The Bangladesh Cigarette Tax Simulation Model (BDTaXSiM): A practitioner's guide

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Background

Since its ratification of the World Health Organization Framework Convention on Tobacco Control (WHO FCTC) in 2003 and enactment of the national Tobacco Control Law in 2005, Bangladesh has taken various measures to reduce tobacco use. These measures include banning advertisement and promotion of tobacco products, adopting text and graphic health warnings on packs, increasing tax and prices, and enhancing mass media campaigns to raise public awareness about the harms of tobacco use. Even though some progress has been made in reducing tobacco consumption since then, the prevalence of tobacco use among adults (18 years and older) in Bangladesh remains high with respect to smoking (18 percent), and even higher with respect to smokeless tobacco (SLT) use (20.6 percent), with overall tobacco use prevalence at 35.3 percent as of 2017 (Bangladesh Bureau of Statistics; National Tobacco Control Cell 2017). The prevalence of tobacco use among youth is 6.9 percent (World Health Organization 2015).

Taxation on tobacco is one of the most cost-effective and effective tobacco control measures available to governments throughout the world. Since tobacco products are generally price-inelastic, higher tobacco taxes can be a win-win policy as they can generate extra tax revenue for the government while reducing demand, especially among youth, who show relatively higher elasticity of demand for tobacco use. A recent study finds that even though smoking participation among youth in Bangladesh is not sensitive to price changes, smoking intensity is (Ahmed et al. 2022), which means price increases will motivate youth smokers to smoke less.

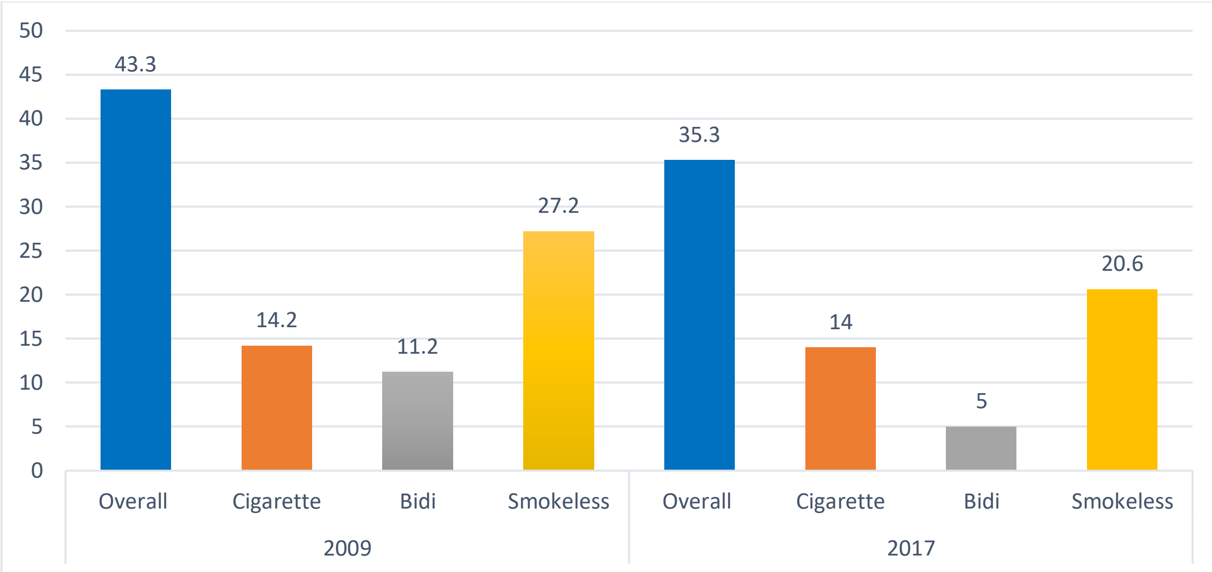
Taxes on cigarettes in Bangladesh are above the WHO benchmark (more than 70 percent of the retail price of the most popular brand of cigarettes). However, the prices of tobacco products are very low. In fact, they are among the lowest in the world (World Health Organization 2021) and the second lowest in the South-East Asia Region (WHO, 2017). Therefore, a high tax share can be misleading as a stand-alone performance measure of tobacco taxation (Nargis et al. 2019). Moreover, Bangladesh experienced relatively high rates of inflation (5.56–12.30 percent) in the last two decades (Ministry of Finance 2021), and tobacco product prices did not keep pace with inflation, which resulted in a lower real price of tobacco products. Rapid income growth in recent decades, coupled with the decreasing real price of tobacco products, has increased their affordability (Nargis et al. 2021).

The effectiveness of tax increases are further marred by the presence of a tiered tax system that may have at least two inadvertent consequences: (i) no or minimal effect on consumption, since consumers may switch to lower-taxed and lower-price alternatives instead of quitting, and (ii) lost government revenue, since manufacturers are induced to reposition brands in lower tax tiers to avoid paying higher taxes when taxes increase (Hossain, M.N.; Abdullah, S M & Huque 2022). As a result, such complex tax systems tend to generate gains for producers through higher profits at the expense of reduced impacts on consumption, public health, and tax revenues.

While the government is putting a lot of emphasis on designing an effective tax system as well as curbing tobacco consumption, the impact may not be optimal if consumers can continue to smoke by switching to lower-price brands despite tax and price increases. It is evident that tobacco industry pricing focuses on cheaper cigarette consumption in Bangladesh (Nargis et al. 2020). Therefore, even though tobacco consumption in Bangladesh has been declining, opportunities for differential taxation and pricing give leeway to brand-switching, especially among lower-income groups. To add to this concern, both the number of adult smokers and smoking intensity (number of cigarettes per adult smoker) increased in recent decades (Table 1). In addition, the prevalence of tobacco consumption is much higher among the poorest segment of the population (Abdullah et al. 2014; Nargis et al. 2015), and the tendency for brand-switching is expected to be strong in this segment of the population.

Therefore, even though overall tobacco consumption in Bangladesh has been declining (Figure 1), holding onto a tiered cigarette tax structure can reduce the effectiveness of tax increases in reducing cigarette smoking, which ultimately may make the target of achieving a tobacco-free country by 2040, as envisioned by the government of Bangladesh, impossible.

Figure 1. Prevalence (%) of different types of tobacco products, 2009 & 2017



Source: Global Adult Tobacco Survey (GATS), Bangladesh, 2009, 2017

Table 1. Trend in number of adult smokers and smoking intensity in Bangladesh, 2009–2017

GATS	Number of adult smokers (million)	Number of cigarettes per adult (sticks)	Number of cigarettes per smoker (sticks)
2009	21.90	498	6,028
2017	22.35	586	7,544

Source: Authors' calculations based on data from the Global Adult Tobacco Survey 2009, 2017

Unless the existing complex tax system is reformed and simplified, tobacco tax will not be effective enough to further accelerate the reduction of tobacco use in Bangladesh. The National Board of Revenue (NBR) of the Ministry of Finance is responsible for imposing and collecting taxes. Even though simplification of tax structures can help increase revenue, the revenue-earning organ of the government rarely takes that opportunity, likely due to two reasons. First, they are hesitant to initiate any larger tax increase or overhaul of the tobacco tax structure, fearing that such a policy may have a negative effect on their revenue-earning potential. Second, they do not have any comprehensive tool to project the immediate and longer-run economic and health impacts of a given tax increase. In other words, potential direct and indirect impacts are not clearly understood.

The WHO TaXSiM model outlines the technical details of projecting the effects of a tax policy change at the country level (World Health Organization 2018). This technical document adapts this model to the specific setting of cigarette tax policy changes in Bangladesh, termed as the Bangladesh Cigarette Tax Simulation Model (BDTaXSiM). Tobacco control experts and partners in Bangladesh have been using this model for several years in the preparation of the annual tobacco tax proposal. The proposal is shared with the NBR and the Ministry of Health and Family Welfare authorities to provide input into the fiscal budget proposal, including tax rates for all tobacco products. The budget is announced on the first Thursday of June by the finance minister for approval by the National Parliament and becomes effective on July 1. This document is intended to serve as a technical companion to the tobacco tax proposal, to discuss in technical detail the estimation of effects the proposed tobacco tax policy changes would have on government revenue, tobacco products sales volume, tobacco industry revenue, and population health.

Objective

The primary objective of this technical document is to tailor the WHO TaXSiM model to the specific circumstances and cigarette tax system in Bangladesh. WHO TaXSiM is a data-intensive model that requires detailed information on tax-paid sales and prices of different brands available for the most popular tobacco product in the consumer market, typically manufactured cigarettes in most countries. In explaining the BDTaXSiM model, this document focuses on the cigarette market in Bangladesh. Based on the data requirement template provided by WHO, additional information can be collected from sources including NBR and previous literature. These data are fed into the BDTaXSiM model to populate the estimates of impacts the planned changes in tobacco tax policy would have on tax revenue, industry revenue, and domestic sales of cigarettes.

This guide will not only provide insights to tobacco control practitioners and advocates about the expected health and economic effects of tobacco tax policy changes in the context of Bangladesh, but it can also be used by researchers as a technical guide to tobacco tax policy simulation.

Cigarette Taxes in Bangladesh

The following table (Table 2) provides cigarette prices and tax rates by price tiers from 2006/2007 to the current fiscal year (2022/2023). Bangladesh imposes supplementary duties on cigarettes at differential rates (as a percentage of retail price) in four price tiers: premium, high, medium, and low. In addition, there is 15-percent value-added tax (VAT) and a one-percent Health Development Surcharge (HDS) applied uniformly across all tiers as a percentage of retail price.

Table 2. Cigarette prices and tax rates, by tier, in Bangladesh from 2006/2007 to 2022/2023

Year	**Premium**		**High**		**Medium**		**Low**	
	Price	**SD**	**Price**	**SD**	**Price**	**SD**	**Price**	**SD**
2006-07	≥ 30.00	57%	18.00-24.99	55%	10.50-12.49	52%	5.25-6.24	32%
2007-08	≥ 35.00	57%	19.00-26.49	55%	12.50-13.49	52%	6.00-6.99	32%
2008-09	≥ 41.00	57%	21.00-28.00	55%	13.25-14.25	52%	6.50-7.50	32%
2009-10	≥ 46.25	57%	23.25-29.25	55%	16.25-17.25	52%	7.25-8.75	32%
2010-11	≥ 52.00	58%	27.00-32.00	56%	18.40-19.00	53%	8.40-9.15	33%
2011-12	≥ 60.00	60%	32.36-36.00	58%	22.50-23.00	55%	11.00-11.30	36%
2012-13	≥ 66.00	61%	35.20-39.50	59%	24.75-25.25	56%	12.10-12.30	39%
2013-14	≥ 80.00	61%	42.00-45.00	59%	28.00-30.00	56%	13.69-13.91	39%
2014-15	≥ 90.00	61%	50.00-54.00	61%	32.50-35.00	60%	15.00-16.50	43%
2015-16	≥ 70.00	64%	≥ 45.00	62%	≥ 45.00	62%	18	48%
2016-17	≥ 70.00	65%	≥ 45.00	63%	≥ 45.00	63%	23	51%
2017-18	≥ 70.00	65%	≥ 45.00	63%	≥ 45.00	63%	27	53%
2018-19	101	65%	75	65%	48	65%	32	55%
2019-20	123	65%	93	65%	63	65%	37	55%
2020-21	128	65%	97	65%	63	65%	39	57%
2021-22	135	65%	102	65%	63	65%	39	57%
2022-23	142	65%	111	65%	65	65%	40	57%

Note: Prices are in Bangladeshi taka.

Source: Nargis et al. (2019) and National Board of Revenue, Ministry of Finance, Government of Bangladesh

From Table 2, it is evident that even though the prices of cigarettes increased over time, the year-on-year changes were not substantial. Besides, the structure of the tax remained very much unaltered. Over the last three fiscal years from 2020/2021 to 2022/2023, the supplementary duty rate remained at 65 percent for the top three price tiers (premium, high, and medium) and significantly lower at 57 percent for the bottom price tier (low). The tax rates are expressed as percentages of retail price. The retail price per pack of cigarettes is recommended by the NBR authority to be used as the base for calculating the tax liability. As such, the tax burden for each pack of cigarette is fixed for every tier, and the current tax system can be characterized as tiered specific.

Assumptions of the Model

The changes in cigarette price, sales, and revenue in response to tax policy changes are simulated with the following assumptions:

1. The producer prices do not change after the tax policy changes.
2. Consumers' income is increased by the amount of GDP growth.
3. Cigarette demand elasticity varies by price category of cigarette brands. The own-price elasticity of demand for low-price brands (low and medium tiers) is -0.1678, and for high-price brands (high and premium tiers) it is -0.2512 (Shimul, S., Hussain 2022).
4. The cross-elasticity of demand for low-price brands with respect to changes in the price of high-price brands is 0.2643, which allows for potential downward substitution of low-price brands for high-price brands in the event of price increases for high-price brands (Shimul, S., Hussain 2022).
5. The income elasticity estimates of demand for cigarettes by price tiers are: -0.1370 for low and medium brands, and 1.4608 for high and premium brands.
6. The tax increase is fully passed onto a price increase.
7. There is no tax avoidance by either consumers or producers of cigarettes.

The BDTaXSiM Model: Baseline scenario

Estimation of cigarette tax revenue

Suppose the supplementary duty for a 10-stick pack is E_b for brand b. The tax rate as a percentage of the retail price for the four tiers is denoted by e_k for $k = 1\ (premium)$, $2\ (high), 3\ (medium), 4\ (low)$. The amount of supplementary duty (E_{bk}) for a 10-stick cigarette pack is calculated as:

$$E_{bk} = e_k * P_{bk}^R \qquad (1)$$

where P_{bk}^R is the recommended price of brand b in tier k and used as the base for calculating the tax as a percentage of retail price.

The amount of VAT per pack of 10-stick cigarettes (V_{bk}) is calculated as follows:

$$V_{bk} = \nu * P_{bk}^{R} \qquad (2)$$

where $\nu = 15\%$ for all price tiers.

The amount of Health Development Surcharge (H_{bk}) for a 10-stick pack is calculated as follows:

$$H_{bk} = h * P_{bk}^{R} \qquad (3)$$

where $h = 1\%$ for all price tiers.

Thus, the total tax on a 10-stick pack of a cigarette brand *b* in tier *k* is determined as follows:

$$T_{bk} = E_{bk} + V_{bk} + H_{bk} \qquad (4)$$

where $E_{bk} + H_{bk}$ is the total excise tax for brand *b*, and V_{bk} is the VAT for brand *b* in tier *k*.

The excise tax revenue, the VAT revenue, and the Health Development Surcharge (HDS) revenue for each brand (b) can be calculated as follows:

$$\begin{aligned} E_{bk}^{Total} &= E_{bk} * S_{bk} \\ V_{bk}^{Total} &= V_{bk} * S_{bk} \qquad (5) \\ H_{bk}^{Total} &= H_{bk} * S_{bk} \end{aligned}$$

where S_{bk} is the sales volume of a 10-stick pack of brand *b* in tier *k*. Subsequently, the total amount of tax revenue from a cigarette brand *b* in tier *k* is calculated as follows:

$$TaxR_{bk} = \sum T_{bk} * S_{bk} \qquad (6)$$

Estimation of consumer and producer price and distribution margin

The final retail price of a cigarette brand that a consumer pays has three broad components. They are:

$$P_{bk}^{R} = P_{bk}^{P} + M_{bk} + T_{bk} \qquad (7)$$

where P_{bk}^{P} is the producer price (cost of production and/or import plus profit), M_{bk} is the distribution margin, and T_{bk} is the total tax per pack of cigarette brand *b* in tier *k*. While there are several actors in the distribution channel (from wholesalers to retail stores/vendors), the amounts of their individual margins can be combined into the total distribution margin (M_{bk}):

$$M_{bk} = t_M * P_{bk}^{R} \qquad (8)$$

where the rate of distributive margin is assumed at $t_M = 10\%$ of retail price for all tiers.

The producer price per pack of cigarettes is, thus, calculated in the model using the following equation:

$$P^P_{bk} = P^R_{bk} - M_{bk} - T_{bk} \qquad (9)$$

Aggregation by tier

As Bangladesh imposes differential tax rates by price tiers, the following calculation of revenues is aggregated by tiers. The average final retail price for all brands in tier k is given by $P^R_k = \frac{\sum_{b=1}^{n_k}(P^R_{bk} * S_{bk})}{\sum_{b=1}^{n_k} S_{bk}}$ for brand b, ranging from 1 to n_k.. The average retail price is weighted by the share of sales of each brand b within tier k. Using the average price for each tier, the excise tax, VAT, HDS, and total tax by tier for a 10-stick pack can be calculated as follows:

$$E_k = e_k * P^R_k$$
$$V_k = v * P^R_k \qquad (10)$$
$$H_k = h * P^R_k$$
$$T_k = E_k + V_k + H_k$$

Now, the excise tax revenue, the VAT revenue, and the HDS revenue for each tier (k) can be calculated as follows:

$$E^{Total}_k = E_k * S_k \equiv \sum_{b=1}^{n_k}(E_{bk} * S_{bk})$$
$$V^{Total}_k = V_k * S_k \equiv \sum_{b=1}^{n_k}(V_{bk} * S_{bk}) \qquad (11)$$
$$H^{Total}_k = H_k * S_k \equiv \sum_{b=1}^{n_k}(H_{bk} * S_{bk})$$

where $S_k = \sum_{b=1}^{n_k} S_{bk}$ is the total sales volume in each tier k.

The total tax revenue—including excise tax, VAT, and HDS—for each tier k can be calculated as follows:

$$TR_k = E^{Total}_k + V^{Total}_k + H^{Total}_k \equiv \sum_{b=1}^{n_k} TR_{bk} \qquad (12)$$

Finally, total excise tax revenue (E), total VAT revenue (V), total HDS revenue (H), and total tax revenue (TR) from cigarettes are calculated as follows:

$$E = \sum_{k=1}^{4} E^{Total}_k \equiv \sum_{b=1}^{N} E^{Total}_{bk}$$

$$V = \sum_{k=1}^{4} V_k^{Total} \equiv \sum_{b=1}^{N} V_{bk}^{Total} \quad (13)$$

$$H = \sum_{k=1}^{4} H_k^{Total} \equiv \sum_{b=1}^{N} H_{bk}^{Total}$$

$$TR = \sum_{k=1}^{4} TR_k \equiv \sum_{b=1}^{N} TR_{bk}$$

where $N = \sum_{k=1}^{4} n_k$.

For each tier, the distribution margin and the producer price for a 10-stick pack in tier *k* will be:

$$M_k = t_M * P_k^R$$

$$P_k^P = P_k^R - M_k - T_k \quad (14)$$

Hence, the total distribution margin (M_k^{Total}), total producer revenue (C_k^{Total}), and total industry revenue (IR_k) for each tier *k* will be as follows:

$$M_k^{Total} = M_k * S_k$$

$$C_k^{Total} = P_k^P * S_k \quad (15)$$

$$IR_k = M_k^{Total} + C_k^{Total}$$

where $P_k^P = \frac{\sum_{b=1}^{n_k}(P_{bk}^P * S_{bk})}{\sum_{b=1}^{n_k} S_{bk}}$ is the average producer price in tier *k*. The average producer price is weighted by the share of sales of each brand *b* within tier *k*. Finally, the total industry revenue (IR) will be:

$$IR = \sum_{k=1}^{4} IR_k \quad (16)$$

The BDTaXSiM Model: Policy intervention scenario

The next step is to estimate the impact of cigarette tax policy changes on cigarette sales, tax revenue, industry revenue, and population health. Suppose the per-pack supplementary duty in tier *k* increases from E_k to E_k'. Assuming the producer price P_k^P remains unchanged after the tax increase and the tax increase is fully passed onto a price increase, the new price is determined as $P_k^{R\prime} = P_k^P + M_k' + T_k'$ through an iterative process, where $M_k' = t_M * P_k^{R'}$ (following equation 8) and $T_k' = E_k' + V_k' + H_k' = E_k' + \nu * P_k^{R'} + h * P_k^{R'}$ (following equations 2 and 3) above.

The supplementary duty E_k may increase in any of the following three forms, depending on how the tax system would be altered:

(1) An increase in the *ad valorem* tax rate from e_k to $e_k{}'$ in equation 11 such that $E_k{}' = e_k{}' * P_k^{R\prime}$.
(2) The *ad valorem* tax system can be replaced with a specific tax system that imposes a fixed amount of tax per pack of cigarettes.
(3) The *ad valorem* tax system can be replaced with a hybrid tax system which is a mix of a specific and an *ad valorem* component.

The percentage change in price in tier *k* after the tax increase is given by:

$$\%\Delta P_k = \left[\frac{\left(\mathrm{P_k^{R\prime}} - \mathrm{P_k^R}\right)}{\mathrm{P_k^R}}\right] * 100 \qquad (17)$$

Estimation of reduction in cigarette sales

To estimate year-on-year changes in sales from any proposed tax policy change, information is needed on how the tax-induced price increase will lead to changes in consumption of cigarettes by price tiers, which is reflected in the price elasticity of cigarette demand estimates by price tiers.

Consumption of a cigarette brand is not only dependent on its own price but it also depends on the income of consumers and the prices of other brands of cigarettes or products that can be close substitutes. Hence, it is important to understand the impact of price or policy changes by price tiers while accounting for income growth and inflation. The sensitivity of consumption of cigarette brands in a specific tier (i) changes in its own price, (ii) the prices of brands in other tiers, and (iii) consumer income is measured by, respectively, the (i) own-price elasticity of demand, (ii) cross-price elasticity of demand, and (iii) income elasticity of demand. The data on cigarette sales and revenue by price tiers for the base period (the complete fiscal year at the time of the analysis) are available from the NBR upon request. Using these data, the projected sales volume in tier *k* can be estimated using the following equation:

$$S_k{}' = S_k * \left[1 + \%\Delta P_k^{own} * \varepsilon_{kp} + \%\Delta P_k^{cross} * \varepsilon_{kc} + \ \%\Delta Y * \varepsilon_Y\right]$$

$$Or, S_k{}' - S_k = \ S_k * \left[1 + \%\Delta P_k^{own} * \varepsilon_{kp} + \%\Delta P_k^{cross} * \varepsilon_{kc} + \ \%\Delta Y * \varepsilon_Y\right] \ (18)$$

where:

$$\%\Delta P_k^{own} = \% \ change \ in \ price \ in \ own - price \ tier$$

$\%\Delta P_k^{cross} = \%\ change\ in\ price\ in\ cross - price\ tier$

$\varepsilon_{kp} = Own - price\ elasticity\ estimate$

$\varepsilon_{kc} = Cross - price\ elasticity\ estimate$

$\%\Delta Y = \%\ change\ in\ income\ (per\ capita\ GDP\ growth\ rate)$

$\varepsilon_Y = Income\ elasticity\ estimate.$

Estimation of change in tax revenue

To estimate the increase in tax revenue from a given tax increase, first the expected revenue is measured in each tier *k* at the new tax level given by $TR'_k = T'_k * S'_k$, following equations 10 and 11, and then aggregated over the four price tiers. The total change in tax revenue from the baseline is then calculated as:

$$\Delta TR = \sum_{k=1}^{4} TR_k{}' - \sum_{k=1}^{4} TR_k \qquad (19)$$

Estimation of change in industry revenue

To estimate the change in industry revenue from a given tax increase, the expected industry revenue is measured in each tier *k* at the new tax level given by $IR'_k = M'_k * S'_k + P_k^P * S'_k$, following equation 15, and then aggregated over the four price tiers. The total change in industry revenue from the baseline is then calculated as:

$$\Delta IR = \sum_{k=1}^{4} IR'_k - \sum_{k=1}^{4} IR_k \qquad (20)$$

Estimation of health impacts

The tax-induced price increase leads to reductions in smoking propensity and intensity, reflected in the reduction in cigarette consumption $(S_k{}' - S_k)$, measured by the reduction in cigarette sales from equation 18. The reductions in smoking propensity and intensity in turn result in health gains due to reductions in smoking-induced diseases and deaths. What follows is a presentation of the step-by-step formulation of this link used for the estimation of the health impacts of cigarette tax and price increases.

Suppose the size of the adult population aged 15 and older is POP_a and the current smoking prevalence among adults is ρ_a. The number of current adult smokers is then:

$$TS_a = POP_a * \rho_a \qquad (21)$$

Similarly, if the size of the youth population under the age of 15 is POP_y, the number of potential future adult smokers is given by:

$$TS_y = POP_y * \ \rho_a \qquad (22)$$

Given the estimate of the price elasticity of adult cigarette smoking prevalence $\left(\varepsilon_{prev}\right)$ from Nargis et al. (2014) at -0.29, the expected reduction in cigarette smoking prevalence among both current and future adults is measured as below:

$$\%\Delta\rho_a = \%\Delta \mathrm{P} * \varepsilon_{prev} \qquad (23)$$

where the percentage change in average cigarette price is given by $\%\Delta P = \left[\frac{\left(P^{R'} - P^R\right)}{P^R}\right] * 100.$

$P^R = \frac{\sum_{k=1}^{4}(P_k^R * S_k)}{\sum_{k=1}^{4} S_k}$ and $P^{R'} = \frac{\sum_{k=1}^{4}(P_k^{R'} * S_k')}{\sum_{k=1}^{4} S_k'}$ are average cigarette prices for all cigarettes before and after the tax-induced price increase, respectively. The average prices are weighted by the corresponding shares of cigarette sales in each tier k.

Note that the smoking prevalence elasticity of -0.29 obtained from Nargis et al. (2014) and used here in assessing the health impact is higher in absolute value than the tier-specific elasticity parameters (-0.1678 for low-price brands and -0.2512 for high-price brands) used in the BDTaXSiM model for projection of changes in cigarette sales and revenue. The price tier-specific price elasticity estimates are not comparable to the previous estimates for three distinct differences in the method of estimation. First, price tier-specific estimation of price elasticity is based on the price sensitivity of the decision to smoke cigarettes, choice of brands from a specific price tier, and the number of cigarettes smoked per day. This approach deviates from the conventional two-step method of price elasticity estimation that accounts for only the decision to smoke and number of cigarettes smoked per day. Second, in previous studies, cigarettes were treated as a homogeneous product without any brand or quality variation. In the price tier-specific analysis, cigarettes are differentiated by price level of brands that allows smokers to switch from high-price to low-price products in response to price increases that can lower price sensitivity particularly at the low end. Third, the price tier-specific elasticities were estimated in a simultaneous regression model for the low- and high-price tiers allowing for interdependence of brand choice from one of the two tiers.

The expected reduced cigarette smoking prevalence among current adults is therefore:

$$\rho_a{}' = \rho_a(1 + \%\Delta\rho_a) \qquad (24)$$

Assuming that cigarette smoking among youth is twice as sensitive to price increases as among adults, the expected reduced cigarette smoking prevalence among the future adults following the prevention of smoking initiation among current youth would be:

$$\rho_a{}'' = \rho_a(1 + 2 * \%\Delta\rho_a) \qquad (25)$$

The expected reduction in the number of cigarette smokers among the current living adult population following the cigarette tax and price increase is thus be given by:

$$\Delta TS_a = POP_a * (\rho_a{}' - \rho_a) \qquad (26)$$

and the expected reduction among the current living youth population is given by:

$$\Delta TS_y = POP_y * (\rho_a{}'' - \rho_a) \qquad (27)$$

According to the US Surgeon General's Report (2004), more than one in two lifetime smokers are likely to die prematurely from smoking-related diseases (U.S. Department of Health and Human Services 2004). Hence, this analysis assumes that the proportion of current and future cigarette smokers who would die prematurely in the lifetime of the current living population is given by φ, which is at least 0.50. In addition, it is assumed that a fraction (λ) of those who quit smoking could survive their normal expected lifetime. The expected reduction in cigarette smoking–attributable deaths from smoking cessation among current adult smokers in response to cigarette tax and price increases in the current period is thus estimated at:

$$\Delta DEATH_a = \Delta TS_a * \varphi * \lambda \qquad (28)$$

For the BDTaXSiM model, λ is assumed to be 0.70.

The expected reduction in cigarette smoking–attributable deaths from the prevention of smoking initiation among the current youth population (who are prospective adult smokers) in response to cigarette tax and price increases in the current period is estimated at:

$$\Delta DEATH_y = \Delta TS_y * \varphi \qquad (29)$$

Conclusion

Designing an optimal tax structure requires estimating the potential impacts of any reforms. Simulation exercises can guide that process. However, a lack of clear understanding by simulation users and policy makers may influence them to overestimate the risks or underestimate the benefits. This technical note, with special consideration of Bangladesh's unique context, provides a comprehensive guideline on tax simulation so that an evidence-based tobacco tax can be implemented.

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