution and characteristics of smokers and on the ability of the taxes to induce behavioral changes through price changes. Depending on these circumstances, higher taxes on tobacco may be justified and even required to achieve progressive, welfare-enhancing policy outcomes. The need to induce changes in tobacco consumption that ultimately translate into net social gains calls for comprehensive policy strategies that address country-specific consumer responses, especially among youth and at-risk groups. To the extent that consumers become more sensitive to price changes and vulnerable groups can be targeted, there is reason for optimism about the long-term economic and health benefits of tobacco taxes.

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Annex A

A. Model

This section describes the partial equilibrium approach used to simulate the impact on consumption of an increase in the price of cigarettes. This approach is used to evaluate the first-order effects of a change in prices. It relies mainly on household expenditure patterns. The focus is on the impact of a rise in the price of cigarettes, a common target of tobacco tax reform.

To assess the distributional impact of an increase in the price of cigarettes, the simulation allows for differences in the responses across consumption deciles to reflect the fact that poor households likely have different price elasticities relative to households with more resources. The different elasticities, combined with the initial consumption patterns across deciles, explain whether a price reform will be more regressive, more neutral, or more progressive.

The loss of real consumption arising from the price increases in a product i is obtained as follows:

$$\left(\omega_{ij,0} + \Delta\omega_{ij}\right) * \frac{\Delta p}{p_0}, \tag{A.1}$$

where ω_{ij} is the share of product i in total household expenditure for a household in decile j; Δp_i is the price increase; and $\Delta\omega_{ij}$ is the change in consumption of the good that depends on price elasticity.[7]

Change in tobacco expenditures

To estimate the variation in cigarette consumption after the price increase, the model considers the change in prices (Δp), the tobacco price elasticity (ε_j) for decile j, and the share of cigarette expenditure in period 0 ($\omega_{ij,0}$). The change in the expenditure of household i in decile j is presented as a share of total expenditure and averaged by decile to quantify the overall impact, as follows:

$$\Delta\text{ Expenditure}_{i,j} = ((1 + \Delta p)(1 + \varepsilon_j * \Delta p) - 1) * \frac{\omega_{ij0}}{\text{Total expenditure}_{ij0}} \tag{A.2}$$

Medical expenditures

The change in medical expenditures associated with tobacco-related diseases is estimated using equation A.3, for which the cost of treatment of tobacco-related diseases for income decile i is obtained from administrative data. The cost of tobacco-related medical expenditures is distributed across income decile i according to the share of households that consume tobacco in decile i. Equation A.3 shows the income gains associated with the reduction in medical expenditures because of reduced tobacco consumption over the long term.

$$\Delta\text{ Medical expenditure}_{i,j} = ((1 + \varepsilon_j * \Delta P) - 1) * \frac{\text{Cost Treat.Tobacco−Related Diseases}_i}{\text{Total expenditure}_{j0}} \tag{A.3}$$

A reduction in tobacco consumption in the long run would be strongly related to a reduction in tobacco-related diseases. The model assumes that the health effects of tobacco-related diseases will immediately

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[7] For a detailed discussion of the methodology, see Coady et al. (2006); Kpodar (2006).

diminish with the reduction in tobacco consumption. Even though this assumption is implausible in the short term because changes in the effects of tobacco-related diseases take time to materialize, it provides an upper-bound estimate of the effects of tax increases.

The increase in working life years

The model estimates the impact on income arising from the increase in working years (equation A.4). To estimate the increase in working years, the years of life lost, YLL, from tobacco-related diseases are distributed across deciles i proportionally to the number of households that consume tobacco (equation A.5). Subsequently, the income lost is estimated as the average income per household in decile i. Overall, the model anticipates that income will increase as the number of years lost because of premature deaths from tobacco consumption declines.

$$\Delta \text{ Income}_i = ((1 + \varepsilon_j * \Delta P)\text{-}1) * \frac{\text{Working Years}_i * \text{Total Expenditure}_i}{\text{Total expenditure}_i} \qquad (A.4)$$

$$Working\ Years_i = (YLL_i * Share\ of\ Smokers_i)/Population_i \qquad (A.5)$$

The total income gains in each income group are estimated by adding the results of the increase in tobacco expenditures, the reduction in medical expenditures, and the gain in working years.

B. Tobacco Price Elasticity, by Decile

Let Q_{id} be defined as the average quantity of cigarettes smoked per day by individual i in income decile d; P the average price per cigarette (unit value of tobacco use); D_i the consumption decile of individual i; and X_{id} the individual characteristics. Then, the smoking intensity equation is written as follows:

$$\ln Q_{id} = \beta_0 + \beta_1 lnP * D_i + \beta_3 X_{id} + \mu_{id} \qquad (A.6)$$

The empirical analysis of equation (A.6) assumes a log-log relationship among smoking intensity, price, and income. lnQ_{id} is observed if and only if the individual in a given decile d is a current smoker.

Several models have been tested to determine the best fit for each country.

C. Data Sources by Country

Elasticity Estimates

Country	Author	Data source	Years
Bangladesh	Fuchs, Del Carmen and Genoni (2018)	Household Income and Expenditure Survey (HIES)	2016/2017
Bosnia and Herzegovina	Fuchs, Orlic and Cancho (2019)	Household Budget Survey	2007, 2011 and 2015
Chile	Debrott Sanchez (2006) and Vergue et al. (2015), adapted by Fuchs and Meneses (2017)		
Indonesia	Fuchs and Del Carmen (2018)	Indonesia National Socioeconomic Survey	2015-2016
Moldova	Fuchs and Meneses (2018)	Household Budget Survey	2012-2015
Russian Federation	Fuchs and Matytsin (2018)	Russia Longitudinal Monitoring Survey–Higher School of Economics (RLMS-HSE)	2010-2016
South Africa	Fuchs et al. (2018)	National Income Dynamics Study, harmonized by World Bank staff	2008-2015
Ukraine	Fuchs and Meneses (2017)	Household Budget Survey	2010-2013

Household Expenditure Data for Price Increase Simulations

Country	Data Source	Year
Bangladesh	Household Income and Expenditure Survey	2016
Bosnia and Herzegovina	Household Budget Survey	2015
Chile	Family Budget Survey VIII	2016–17
Indonesia	National Socioeconomic Survey	2016
Moldova	Household Budget Survey	2016
Ukraine	Household Living Conditions Survey	2016
Russian Federation	Russia Longitudinal Monitoring Survey–Higher School of Economics	2016
South Africa	Household Living Conditions Survey	2014-2015

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