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DISTRIBUTIONAL EFFECTS OF TOBACCO TAXATION ON POVERTY AND INEQUALITY IN SERBIA

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DISTRIBUTIONAL EFFECTS OF TOBACCO TAXATION ON POVERTY AND INEQUALITY IN SERBIA

Abstract

Background

Because smoking, tobacco spending, and price responsiveness are socially patterned, tobacco taxation is relevant not only as a fiscal and public health instrument, but also as a health equity issue. Previous studies for Serbia suggest that higher tobacco taxes are progressive and may benefit lower-income households. However, the effects of tobacco taxation on poverty and inequality in Serbia have not been assessed using formal poverty and inequality measures within an explicit analytical framework.

Methods

The analysis combines two sets of simulations based on household-level data for Serbia. First, we estimate the effects of higher tobacco taxation on poverty using the Foster-Greer-Thorbecke poverty measures (headcount ratio, poverty gap, and poverty severity) and the consumption dominance approach. Second, we assess the distributional effects of higher tobacco taxation on inequality using concentration curves and the Kakwani index. Microsimulations of changes in cigarette consumption are based on income-group-specific price elasticities estimated in previous studies.

Results

We examine two scenarios relative to the 2021 baseline: a 25% increase in the specific tobacco excise and a 50% increase in the specific tobacco excise. The simulations suggest that higher tobacco taxation

produces modest increases in poverty in absolute percentage-point terms, with the headcount ratio rising by up to 1 percentage point in the higher-tax scenario, while proportional increases are more pronounced for the poverty gap and poverty severity measures. This effect can be reduced under a revenue-neutral reform, although the specific simulation based on subsidizing out-of-pocket health expenditure does not fully offset the poverty effect. The inequality analysis indicates that the tax increase makes cigarette expenditure less regressive relative to income.

Conclusion

In Serbia, higher tobacco taxation is associated with a less regressive post-reform distribution of cigarette expenditure relative to income among smoking households, but it may also worsen poverty if additional revenues are not used in ways that protect lower-income households. These findings suggest that tobacco taxation should be assessed not only as a fiscal and tobacco-control instrument, but also as a health equity issue, because its distributive consequences depend partly on how the resulting revenues are used.

Keywords

health equity, poverty, inequality, tobacco taxation, excise tax, Serbia

Introduction

Tobacco taxation is widely recognized as the most effective single control measure for reducing tobacco demand. Higher excise taxes increase retail prices, reduce the affordability of tobacco products, and thereby lower tobacco consumption. Over time, this contributes to better public health

outcomes through reductions in smoking-related morbidity and mortality [1]. At the same time, tobacco tax increases usually generate additional government revenue. However, despite this well-established public health and fiscal rationale, tobacco tax reforms continue to face political resistance, and one of the most persistent arguments against them concerns their potential effects on poverty and inequality.

This concern is understandable. If low-income smokers continue to smoke at the same intensity after a tax increase, they will need to spend a larger share of their income on tobacco products, which makes the tax appear regressive. For this reason, the tobacco industry has repeatedly used distributional arguments to oppose higher tobacco taxes [2]. Although a tobacco tax increase may appear regressive when assessed only through the immediate increase in cigarette spending relative to income among smokers, its broader distributional effects may be less regressive or even progressive once differences in smoking prevalence, consumption patterns, and price responsiveness across income groups are taken into account. A large body of research shows that lower-income smokers are generally more responsive to price increases than higher-income smokers, which means that they are more likely to reduce consumption or quit smoking when taxes rise [3, 4]. In that sense, the short-term financial burden of higher tobacco taxes has to be considered together with behavioral responses and with the longer-term health and welfare gains that may be concentrated among lower-income groups.

This issue is particularly important in low- and middle-income countries, where smoking is often more concentrated among poorer households and where differences in price elasticity across socioeconomic groups tend to be substantial [5]. Empirical studies from Southeastern Europe support this pattern. Evidence from Albania, North Macedonia, Bosnia and Herzegovina, and Montenegro suggests that

lower-income groups are more responsive to cigarette price increases than higher-income groups [6, 7, 8, 9, 10, 11]. In economic terms, this means that cigarette demand is more price-elastic among lower-income groups, so the same percentage increase in price produces a larger percentage reduction in cigarette demand. This response may reflect reductions in smoking intensity, smoking prevalence, or both. Accordingly, higher tobacco taxes may reduce smoking more strongly among poorer households and, under certain conditions, may produce progressive distributional effects rather than regressive ones. In addition, the use of additional tax revenue matters. If governments direct at least part of this revenue toward goods and services that are especially important for lower-income households, such as health care, education, or other socially important expenditures, the overall impact of tobacco tax reform may become even more favorable from the perspective of equity [2, 12].

Serbia continues to face a substantial tobacco-related public health burden. In 2019, 37% of adults were current smokers, while tobacco use was estimated to account for 19,872 deaths. Serbia ratified the WHO Framework Convention on Tobacco Control in 2006 and subsequently introduced several tobacco-control measures, including the 2010 Law on the Protection of the Population from Exposure to Tobacco Smoke, the 2016 Law on Advertising, and gradual increases in the specific cigarette excise. However, these tax increases have generally not outpaced income growth and have therefore not consistently reduced cigarette affordability. More recently, the 2024 WHO FCTC investment case for Serbia identified stronger taxation and fuller implementation of other tobacco demand-reduction measures as policy priorities. This combination of a high tobacco-related burden and persistently affordable cigarettes strengthens the rationale for evaluating more substantial tax reforms and their distributional consequences [13].

Existing research for Serbia points to potentially progressive effects of higher tobacco taxation, but the evidence is still incomplete. Previous work has documented a marked decline in cigarette consumption and in the share of smoking households over time, alongside excise-driven increases in cigarette prices. Using household-level data on smoking prevalence, cigarette consumption, prices, and household expenditures, Vladisavljević et al. [14] estimated total price elasticities for different income groups and found that cigarette demand was most elastic among low-income households (–1.076), less elastic among middle-income households (–0.631), and least elastic among high-income households (–0.220). This already suggests that higher tobacco taxes in Serbia are likely to have progressive effects. Other Serbia-specific evidence indicates that tobacco spending crowds out expenditures on food, clothing, education, recreation, and culture, especially among lower-income households, implying that reductions in tobacco consumption may bring broader welfare gains for poorer households [15]. A recent extended cost-benefit analysis for Serbia similarly found that higher tobacco excise taxes would generate progressive net gains in disposable household budgets, with the largest gains among low-income households once changes in tobacco expenditure, medical costs, working life, and pension years are taken into account [16]. However, these studies do not directly estimate the effects of higher tobacco taxation on poverty and inequality using formal poverty and distributional indicators.

In recent years, several studies have moved beyond simple comparisons of elasticities across income groups and have used more explicit analytical frameworks to assess the distributional effects of tobacco taxation. This broader line of research includes both formal poverty and inequality approaches and related equity-oriented analyses of health and financial outcomes. For example, Saenz-de-Miera et al. [17] used an extended cost-effectiveness framework to examine the distributional effects of tobacco tax increases across Mexican regions. For the present study, however, the closest

methodological benchmark is provided by Huesca et al. [18, 19], who applied formal poverty and inequality measures in scenario-based analyses of tobacco tax reforms in Mexico and showed that higher tobacco taxes may produce progressive effects and, under some conditions, may also reduce poverty. These studies provide an important methodological benchmark for the present paper. To our knowledge, no study has yet applied a comparable framework to Serbia in order to assess the effects of tobacco taxation on poverty and inequality. This paper addresses that gap. Using household-level data and scenario-based microsimulations, we examine how higher tobacco taxation in Serbia may affect poverty and inequality, and whether the use of additional tax revenue may alter these effects. In this sense, the paper treats tobacco taxation not only as a fiscal instrument, but also as a health equity issue, because tax-induced changes in tobacco expenditure may affect financial vulnerability, poverty risk, and the distribution of welfare across socioeconomic groups. In this way, the paper aims to contribute both to the evidence base on tobacco taxation in Serbia and to the broader discussion on the equity implications of fiscal tobacco control policies.

Methods

Data sources and tax scenarios

The analysis uses microdata from the 2021 Household Budget Survey (HBS) for Serbia as the main data source. These data are used to compute poverty and inequality indicators and to simulate changes in household cigarette consumption under alternative tobacco tax scenarios. Information on the poverty line is taken from the Statistical Office of the Republic of Serbia (SORS). In the poverty analysis, we use the equivalized poverty line published by SORS for 2021, estimated at RSD 24,064. Estimates of

cigarette price elasticities by income group are taken from Vladisavljević et al. [14] and are used as inputs for the microsimulations. The calculation of poverty and inequality measures is performed using the Distributive Analysis Stata Package (DASP) [20]. Pointwise 95% confidence intervals for the differences between the baseline and post-reform concentration curves were estimated using the DASP module (diclorenz), taking the HBS sampling weights into account.

The same tax scenarios are applied in both the poverty and inequality analyses. We consider two alternative increases in the specific excise on cigarettes relative to the 2021 baseline. The first scenario assumes a moderate increase in the specific excise of 25%, while the second assumes a larger increase of 50%. Based on the 2021 weighted average retail price (WARP), these changes imply an increase in cigarette prices of 12.18% and 24.36%, respectively. Table 1 presents the structure of cigarette prices under the baseline and under both tax scenarios, including the specific excise, ad valorem excise, VAT, and the resulting tax burden.

Table 1: Scenarios of tobacco taxation

Weighted average retail price	Baseline	+25% specific tax	+50% specific tax
Price	313.00	351.12	389.24
Specific excise	76.75	95.94	115.13
Ad valorem excise (33%)	103.29	115.87	128.45
VAT (20%)	52.17	58.52	64.88
Net-of-tax price	80.79	80.79	80.79
Tax burden	74.19%	76.99%	79.24%
Excise burden	57.52%	60.32%	62.58%
Price Increase		12.18%	24.36%

Source: Authors' calculation based on data from the Tobacco Administration

Note: All monetary values are expressed in local currency (Serbian Dinar – RSD); for reference, the average exchange rate in 2021 was 1 EUR ≈ 117.5 RSD

Analytical framework and key assumptions

Assessing the effects of higher cigarette prices on poverty and inequality requires information on how tobacco consumption changes across the income distribution after a price increase. The simulations use total price elasticities of −1.076 for low-income households, −0.631 for middle-income households, and −0.220 for high-income households [14]. In the source study, households were divided into three equally sized weighted groups according to total household expenditure per capita, which was used as a proxy for income. In the present simulation, the corresponding elasticity is first applied to the percentage change in cigarette price to estimate the percentage change in the quantity of cigarettes consumed. The simulated post-reform quantity is then combined with the new cigarette price to calculate post-reform cigarette expenditure for each household.

In the present analysis, each income-group-specific elasticity is treated as constant across the two simulated price increases and is applied uniformly within the corresponding income group. In the poverty analysis, these elasticity estimates are combined with the consumption dominance framework to assess how higher cigarette prices affect poverty indicators around the poverty line. In the inequality analysis, the corresponding elasticity is applied to the percentage change in cigarette price to simulate the change in cigarette quantity among smoking households. Post-reform cigarette expenditure is then calculated using the simulated quantity and the new cigarette price. The model therefore captures the average behavioral response within each income group, but does not allow elasticity to vary with the magnitude of the price increase or across households within the same group.

Poverty analysis

Poverty is assessed using the Foster-Greer-Thorbecke (FGT) family of indices [21]. The general form of the FGT measure is:

$$FGT(\alpha) = \frac{1}{N}\sum_{p=1}^{P}\left(\frac{z-y_p}{z}\right)^{\alpha} \quad (1)$$

where z is the poverty line (threshold), P is the total number of poor individuals (or households), N is the total population, while y denotes the welfare indicator, measured here by equivalized income. In the empirical analysis, we use three standard poverty measures from the FGT family: the headcount ratio $(\alpha = 0)$, the poverty gap $(\alpha = 1)$, and poverty severity $(\alpha = 2)$. Together, these indicators capture not only the incidence of poverty, but also its depth and severity.

The poverty analysis is based on equivalized household income. Following the modified OECD equivalence scale [22], a weight of 1 is assigned to the first adult household member, 0.5 to each

additional adult, and 0.3 to each child. The corresponding equivalized poverty line for 2021 is taken from SORS and amounts to RSD 24,064.

To assess the effect of higher cigarette prices on poverty, we rely on the consumption dominance (CD) approach proposed by Makdissi and Wodon [23] and applied in a tobacco taxation setting by Huesca et al. [18]. This approach allows us to evaluate how changes in cigarette prices may affect poverty measures around the poverty line through their effect on real household resources. In practical terms, the CD framework does not attempt to reconstruct the exact post-reform smoking status and consumption of each household. Instead, it uses the observed distribution of household resources and cigarette expenditure to evaluate how a price increase translates into changes in poverty measures around a given poverty threshold. Put differently, the approach asks whether households close to the poverty line devote enough resources to cigarettes for a price increase to worsen poverty, and how strongly this effect varies across different poverty lines. In our application, we use this framework to estimate the direction and magnitude of the poverty effect under each tax scenario, and then evaluate the same logic under a revenue-neutral reform. A brief derivation of the CD approach used in this study is provided in the Supplementary Material.

The poverty analysis proceeds in three steps. First, we estimate the baseline poverty indicators for 2021 using the selected FGT measures and the official equivalized poverty line. Second, for each tax scenario, we estimate the change in poverty implied by higher cigarette prices using the tobacco consumption dominance curves. Third, we assess the conditions under which the adverse poverty effects of higher cigarette taxation may be mitigated under a revenue-neutral reform, assuming that additional tax revenues are used to subsidize out-of-pocket health expenditure.

Inequality analysis

The inequality analysis focuses on the distribution of cigarette expenditure across the income distribution and on how the distribution of cigarette expenditure relative to income changes under the two simulated tax scenarios. It is based on three related tools: the Lorenz curve, the concentration curve, and the Kakwani index. The Lorenz curve describes the distribution of income, while the concentration curve shows how cigarette expenditure is distributed across households ranked by income. The Kakwani index summarizes the degree of progressivity by comparing the concentration curve for cigarette expenditure with the Lorenz curve. Positive values indicate progressivity, while negative values indicate regressivity.

Unlike the poverty analysis, the inequality analysis is restricted to smoking households. Its purpose is to assess how positive cigarette expenditure is distributed among households that are directly exposed to changes in cigarette prices. Non-smoking households have zero cigarette expenditure both at baseline and in the simulations, and therefore experience no direct change in cigarette expenditure following the tax increase. Including them would introduce a large number of structural zeros and would combine two analytically distinct dimensions: the socioeconomic distribution of smoking prevalence and the distribution of cigarette expenditure conditional on smoking. Population-wide effects are instead assessed in the poverty analysis, which is based on the full household sample.

To simulate changes in cigarette consumption after the tax increase, we apply the income-group-specific total price elasticities described above to smoking households in the corresponding income

groups. In the source study, households were divided into three weighted terciles according to total household expenditure per capita, which was used as a proxy for income. The resulting changes in cigarette quantities are then combined with the simulated post-reform prices to calculate cigarette expenditure under each scenario. Because the HBS does not identify the number of smokers within each household, the simulation cannot distinguish whether a reduction in total household cigarette consumption reflects smoking cessation by one household member, reduced smoking intensity among several members, or a combination of both. The results therefore refer to changes in aggregate household cigarette quantity and expenditure, rather than to individual smoking transitions.

The inequality analysis proceeds in three steps. First, we estimate the baseline concentration curve of cigarette expenditure for smoking households. Second, for each tax scenario, we simulate changes in cigarette quantities using the income-group-specific price elasticities, calculate post-reform cigarette expenditure using the simulated quantities and prices, and estimate the corresponding concentration curves. Third, we compute the Kakwani index for the baseline and reform scenarios and test Kakwani dominance in order to assess whether higher cigarette taxation becomes more or less progressive under the simulated reforms.

Results

Impact of tobacco taxation on poverty

Table 2 shows the baseline values of the FGT poverty indices for 2021, calculated using equivalized household income and equivalized household expenditure per capita as alternative welfare measures. Poverty estimates are slightly higher when income is used. Since the differences between the two measures are not large, the remaining analysis is based on equivalized income. The estimated headcount ratio, $FGT(0)$, shows that 23.3% of the population had income below the poverty line in 2021. The estimated poverty gap, $FGT(1)$, indicates that the average transfer needed to bring members of poor households to the poverty line amounted to 6.65% of the poverty line.

Table 2: Estimated poverty measures (%)

Poverty measure	Eq. income per capita	Eq. expenditure per capita
Headcount index – $FGT(0)$	23.36%	22.77%
Poverty gap index – $FGT(1)$	6.65%	5.67%
Poverty severity index – $FGT(2)$	2.90%	2.12%

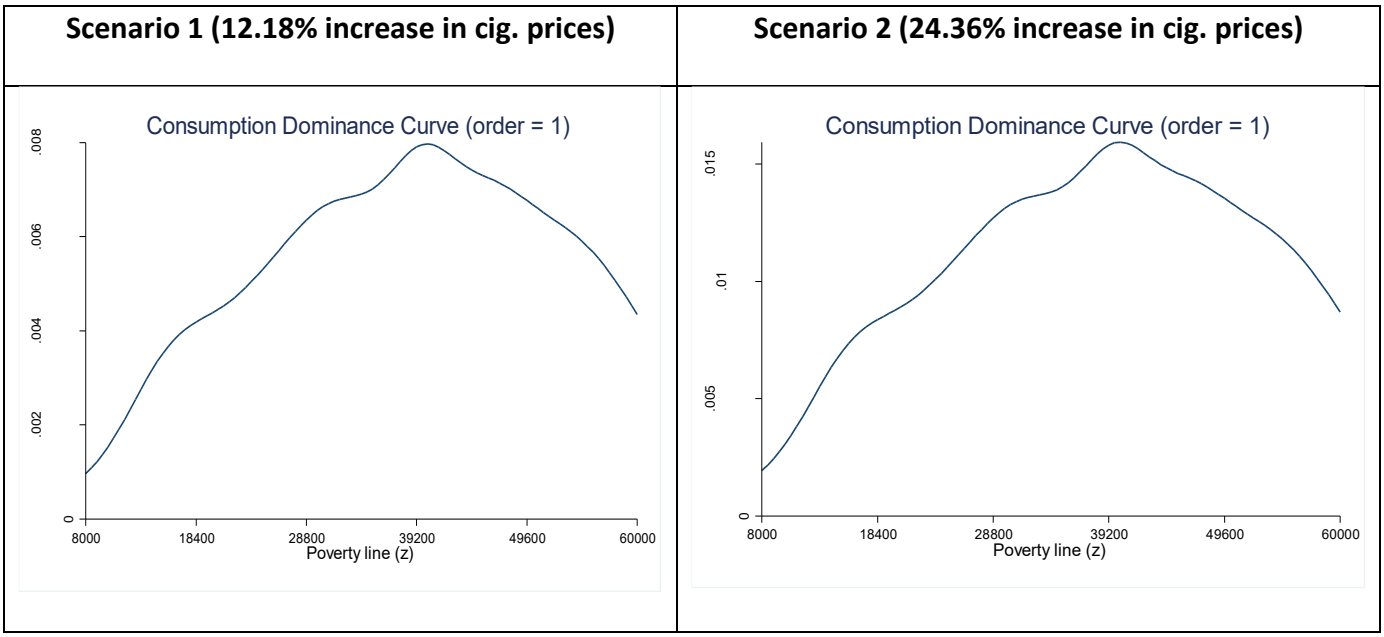
Source: Authors' calculation based on HBS (2021) data

Note: The poverty line is set to 24,064 RSD based on SORS

We first assess the effects of higher cigarette taxation under the two tax scenarios without any compensatory subsidy. Figure 1 presents the estimated tobacco consumption dominance curves, $CD(z, s = 1)$, over the interval from RSD 8,000 to RSD 60,000. In both scenarios, the curves remain

above zero across the full range of poverty lines considered, which indicates an increase in poverty following the tax increase. The effect is stronger in the higher-tax scenario and reaches its peak at poverty lines around RSD 40,000.

Figure 1: Consumption dominance curves for cigarettes



Source: authors' calculation based on HBS (2021) data

Table 3 reports the estimated changes in poverty measures in the neighborhood of the official poverty line of RSD 24,064. Under Scenario 1, the 12.18% increase in cigarette prices raises the headcount ratio by about 0.5 percentage points. Under Scenario 2, the corresponding increase is about 1 percentage point. The estimated changes in the poverty gap and poverty severity are also positive in both scenarios. Although the absolute changes are modest in percentage-point terms, the proportional increases are more pronounced for the poverty gap and poverty severity measures.

Table 3: Estimated change in poverty measures at the official poverty line (percentage points)

Change in poverty measure	Scenario 1 (12.18% increase in cig. prices)	Scenario 2 (24.36% increase in cig. prices)
Headcount index – $FGT(0)$	+0.516	+1.033
Poverty gap index – $FGT(1)$	+0.231	+0.462
Poverty severity index – $FGT(2)$	+0.133	+0.265

Source: Authors' calculations based on HBS (2021) data

Note: Estimates are reported as changes in percentage points at the poverty line of RSD 24,064.

As an additional sensitivity check, we re-estimated the changes in the FGT indices using poverty thresholds corresponding to 90% and 110% of the official poverty line. At both alternative thresholds, all estimated changes remained positive and close to those obtained at the official threshold, while Scenario 2 continued to produce approximately twice the effect of Scenario 1 (see Supplementary Table S1).

We next examine whether these adverse poverty effects can be mitigated under a revenue-neutral reform in which the additional cigarette tax revenue is used to subsidize another category of household spending. Using the revenue-neutral reform framework applied by Huesca et al. [18], we consider one illustrative scenario in which the additional revenue is used to subsidize out-of-pocket health expenditure. Huesca et al. examined several possible subsidy categories, including health expenditure, milk, and a basket of basic food products, and found that food subsidies had the strongest poverty-reducing potential in the Mexican context. Our analysis focuses on out-of-pocket health expenditure because it represents a policy-relevant use of tobacco tax revenue within the health

equity framework of the study. The purpose of this exercise is to assess one relevant compensatory mechanism rather than to identify the optimal allocation of additional revenue.

In this exercise, subsidizing out-of-pocket health expenditure is modeled as a uniform reduction in the price paid by households for medication and health care not covered by mandatory health insurance, rather than as a direct cash transfer or reimbursement. The size of the price reduction is determined so that the estimated cost of the subsidy equals the additional government revenue generated by the cigarette tax increase, taking into account the assumed own-price elasticity of out-of-pocket health expenditure. Since no such elasticity estimate is available for Serbia, we assume a value of –0.3 and additionally test values up to –1.3. The substantive conclusions do not change across these alternatives. Table 4 presents the implied changes in cigarette consumption, government revenue, cigarette prices, the simulated price reduction for out-of-pocket health expenditure, and the estimated efficiency cost of taxation under the two scenarios.

Table 4: Scenarios of revenue-neutral tax reform

	Change in monthly per capita cigarette consumption in packs	Change in monthly per capita government revenues (RSD per month)	Change in price of cigarettes in RSD (%)	Revenue-neutral change in price of out-of-pocket health items in RSD (%)	Efficiency cost of taxation γ
Scenario 1	–0.208	106.93	38.12 (12.18%)	–64.6 (8.89%)	1.06
Scenario 2	–0.417	197.97	76.24 (24.36%)	–121.1 (16.66%)	1.13

Source: Authors' calculations based on HBS (2021) data

Note: per capita with respect to total population, not only smoking households

Table 5 reports the poverty-improvement condition evaluated at the official poverty line. The condition is satisfied when the distributive gain from the subsidy exceeds the efficiency cost of the cigarette tax increase. All estimated values are negative, indicating that subsidizing out-of-pocket health expenditure is not sufficient to produce a poverty-improving outcome under either scenario.

Table 5: Estimated values of the poverty-improvement condition at the official poverty line

Poverty improvement	Condition	Scenario 1	Scenario 2
Headcount ratio	$CD(X_l; z, 1) - \gamma CD(X_j; z, 1)$,	–0.003178	–0.006707
Poverty gap	$CD(X_l; z, 2) - \gamma CD(X_j; z, 2)$,	–0.001541	–0.003221
Poverty severity	$CD(X_l; z, 3) - \gamma CD(X_j; z, 3)$,	–0.000942	–0.001956

Source: Authors' calculation based on HBS (2021) data

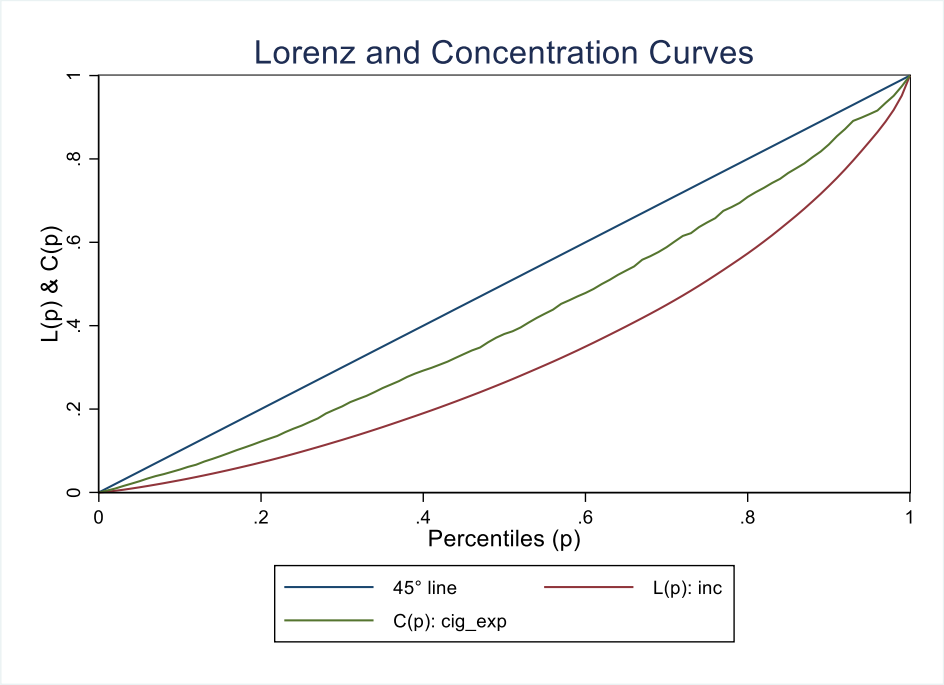
Note: Values report the estimated poverty-improvement condition evaluated at the poverty line of RSD 24,064.

Impact of tobacco taxation on inequality

The inequality analysis is restricted to smoking households, defined as households with positive cigarette expenditure. Figure 2 presents the Lorenz curve for income and the concentration curve for cigarette expenditure per capita. These variables serve different analytical purposes and are not compared directly in monetary terms. Income is used to rank households and to construct the Lorenz curve, while per capita cigarette expenditure is the outcome used to construct the concentration curve; the Kakwani index compares the resulting distributional indices. Ideally, the analysis would be based on household-level cigarette tax payments. Although approximate tax amounts could be imputed by combining reported cigarette expenditure and quantities with the statutory tax structure, such estimates would remain model-based because the HBS does not report the tax component of individual purchases or allow us to verify whether all purchases were fully tax-paid. We therefore use observed cigarette expenditure as a transparent proxy. The results should be interpreted as describing

the distribution of cigarette expenditure relative to income among smoking households, rather than as a direct estimate of household tax incidence.

Figure 2: Lorenz curve and concentration curve for cigarette expenditures of smoking households



Source: authors' calculation based on HBS (2021) data

Note: inc denotes income, cig_exp denotes cigarette expenditures

Figure 2 shows that the concentration curve for per capita cigarette expenditure lies below the line of equality, indicating that higher-income smoking households account for a larger absolute share of total cigarette expenditure. However, regressivity is assessed by comparing the concentration curve with the Lorenz curve for income. Since the concentration curve lies above the Lorenz curve, households in the lower part of the income distribution account for a larger cumulative share of cigarette expenditure than their cumulative share of total income, whereas the reverse is true for households in the upper part of the distribution. Cigarette expenditure is therefore regressive relative to income,

although its absolute amount is more concentrated among higher-income smoking households. The changes following the simulated tax increases are presented in Figure 3.

We next simulate changes in cigarette expenditure under the two tobacco tax scenarios. For each smoking household, the unit price of cigarettes is increased in line with the assumptions of Scenario 1 and Scenario 2, corresponding to price increases of RSD 38.12 and RSD 76.24 per pack, respectively. The resulting average unit prices and their changes across income groups are reported in Table 6. To account for behavioral responses, post-reform cigarette consumption is simulated using the income-group-specific price elasticities estimated by Vladisavljević et al. [14]. The same elasticity is applied uniformly to all smoking households within a given income group. Based on the simulated changes in prices and quantities, we then recalculate cigarette expenditure for each household under both reform scenarios.

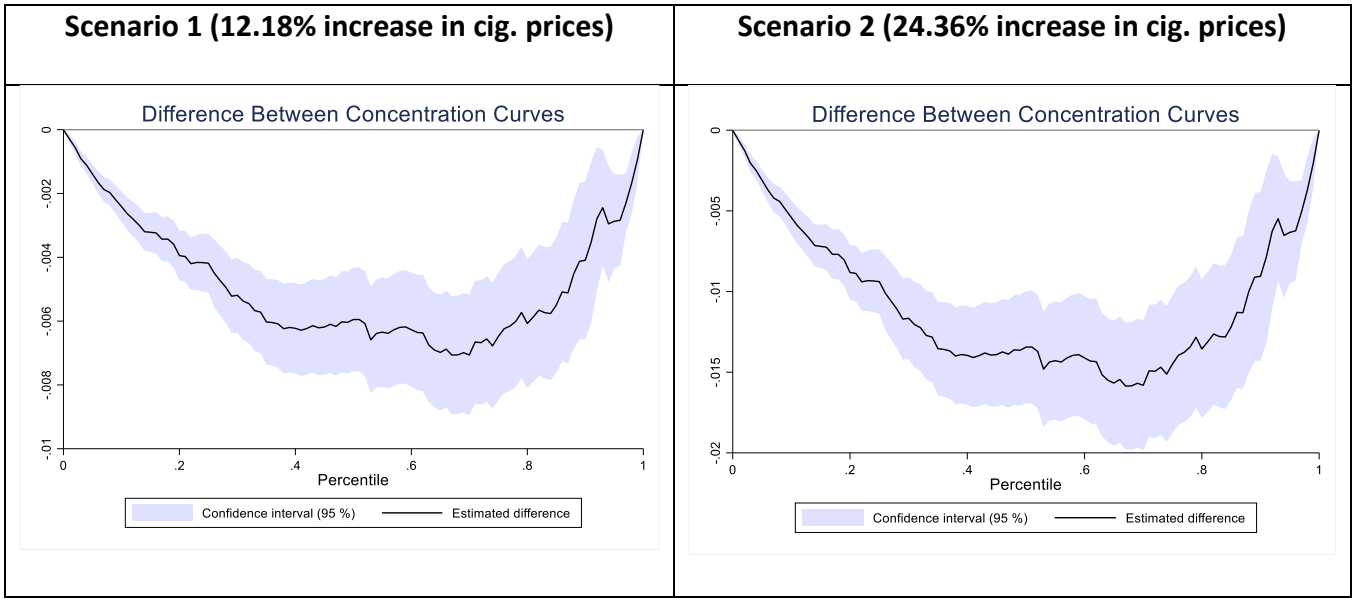
Table 6: Simulated changes in average price of cigarettes across income groups

Income group	Cig. price 2021	Cig. price Scenario 1	Cig. price % change	Cig. cons. % change	Cig. price Scenario 2	Cig. price % change	Cig. cons. % change
Low	291.3502	329.4702	13.08	–14.27	367.5902	26.17	–28.55
Middle	299.1704	337.2904	12.74	–8.15	375.4104	25.48	–16.30
Upper	304.3296	342.4496	12.53	–2.79	380.5696	25.05	–5.60
Total	299.4916	337.6116	12.73	–7.41	375.7316	25.46	–14.81

Source: Authors' calculation based on HBS (2021) data

Figure 3 shows how the concentration curve changes relative to the baseline after the two simulated tax increases. If higher tobacco taxation leads to a less regressive post-reform distribution of cigarette expenditure relative to income, the concentration curve should move farther away from the line of equality. This is exactly the pattern observed in both scenarios. The differences between the baseline concentration curve and the post-reform concentration curves are negative over the relevant part of the income distribution, which indicates that the cumulative share of cigarette expenditure borne by lower-income smoking households declines after the tax increase. The effect is stronger in Scenario 2, as expected. For example, under the larger tax increase, the bottom 20 percent of smoking households account for a smaller cumulative share of cigarette expenditure than in the baseline, by roughly 1 percentage point.

Figure 3: Differences between concentration curves of baseline and proposed scenarios



Source: authors' calculation based on HBS (2021) data

Note: Cumulative % of population ranked by income on the x-axis

Table 7 summarizes these changes using the Kakwani index. Since the income distribution is unchanged across scenarios, the Gini coefficient remains constant, while the concentration index for cigarette expenditure increases after the tax reform. As a result, the Kakwani index becomes less negative in both scenarios, moving from –0.1786 in the baseline to –0.1690 in Scenario 1 and –0.1571 in Scenario 2. This pattern indicates that the post-reform distribution of cigarette expenditure becomes less regressive relative to income as cigarette taxation increases. The corresponding t-statistics also show that the Kakwani indices remain statistically different from zero in all cases.

Table 7: Kakwani index

Scenarios	Gini index	Concentration index (cigarettes)	Kakwani index (Concentration – Gini)	t-stat (p-value)
Baseline	0.3489687	0.1703343	–0.1786345	–11.3702 (0.000)
Scenario 1	0.3489687	0.1799473	–0.1690215	–10.5156 (0.000)
Scenario 2	0.3489687	0.1918782	–0.1570905	–9.50641 (0.000)

Source: authors' calculation based on HBS (2021) data

Taken together, the concentration-curve analysis and the Kakwani index point in the same direction. Although cigarette expenditure is regressive relative to income in the baseline distribution among smoking households, higher tobacco taxation makes this distribution less regressive. In that sense, the simulated tax increases shift a relatively larger share of cigarette expenditure toward higher-income smoking households and therefore produce a less regressive distributional pattern relative to the baseline.

Discussion

The results of this study suggest that higher tobacco taxation in Serbia may have two effects at the same time. On the one hand, both simulated tax increases are associated with modest increases in absolute percentage-point terms around the official poverty line, although the proportional increases are more pronounced for the poverty gap and poverty severity measures. On the other hand, the post-

reform distribution of cigarette expenditure becomes less regressive relative to income among smoking households. From a health equity perspective, these findings point to an important policy trade-off. A tax increase may improve the socioeconomic distribution of tobacco-related financial burden among smokers, while still increasing poverty risk for some households near the poverty line if additional revenues are not recycled in a compensatory way. These findings are not contradictory. A tax increase may still impose an additional burden on some households near the poverty line, while at the same time shifting a relatively larger share of cigarette expenditure toward higher-income smokers because lower-income smokers respond more strongly to higher prices.

The poverty results can be discussed alongside those reported by Huesca et al. [18] because their study applies a closely related consumption dominance framework. However, the numerical magnitudes should not be interpreted as directly comparable, given the differences in tax scenarios, poverty thresholds, sample composition, smoking patterns, and behavioral assumptions between Mexico and Serbia. The common qualitative finding is that higher tobacco taxes may worsen poverty around the relevant poverty line when additional revenues are not used in a compensatory way. The Serbian estimates should therefore be interpreted as scenario-specific approximations of the likely direction and magnitude of the poverty effect rather than as values validated by the Mexican results. Although the total price elasticities used in the analysis incorporate changes in smoking prevalence and smoking intensity at the income-group level, the framework does not assign these responses to individual households. It therefore does not identify which particular households reduce smoking intensity or quit smoking, and the estimates should not be interpreted as a precise forecast of the number of additional poor.

The inequality results point in the opposite direction. In both scenarios, cigarette expenditure becomes less regressive relative to income among smoking households, and this pattern is visible both from the concentration curves and from the Kakwani index. The effect is stronger in the higher-tax scenario, which suggests that larger tax increases are associated with a less regressive post-reform distribution of cigarette expenditure. This finding is in line with earlier evidence from Serbia showing that lower-income households are more responsive to cigarette price increases than middle- and high-income households [14]. It is also consistent with the general expectation that, when lower-income smokers reduce consumption more strongly after a tax increase, cigarette expenditure becomes more concentrated among higher-income smokers.

The absence of explicit household-level modeling of smoking prevalence is unlikely to overturn this main inequality result. Although the elasticity inputs used in the simulations reflect overall behavioral responses at the income-group level, the framework does not allow us to identify how these responses are divided between reduced smoking intensity and smoking cessation across households. If anything, this limitation may lead to a conservative estimate of the reduction in regressivity, given that smoking prevalence is typically more price-responsive in lower-income groups. This interpretation is also consistent with Huesca et al. [19], who used a more advanced microsimulation framework and reported only small differences in tobacco burden across income groups when households that quit smoking after the tax increase were included or excluded. While our framework is simpler, their results suggest that the main distributional conclusion is not likely to depend strongly on this specific modeling choice.

Still, the Serbian pattern should not be treated as universal. Huesca et al. [19] in their analysis for Mexico, found a different baseline distribution, reflecting a different socioeconomic pattern of smoking. In that sense, Serbia appears to be closer to the case of Turkey, where Önder and Yürekli [24] also reported a regressive baseline distribution of cigarette expenditure relative to income. This suggests that the distributional effects of tobacco taxation depend not only on tax design, but also on the social patterning of smoking across income groups.

An additional part of the analysis examined whether the adverse poverty effect of higher tobacco taxation could be offset under a revenue-neutral reform in which the additional revenue is used to subsidize out-of-pocket health expenditure. The results suggest that this particular compensatory mechanism does reduce the adverse poverty effect of higher tobacco taxation, but not sufficiently to produce a poverty-improving reform at the official poverty line. In both scenarios, the distributive gain remains below the estimated efficiency cost of the reform, which means that the relevant poverty-improvement conditions are not fully satisfied. In other words, using additional tobacco tax revenue to reduce the price of out-of-pocket health expenditure helps mitigate the poverty effect of higher cigarette prices, but does not fully offset it.

This result is again comparable to the findings reported by Huesca et al. [18], who also found limited distributive efficiency of subsidizing health expenditure. Their analysis suggested that subsidizing goods with larger shares in the consumption basket of poor households, especially food products, would be more effective in generating a poverty-improving outcome. Our findings point in the same direction. The most likely reason why the health-expenditure subsidy does not fully offset the increase in poverty in Serbia is the relatively low share of out-of-pocket health expenditure in the consumption baskets of

poor households. If the policy objective is to avoid an increase in poverty after a tobacco tax increase, then the use of additional revenues should probably be directed toward goods and services that have greater weight in the budgets of lower-income households.

At the same time, the limited poverty-reducing effect of subsidizing out-of-pocket health expenditure in this exercise should not be interpreted as evidence that directing tobacco tax revenue toward health is a poor policy choice. It only suggests that a uniform price reduction for all households is not sufficiently well targeted from the perspective of poverty reduction. From a broader policy perspective, health-related spending may still be justified. In that sense, the policy relevance of tobacco taxation is closely linked to the broader question of equitable public financing. Recent evidence from Mexico [25] shows that even increases in public spending do not automatically translate into equitable allocation if financing structures remain segmented or weakly redistributive. Zubović and Zdravković [26] also show that increased demand for health services may have positive macroeconomic effects through higher output, employment, and household income. International experience also suggests that using tobacco tax revenues to expand access to health services may produce important social benefits, as shown in the Philippines [27]. Therefore, the main implication of our results is not that health spending should be excluded, but that additional tobacco tax revenue should be directed toward more effectively targeted measures, including goods and services that carry greater weight in the consumption baskets of lower-income households.

Several limitations of this study should be acknowledged. Although the study does not estimate direct health outcomes or healthcare utilization effects, it examines one important pathway through which tobacco taxation may affect health equity, namely the distribution of financial burden and poverty risk

across socioeconomic groups. The main data constraint is that the analysis relies on previously estimated total price elasticities by broad income groups rather than on household-level elasticities defined continuously over the income distribution. The simulations also assume that the income-group-specific price elasticities remain constant across both tax scenarios. The model therefore does not capture possible nonlinear responses to larger price increases. If cigarette demand becomes more responsive at substantially higher price levels, the present analysis may underestimate the resulting reduction in cigarette consumption and the associated equity benefits. The findings should therefore not be directly extrapolated to tax-induced price increases substantially larger than those examined here. This also helps explain why the poverty and inequality analyses rely on different empirical implementations, even though both are based on the same tax scenarios and the same underlying behavioral inputs. In addition, although the elasticity inputs used in the simulations reflect overall behavioral responses at the income-group level, the present framework does not allow explicit household-level modeling of how these responses are divided between reduced smoking intensity and smoking cessation. The inequality analysis is also limited to smoking households and uses cigarette expenditure as a proxy for cigarette tax burden, although a tax-burden concentration curve would be a more direct measure of progressivity. The revenue-neutral exercise focuses on subsidizing out-of-pocket health expenditure, but the available data do not allow us to distinguish whether the relatively low budget share of such expenditure among poorer households reflects financial protection, lower use of care, or unmet need. The analysis also does not account for regional differences in the cost of living, which are substantial in Serbia, so the use of a single national poverty line may not fully reflect real differences in living standards across regions. One possible improvement in future work would be to adjust household income using regional price indices. The tax simulations assume full pass-through and a constant net-of-tax price. In practice, tobacco manufacturers may overshift excise increases by

raising their own margins, which could alter the final retail price response and, consequently, the size of the simulated distributional effects. These limitations do not invalidate the exercise, but they do mean that the results should be interpreted as approximations of likely distributional effects rather than as exact estimates of post-reform outcomes. Future work would benefit from richer data on smoking intensity, prevalence changes, regional cost-of-living differences, and a more developed microsimulation framework for Serbia.

Overall, the main message of the paper remains clear. Higher tobacco taxation in Serbia appears to generate a less regressive post-reform distribution of cigarette expenditure among smoking households, but the poverty effect depends partly on what happens with the additional revenues. If those revenues remain outside any compensatory framework, poverty may increase for some households. If, however, they are redirected toward well-targeted goods and services that matter more for lower-income households, the overall reform may become more equitable and potentially poverty-improving. From a health equity perspective, this suggests that tobacco tax policy should be discussed not only in terms of tax rates, but also in terms of how the resulting revenues are used and whether the broader policy package protects financially vulnerable households.

Robustness checks

The sensitivity analysis reported in the Results indicates that the estimated poverty effects are not driven by the choice of the official poverty threshold. When the poverty line was set at 90% and 110% of the official level, the estimated changes in all three FGT measures retained the same sign and remained similar to those obtained at the official threshold. Scenario 2 also consistently produced

approximately twice the effect of Scenario 1. Together with the fact that the consumption dominance curves remain above zero across the full range of poverty lines examined, these results support the robustness of the main poverty conclusion.

Conclusions and policy implications

This study examined the effects of higher tobacco taxation on poverty and inequality in Serbia using scenario-based analysis. The results suggest that higher tobacco taxation is associated with modest increases in poverty in absolute percentage-point terms, while at the same time making the distribution of cigarette expenditure less regressive relative to income among smoking households. The stronger tax scenario produces a more pronounced reduction in regressivity. The revenue-neutral exercise further shows that using additional tobacco tax revenue to subsidize out-of-pocket health expenditure reduces, but does not fully offset, the adverse poverty effect of higher cigarette prices.

Taken together, these findings suggest that tobacco taxation should be assessed not only as a fiscal and tobacco-control instrument, but also as a health equity issue. In Serbia, the equity profile of such reforms depends partly on how additional revenues are used, especially if the policy goal is to avoid worsening financial vulnerability among lower-income households. If policymakers aim to minimize or offset the poverty effect of higher cigarette taxes, additional revenues should be directed toward goods and services that are more important in the consumption baskets of lower-income households. In that sense, the equity effects of tobacco taxation should be considered not only in terms of the tax increase itself, but also in terms of the design of accompanying revenue-use policies. Designing such policies more precisely would require a better understanding of which households are most exposed to

adverse effects and how behavioral responses vary within broad income groups. Future research could therefore complement the present distributional simulations with household-level multivariate econometric models examining how socioeconomic characteristics, smoking behavior, and household composition shape the poverty and distributional effects of tobacco tax reforms.

List of abbreviations

CD: Consumption dominance

DASP: Distributive Analysis Stata Package

FGT: Foster-Greer-Thorbecke

HBS: Household Budget Survey

SORS: Statistical Office of the Republic of Serbia

VAT: Value-added tax

WARP: Weighted average retail price

Declarations

Ethics approval and consent to participate

This study is based on secondary analysis of anonymized microdata from the Household Budget Survey, obtained from the Statistical Office of the Republic of Serbia under a data access agreement. The authors had access only to anonymized data and no information that could disclose the identity of

survey participants. Ethics approval and informed consent to participate were not required for this secondary analysis.

Consent for publication

Not applicable.

Availability of data and materials

The analysis is based on anonymized microdata from the Household Budget Survey (HBS), obtained from the Statistical Office of the Republic of Serbia (SORS) under a data access agreement. These data are not publicly available. Researchers interested in accessing the same data should contact SORS directly and comply with its data access procedures.

Competing interests

The authors declare that they have no competing interests.

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Authors' contributions

AZ: conceptualization, methodology, formal analysis, software, validation, writing – original draft. JZ: conceptualization, methodology, project administration, supervision, writing – original draft. BN: conceptualization, writing – original draft, writing – review and editing. All authors read and approved the final manuscript.

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Supplementary Material

Theoretical framework for modeling the impact of indirect taxation on poverty

The methodology used in this study builds on the concepts of equivalent income, the money metric utility function, stochastic dominance, and consumption dominance curves, following King [28], Besley and Kanbur [29], Foster and Shorrocks [30], Makdissi and Wodon [23], and Duclos et al. [31]. Since the full framework involves substantial algebra, only the main steps relevant for the present analysis are summarized here.

In line with the common microeconomic theory, let us assume an individual with income y whose preferences may be represented by the utility function $u = u(x)$, where x is a consumption bundle. For a given set of prices q and income y, the indirect utility function maximizing level of x reads as $v = v(y, q)$, while the expenditure function minimizing the cost of obtaining particular utility level u reads as $m = m(u, q)$. When the prices are fixed, expenditure function boils down to the monotonic transformation of the utility function, thus representing utility in monetary terms, commonly referred to as the money metric utility function. Since the expenditure function and indirect utility function are inverses of each other, the money metric utility function is often called the minimum income function, as it gives the minimum cost of obtaining the utility of the vector x when prices are q.

The money metric utility is further exploited by King [28] for the sake of comparing the levels of an individual's welfare when they face different consumption possibility sets, with respect to some arbitrarily chosen set of reference prices q^R. King introduced the concept of equivalent income y^E as an income that affords the same level of utility at the reference price vector as can be afforded under the budget constraint (y, q), $v(y^E, q^R) = v(y, q)$. Subsequently, equivalent income can be rewritten as a function of the remaining arguments from the previous equation, $y^E = y^E(y, q, q^R)$. The equivalent income is then interpreted as a monetary measure of the individual's welfare – that is, it indicates the amount of money necessary to keep an individual's well-being under the given set of reference prices. Therefore, equivalent income can be thought of as the real income, since a marginal change in price would indicate a change in consumer welfare.

The concept of equivalent income is utilized by Besley & Kanbur [29] to develop a framework for the analysis of the impact of taxation on poverty that was further extended by Makdissi and Wodon [23] and Duclos et al. [31]. Within this framework, it is assumed that producers' prices are fixed, so that price of each commodity equals the sum of producer price e_i and respective tax rate t_i, $q_i = e_i + t_i$; the latter implies that $dq_i = dt_i$. Assume that income y is distributed according to certain probability function $F(y)$ over the interval $(0, Y)$. The contribution of an individual with income y to the total poverty is measured by the function $p(y^E, z)$, where z is a given poverty line defined in the equivalent income space. Integration of poverty measure over y^E provides the additive poverty index,

$$P(F, y) = \int_0^Y p(y^E, z)\, dF(y), \quad z < Y, \tag{A1}$$

so that the contribution of the individuals with equivalent income higher than the poverty line equals zero.

If the government decides to change the taxation of some commodity, it will affect equivalent income through change in price and, eventually, the poverty measure through change in equivalent income. Suppose that a set of reference prices is set to the pre-reform prices, $q^R = q$, which further implies that $y^E = y$. In that case, Besley & Kanbur [29] show using Roy's identity that change in equivalent income imposed by the marginal change in taxation can be computed as

$$\left.\frac{dy^E}{dt_i}\right|_{q^R = q} = -x_i(q, y), \tag{A2}$$

where $x_i(q, y)$ is a Marshallian function of demand for good i. As noted by Duclos et al. [31], the previous equation states that "*observed pre-reform consumption of good i is a sufficient statistic to know the impact on consumer welfare of a marginal change in the price of good i*

Going back to poverty measure, change in poverty imposed by the marginal change in taxation reads as

$$\frac{dp}{dt_i} = \frac{\partial p}{\partial y^E}\frac{dy^E}{dt_i} \tag{A3}$$

when (A2) is inserted into (A3), and the RHS of the equation is multiplied and divided by the per capita consumption of good i denoted as X_i, total change in poverty measure can be rewritten as

$$dp = -X_i dt_i \frac{\partial p}{\partial y^E}\frac{dy^E}{dt_i} CD(i; y, 1). \tag{A.4}$$

Makdissi and Wodon [23] introduced concept of consumption dominance curve of the order s, $CD(i;y,s)$, where $CD(i;y,1) = x_i/X_i$ and $CD(i;y,s) = \int_0^y CD(i;y,s-1)$ for orders $s > 1$. Subsequently, change in additive poverty index $P(F,y)$ is obtained by integrating over y,

$$\frac{dP}{dt_i} = -X_i dt_i \int_0^Y \frac{\partial p}{\partial y^E}\frac{dy^E}{dt_i} CD(i;y,1)\, dF(y). \tag{A.5}$$

This can be generalized for any order s. If the higher orders of income distribution F are defined as $D(z,s) = \int_0^z D(y,s-1)dy$, $D(z,s) = F(z)$, they can be expressed in form of stochastic dominance curves of the order s as $D(z,s) = \frac{1}{(s-1)!}\int_0^z (z-y)^{s-1} dF(y)$ [32]. As noted by Duclos et al. [31], dominance curves are just sums of powers of poverty gaps, which can be easily related to the $FGT(z,\alpha)$ poverty indices since $FGT(z,\alpha) = \alpha!\, z^{-\alpha} D(z,\alpha+1)$. Furthermore, CD curve for some good k can be also linked to the $FGT(z,\alpha)$ through stochastic dominance curve since

$$CD(k;z,s) = \frac{\partial D(z,s)}{\partial t_k}. \tag{A.6}$$

This is convenient feature of CD curves, as they can be used to compute impact of a marginal increase in price of good k on the $FGT(z,\alpha)$.

Use of CD curves to analyze impact of indirect taxation on the poverty can be easily extended to comprise revenue-neutral taxation policy in which additional revenues from higher taxation of one good are used to subsidize consumption of some other. Assume that taxed good is X_j and subsidized good is X_l; revenue-neutral condition of tax reform is then imposed as (see, for instance, Makdissi and Wodon [23]):

$$dt_j = \gamma\left(\frac{X_l}{X_j}\right) dt_l,\ \gamma = \frac{X_l + \sum_{k=1}^{K}\frac{\partial X_k}{\partial t_l}}{X_l} \Big/ \frac{X_j + \sum_{k=1}^{K}\frac{\partial X_k}{\partial t_j}}{X_j}, \tag{A.7}$$

where K stands for total number of goods consumed. The coefficient γ in this context represents efficiency cost of taxation, i.e. it indicates deadweight loss from taxation. Makdissi & Wodon [23] further show that for any additive poverty index of order s, sufficient and necessary condition to be poverty-improving $(dP \le 0)$ over the selected interval of poverty lines $z < z^+$ is

$$CD(l;z,s) - \gamma CD(j;z,s) \ge 0,\ \ \forall z < z^+. \tag{A.8}$$

The relation between CD curves may be considered as a measure of the distributional benefit of taxation [18], so the condition (A.8) can be alternatively interpreted as stating that a poverty- improving neutral tax reform is achieved if the distributional benefit is equal to or higher than the efficiency cost.

If the condition A.8 is fulfilled, it can be stated that neutral tax reform is s-order poverty-improving, following the concept of poverty ordering [30]. In case of FGT class of indices, it is straightforward to see that first-order poverty improving means diminishing proportion of poor in total population for the given poverty line (that is, a fall in headcount ratio), and so on. Orders higher than $s = 3$ are rarely used in poverty analysis.

Robustness checks

Supplementary Table S1: Sensitivity of estimated poverty effects to alternative poverty thresholds

Poverty threshold	Threshold (RSD)	Scenario	FGT(0)	FGT (1)	FGT(2)
90% of official line	21,658	Scenario 1	+0.461	+0.205	+0.112
90% of official line	21,658	Scenario 2	+0.923	+0.410	+0.223
Official line	24,064	Scenario 1	+0.516	+0.231	+0.133
Official line	24,064	Scenario 2	+1.033	+0.462	+0.265
110% of official line	26,470	Scenario 1	+0.577	+0.259	+0.153
110% of official line	26,470	Scenario 2	+1.154	+0.519	+0.306

Note. All changes are presented as changes in percentage points