The price sensitivity of cigarette consumption in Bangladesh: evidence from the International Tobacco Control (ITC) Bangladesh Wave 1 (2009) and Wave 2 (2010) surveys

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ABSTRACT

Background In Bangladesh, the average excise tax on cigarettes accounted for just 38% of the average retail price of cigarettes in 2009, and 45% in 2010. Both these rates are well below the WHO recommended share of 70% of the retail price at a minimum. There is thus ample room for raising taxes on cigarettes in Bangladesh.

The objective of the present work was therefore to estimate the price elasticity of demand for cigarettes and the effect of tax increases on the consumption of cigarettes and on tax revenue in Bangladesh.

Methods Based on data from Wave 1 (2009) and Wave 2 (2010) of the International Tobacco Control Bangladesh Survey, we estimated the overall impact of a price change on cigarette demand using a two-part model. The total price elasticity of cigarettes was measured by the sum of the elasticity of smoking prevalence and the elasticity of average daily consumption conditional on smoking participation. The price elasticity estimates were used in a simulation model to predict changes in cigarette consumption and tax revenue from tax and price increases.

Results The total price elasticity of demand for cigarettes was estimated at −0.49. The elasticity of smoking prevalence accounted for 59% of the total price elasticity. The price elasticity of cigarette consumption is higher for people belonging to lower socioeconomic status. Increases in taxes would result in a significant reduction in cigarette consumption while increasing tax revenue.

Conclusions Raising cigarette prices through increased taxation could lead to a win-win-win situation in Bangladesh: it would reduce cigarette consumption, increase tobacco tax revenue and potentially decrease socioeconomic inequities.

INTRODUCTION

Tobacco use is a leading cause of death and disability around the world. Currently, there are 41.1 million people who use tobacco in Bangladesh, including 20.9 million people who smoke.[1] Although an estimated 57 000 people already die each year from tobacco use,[2] this number will climb considerably in the near future. The level of tobacco consumption has been moved even higher in Bangladesh by a bottom-heavy demographic structure (one-third of users are aged below 15 years),[3] widespread illiteracy and poverty (31.5% of the total population lives below the poverty line).[4] By any standards, therefore, tobacco use represents a critical threat to the health and welfare of the Bangladeshi people and strong action must be taken to avert this present and ever-deepening threat.

Bangladesh has a history of commitment to tobacco control. It was the first country to sign the WHO Framework Convention on Tobacco Control (FCTC) and among the first 40 countries to become a Party to the FCTC. In 2005, Bangladesh enacted the Tobacco Control Act (TCA), with the corresponding regulations being implemented in 2006. However, recent evidence from two nationally representative surveys conducted in 2009—the Global Adult Tobacco Survey (GATS)[5] and the International Tobacco Control (ITC) Bangladesh Survey[1]—have found that despite the enactment of the TCA, Bangladesh experienced an alarming increase in tobacco consumption from 2004 to 2009.

In part, the role of the TCA in failing to reduce tobacco consumption and prevalence in Bangladesh may be due to low levels of enforcement of non-tax measures of the TCA, such as the advertising ban and smoke-free public places, and relatively low levels of implementation of warning labels (which, in accordance with the more recent Article 11 Guidelines, should include graphic images rather than the current text-only warnings). However, increases in tobacco excise taxes that increase prices have been proven to result in a decline in overall tobacco use.[6] In this paper, we describe findings from the recent ITC Surveys (2009 and 2010) in Bangladesh that provide evidence in support of the potential effectiveness of increasing excise tax on cigarettes in reducing cigarette consumption in Bangladesh.

We estimated the price and income elasticity of demand for cigarettes in order to examine the effect of cigarette tax and price increases on: (1) an individual's decisions to smoke (ie, smoking prevalence); and (2) the number of cigarettes consumed per day by smokers (ie, smoking intensity). With these results, we estimated the impact of increases in cigarette taxes in Bangladesh.

Existing studies on the price responsiveness of cigarette demand in Bangladesh are very few in number. Using time series data from 1983 to 1999, Ali *et al* estimated statistically insignificant price elasticity of −0.27 and statistically significant income elasticity of 0.62 for cigarettes.[7] Similarly, Guindon *et al* used time series data from 1970 to 2000 and did not find

any statistically significant impact of price change on cigarette demand.[8] A more recent study by Barkat *et al* used time series data from 1984 to 2004 to obtain statistically significant negative price elasticity and positive income elasticity of demand for cigarettes in Bangladesh.[9] These studies are limited by a lack of individual-level data capturing the cross-sectional variation in the factors affecting cigarette demand, as they control for only price and income in estimation and leave out other determinants of cigarette demand. Moreover, these studies are unable to distinguish between the price effects on smoking prevalence and smoking intensity. The present paper offers significant improvement in the data and method of estimating the effect of tax and price increase on cigarette consumption in Bangladesh. The preliminary results of this study were published as working papers of the University of Waterloo, Canada.[10 11]

DATA

The ITC Bangladesh Project was created in 2008 to evaluate the impact of tobacco control legislation in Bangladesh. The ITC Bangladesh Survey is a face-to-face survey conducted by trained interviewers from the Bureau of Economic Research at the University of Dhaka, Bangladesh, in collaboration with the ITC Project team at the University of Waterloo in Canada.

The analysis in this paper is based on data collected in Wave 1 and Wave 2 of the survey, conducted in 2009 and 2010, respectively. The Wave 1 Survey consisted of a nationally representative probability sample of 2510 adult cigarette and bidi smokers and 2116 adult non-smokers aged 15 years and older selected through a multistage cluster sampling design (sampling with probability proportional to population size at the levels of administrative units such as district, upazila/thana and village/ward). These respondents form a cohort. They were contacted again to answer follow-up surveys in 2010 with an attrition rate of 8.3%.

The smokers were oversampled for the purpose of generating a sufficiently large sample size of smokers. For the present analysis, we have limited the sample to cigarette smokers and non-smokers and excluded the bidi smokers. Thus, the final full sample size of pooled observations of cigarette smokers and non-smokers was 8507 and of cigarette smokers was 3652.

BANGLADESH HAS AMPLE ROOM TO RAISE CIGARETTE TAX

The current cigarette tax in Bangladesh is composed of 2 components collected at the producer level: a value added tax (VAT) of 15% of retail price and an excise tax, which is a supplementary duty (SD) imposed as a percentage of the retail price of cigarettes, that varies at different price ranges of cigarette packs of 10 sticks. Between 2009 and 2010, the price bands for the four tiers of cigarette prices were increased and the SD for each tier was raised by 1 percentage point (see table 1). The ranges of price bands are, however, not continuous. The gaps between successive tiers are shown in the row under each tier with corresponding percentage of smokers who reported prices in that range. In order to calculate the average SD, we imputed the tax rate for each price tier to the price gap above that tier up to the lower limit of the next higher tier, in view of the fact that larger percentage of the price reported by smokers falls in the gap above the designated price tier (see last column of table 1). The existence of gaps between price tiers is a definite advantage for the producers because they pay the tax rate corresponding to the lower tier until the retail price reaches the upper tier, while enjoying higher prices and thus greater profit.

Table 2 2009–2010 Cigarette price, excise tax, VAT and consumption

Details	2009	2010
Average cigarette price (2009 Taka per pack of 10)	17.4	19.3
Average excise tax rate (% of retail price)	37.9	45.1
VAT (% of retail price)	15.0	15.0
Average number of cigarettes smoked per day	10.2	10.5

NB: 2010 prices are discounted by 8% to adjust for inflation during 2009–2010.
Source: ITC Bangladesh Survey, 2009, 2010.
ITC, International Tobacco Control; VAT, value added tax.

After weighting by the number of cigarettes smoked per day as reported by individual smokers, we find that the average SD increased from 38% of retail price in 2009 to 45% of retail price in 2010 and average real price of a pack of 10 cigarettes increased from 17.4 to 19.3 Taka in 2009 prices (see table 2). The average SD and cigarette price are driven down by the concentration of smokers in the lowest two price tiers: 79.8% in 2009 and 76.6% in 2010.

Although the real price of cigarettes increased between 2009 and 2010, this was also a time of significant growth of 5.2% in the gross domestic product (GDP) per capita.[12] During this time, the number of cigarettes smoked per day remained almost the same: 10.2 sticks per day in 2009 and 10.5 sticks per day in

Table 1 2009–2010 Cigarette taxes and distribution of smokers by price tiers (weighted by average daily cigarette consumption)

Year of observation	Cigarette price band	Price tier (Taka/pack of 10)	Excise tax (percentage of retail price)	Percentage of cigarette smokers
Wave 1 (2009)	Low	Tier 1: 7.25–8.75	32	10.1
		Gap: 8.75–16.25		63.6
	Medium	Tier 2: 16.25–17.25	52	0.0
		Gap: 17.25–23.25		6.1
	High	Tier 3: 23.25–29.25	55	5.3
		Gap: 29.25–46.25		12.0
	Premium	Tier 4: 46.25 +	57	2.8
Wave 2 (2010)	Low	Tier 1: 8.40–9.15	33	10.0
		Gap: 9.15–18.40		32.9
	Medium	Tier 2: 18.40–19.00	53	1.0
		Gap: 19.00–27.00		32.7
	High	Tier 3: 27.00–32.00	56	14.7
		Gap: 32.00–52.00		7.6
	Premium	Tier 4: 52.00+	58	1.1

Source: National Board of Revenue, Government of Bangladesh; ITC Bangladesh Surveys, 2009, 2010.
ITC, International Tobacco Control.

2010 (table 2). It is likely that the negative effect of a modest price increase on inelastic cigarette demand was more than offset by a strong positive effect of income growth in Bangladesh.

The minor increase in the share of SD in cigarette price, with almost unaltered average consumption, indicates that the Bangladesh government has yet to gain control over cigarette prices and consumption. At the current rates of SD on cigarettes, the average share of SD in the purchase price of cigarettes has remained far below the WHO recommended level of 70%.[13] Thus we find that there is ample room for increasing excise tax on cigarettes.

ECONOMETRIC MODEL OF CIGARETTE DEMAND

In order to estimate the overall impact of a price change on cigarette consumption resulting from lower smoking prevalence as well as lower smoking intensity of existing smokers, we constructed a two-part model following the method of Cragg.[14] The total price elasticity of cigarettes is estimated as the sum of the elasticities of smoking prevalence and smoking intensity. Despite having cohort data, we did not use panel data techniques to estimate the effect of price on cigarette demand that would hold unobserved individual level heterogeneity constant. When we ran a sensitivity analysis using a fixed effects model, the effect of price became statistically insignificant, which is attributable to lack of sufficient variation in the price of cigarettes within observations for the same smoker over the 2 years. However, we expected significant cross-sectional variation in price by geographic area (village), source of purchase and mode/volume of purchase (eg, pack or loose). Therefore, we undertook a pooled cross-sectional analysis of the Wave 1 and Wave 2 survey data. We took into account the within-person correlation of observations by correcting the standard errors (SEs) for repeated observations on the same individual using the cluster correction technique.

In the first step, we estimated the probability of smoking cigarettes as a function of price, demographic characteristics, indicators of socioeconomic status of individuals and rural/urban area of residence. The regression was weighted to adjust for the over-representation of smokers in the survey; 18.9% of the population of adults are cigarette smokers, while this share is 41.8% in the sample. We estimated the smoking probability using the probit model:

$$\begin{aligned}&\Pr(\text{smoking cigarette} = 1)\\&= \Phi(\beta_0 + \beta_1\,\text{Price} + \beta_2\,\text{Household income} + \beta_3\,\text{Female}\\&+ \beta_4\,\text{Age} + \beta_5\,\text{Married} + \beta_6\,\text{Household size} + \Sigma\beta_{7i}\text{Education}_i\\&+ \Sigma\beta_{8j}\,\text{Occupation}_j + \beta_9\text{Household restriction on indoor smoking}\\&+ \beta_{10}\text{Restriction onsmoking in workplace} + \beta_{11}\,\text{Wave 2}\\&+ \beta_{12}\,\text{Urban area of residence} + u)\end{aligned} \tag{1}$$

where $\Phi(.)$ is cumulative normal distribution and u is random disturbance term.

The price elasticity of smoking participation (b_P) is obtained using the following formula:

$$b_P = \phi(.)\beta_1 * \text{Average price}/\text{Population probability of cigarette smoking}$$

where $\phi(.)$ is the normal density valued at the average levels of the explanatory variables and the estimated parameters of equation (1) and β_1 is estimated from equation (1). Similarly, the income elasticity of smoking participation (b_I) is given by:

$$b_I = \phi(.)\beta_2 * \text{Average house hold income}/\text{Population probability of cigarette smoking}$$

In the second step, we estimated the cigarette consumption equation conditional on smoking participation from the following weighted ordinary least squares (OLS) regression:

$$\begin{aligned}\ln(C) =&\alpha_0 + \alpha_1\text{Price} + \alpha_2\text{Household income} + \alpha_3\text{Female}\\&+ \alpha_4\text{Age} + \alpha_5\text{Married} + \alpha_6\text{Household size}\\&+ \Sigma\alpha_{7i}\text{Education}_i + \Sigma\alpha_{8j}\text{Occupation}_j\\&+ \alpha_9\text{Household restriction on indoor smoking}\\&+ \alpha_{10}\text{Restrictionon smoking in workplace}\\&+ \alpha_{11}\text{Wave 2} + \alpha_{12}\text{Urbanarea of residence} + e\end{aligned} \tag{2}$$

where ln is natural logarithm and e is a random disturbance term. This log-linear specification of the conditional demand function is determined by using the Ramsey Regression Equation Specification Error Test (RESET).[15] The coefficients of price and household income, α_1 and α_2, estimated from equation (2) need to be multiplied by the average price and income levels, respectively, to calculate the price and income elasticities of the conditional demand for cigarette consumption. The total price elasticity is given by $b_P+\alpha_1$* Price and the total income elasticity is given by $b_I+\alpha_2$* Income.

One criticism that is often raised in the context of the estimation of demand equation is that self-reported price is an endogenous variable due to the simultaneity of consumption decision and the self-reported price of consumers.[16] The endogeneity of self-reported price can potentially create bias in the estimated effect of price on smoking decision of individuals and their daily cigarette consumption. In order to address this concern, the price variable was constructed by averaging the prices reported by smokers in a specific geographic area of residence (village) for each wave. This price was then assigned to smokers and non-smokers in that area.

In order to address the endogeneity problem, we also estimated a second set of equations using instrumental variable probit model for smoking participation and two-stage least squares (2SLS) model for daily consumption. In the first stage, the price was regressed on the tax variable given by the sum of the SD and the VAT rates along with other socioeconomic and demographic characteristics of individual respondents present in equations (1) and (2). The price variable predicted from the first stage regression was then used in the second stage estimation of smoking participation and daily consumption.

As the SD is ad valorem with four tiers corresponding to four price bands and the rates differ between the 2 years of the survey (table 1), we can identify the price variable in two waves with eight different SD rates. For example, if the price facing an individual was 8 Taka per pack in 2009, the value of the tax variable for that individual is the sum of the corresponding SD rate of 32% and the value added tax of 15%, that is 47%.

The coefficient of the tax variable in the reduced form regression for price is 75.18, which implies that if the tax rate increases by 1 percentage point, the average price per pack of 10 cigarettes increases by 0.75 Taka (see online supplementary table A3). The statistically significant coefficient of the tax

variable indicates that it is highly correlated with price. This tax variable was also tested as a valid instrumental for price, as we found a very large F statistic (greater than 10) in the reduced form regression for price. According to Stock and Watson, if there is one right-hand-side endogenous variable, one can use the F statistic from the first-stage regression to test for the significance of the instrument if the F statistic should be greater than 10.[17]

All the equations were estimated for the tertiles of individuals stratified on the basis of the housing index representing their socioeconomic status (low, medium and high). Thus, we obtained price and income elasticity estimates for the overall population and for population subgroups by socioeconomic status.

RESULTS OF ESTIMATION

The participation equations for cigarette smoking obtained from probit and instrumental probit estimation are reported in tables 3 and 4, respectively. The conditional demand equation for daily cigarette consumption of smokers obtained from OLS and 2SLS estimation are reported in tables 5 and 6, respectively. The tables in the Appendix present the means of the variables used in the estimation (see online supplementary table A1), the reduced form equation for price used in instrumental variable probit model (see online supplementary table A2) and the reduced form equation for price used in the 2SLS model (see online supplementary table A3).

In the instrumental probit regression, the Wald test of exogeneity of regressors was used to test for the orthogonality of the unobserved disturbances in the decision to smoke and the price equation.[18] The Wald χ^2 statistic reported in table 4 rejects the hypothesis of the exogeneity of regressors in the smoking prevalence equation, indicating that self-reported price is endogenous. Similarly, the orthogonality of the unobserved disturbances in the daily consumption of cigarettes and the price equation was tested in the 2SLS regression for the conditional demand function for all smokers. In this regression, the exogeneity of regressors was also rejected as indicated by the statistically significant robust regression F statistics in table 6.

The validity of the use of the tax variable as an instrument for self-reported price is indicated by the estimates of the coefficient of the tax variable that are statistically significantly different from zero in the reduced form price equations corresponding to the instrumental probit and 2SLS regression

Table 3 Probit estimates for prevalence of cigarette smoking (dependent variable 1 if cigarette smoker, 0 if non-smoker)

	Socioeconomic status group			
Demographic	**(1) All**	**(2) Low**	**(3) Medium**	**(4) High**
Cigarette price/pack (2009 Taka)	0.00312 (0.73)	0.000595 (0.07)	−0.000291 (−0.04)	0.0103 (1.36)
Monthly household income (2009 Taka)	0.00312 (0.73)	0.000595 (0.07)	−0.000291 (−0.04)	0.0103 (1.36)
Female	−1.719*** (−21.86)	−1.477*** (−12.13)	−1.822*** (−11.69)	−1.965*** (−12.92)
Age	−0.00863*** (−5.75)	−0.00852*** (−3.82)	−0.00783** (−2.80)	−0.0111*** (−3.58)
Married	0.243*** (4.53)	0.251** (2.93)	0.413*** (4.21)	0.155 (1.49)
Household size	0.0502*** (3.55)	0.0369 (1.57)	0.0535* (1.96)	0.0557* (2.15)
Education				
Primary (1–5 years)	0.177*** (3.42)	0.243*** (3.46)	0.148 (1.60)	−0.211 (−1.38)
Secondary (6–8 years)	0.207*** (3.37)	0.214* (2.40)	0.253* (2.23)	−0.138 (−0.86)
Secondary School Certificate (9–10 years)	0.0968 (1.32)	0.185 (1.47)	0.258* (1.96)	−0.396* (−2.41)
Higher Secondary Certificate (11–12 years)	0.259** (2.68)	0.303 (1.23)	0.648*** (3.38)	−0.283 (−1.62)
Bachelor's (14–16 years)	0.368** (3.15)	1.888*** (5.97)	0.731** (2.64)	−0.164 (−0.92)
Master's (15–17 years)	0.404* (2.25)	−0.119 (−0.18)	–	−0.0791 (−0.33)
Above Master's	−0.0255 (−0.05)	–	–	−0.932 (−1.83)
Occupation				
Tenant farmer	0.144 (1.60)	0.0244 (0.17)	0.267 (1.67)	0.426* (2.17)
Self-employed in non-farm agriculture	−0.221* (−2.07)	−0.165 (−1.14)	−0.601** (−2.94)	0.302 (0.90)
Self-employed in non-agricultural activity	0.191 (1.91)	0.367* (2.23)	0.0903 (0.55)	0.197 (0.95)
Farm wage labourer	0.101 (1.20)	0.0290 (0.24)	0.107 (0.69)	0.664** (3.09)
Non-farm agricultural wage labourer	−0.176 (−0.86)	−0.348 (−0.77)	−0.394 (−0.88)	0.447 (1.35)
Non-agricultural wage labourer	0.339** (3.08)	0.385* (2.22)	0.230 (1.18)	0.699** (2.80)
Professional	−0.625*** (−4.91)	−0.924*** (−3.53)	−0.953** (−3.25)	−0.212 (−0.97)
Managerial/administrative/clerking	−0.111 (−1.10)	−0.281 (−1.69)	−0.210 (−1.13)	0.237 (1.16)
Student	−1.054*** (−10.08)	−1.449*** (−7.33)	−1.383*** (−6.44)	−0.586** (−2.93)
Unemployed	0.0884 (1.09)	0.0471 (0.39)	−0.0234 (−0.16)	0.445* (2.42)
Homemaker	−0.775*** (−6.31)	−0.702*** (−3.74)	−0.826*** (−3.91)	−0.914*** (−3.54)
Others	0.196* (2.51)	0.320** (2.67)	0.161 (1.16)	0.254 (1.52)
Indoor smoking restriction (1 yes, 0 no)	−0.109** (−2.83)	−0.0200 (−0.35)	−0.130 (−1.84)	−0.312*** (−3.68)
Workplace smoking restriction (1 yes, 0 no)	−0.000261 (−0.00)	0.237 (1.72)	−0.0826 (−0.61)	−0.122 (−1.14)
Urban area of residence	0.218*** (3.82)	0.193* (2.06)	0.188 (1.87)	0.208 (1.70)
Wave 2	−0.182*** (−5.14)	−0.302*** (−5.04)	−0.192** (−2.83)	0.0600 (0.77)
Observations	8507	3484	2540	2477

Coefficients are marginal effects. For dummy variables, the marginal effect refers to effect of discrete change in the dummy variable from 0 to 1. The *z* statistics of the coefficients are in parentheses. Omitted categories include male gender, illiterate, owner farmers (occupation), the time effect of wave 1 and rural area of residence.
*p<0.05, **p<0.01, ***p<0.001.

Table 4 Instrumental variable probit estimates for prevalence of cigarette smoking (dependent variable 1 if cigarette smoker, 0 if non-smoker)

	Socioeconomic status group			
Demographic	**(1) All**	**(2) Low**	**(3) Medium**	**(4) High**
Predicted price of cigarette/pack (2009 Taka)	−0.0217*** (−4.83)	−0.0384** (−3.24)	−0.0252** (−3.15)	−0.0104 (−1.29)
Monthly household income (2009 Taka)	0.0000192*** (4.14)	0.0000252** (2.76)	0.0000165 (1.85)	0.0000116 (1.60)
Female	−1.680*** (−21.63)	−1.488*** (−12.32)	−1.783*** (−11.65)	−1.887***(−12.57)
Age	−0.00823*** (−5.61)	−0.00760*** (−3.41)	−0.00811** (−2.96)	−0.00947** (−3.19)
Married	0.222*** (4.16)	0.235** (2.72)	0.388*** (4.00)	0.111 (1.10)
Household size	0.0474*** (3.38)	0.0340 (1.46)	0.0516 (1.93)	0.0554* (2.19)
Education				
Primary (1–5 years)	0.187*** (3.71)	0.269*** (3.83)	0.158 (1.74)	−0.220 (−1.50)
Secondary (6–8 years)	0.236*** (3.89)	0.253** (2.85)	0.283* (2.51)	−0.123 (−0.80)
SSC (9–10 years)	0.142 (1.94)	0.231 (1.82)	0.280* (2.13)	−0.365* (−2.28)
Higher Secondary Certificate (11–12 years)	0.372*** (3.81)	0.422 (1.73)	0.727*** (3.66)	−0.209 (−1.22)
Bachelor's (14–16 years)	0.538*** (4.43)	1.865*** (5.78)	0.848** (2.98)	−0.0831 (−0.46)
Master's (15–17 years)	0.701*** (3.54)	0.0194 (0.03)	–	0.108 (0.43)
Above master's	0.128 (0.26)	–	–	−0.784 (−1.63)
Occupation				
Tenant farmer	0.154 (1.73)	0.0352 (0.25)	0.217 (1.38)	0.458* (2.43)
Self-employed in non-farm agriculture	−0.240* (−2.30)	−0.198 (−1.38)	−0.634** (−3.13)	0.321 (1.02)
Self-employed in non-agricultural activity	0.194* (1.96)	0.361* (2.18)	0.0802 (0.49)	0.253 (1.28)
Farm wage labourer	0.0859 (1.04)	0.0117 (0.10)	0.0674 (0.44)	0.668** (3.24)
Non-farm agricultural wage labourer	−0.166 (−0.78)	−0.210 (−0.48)	−0.453 (−1.01)	0.461 (1.39)
Non-agricultural wage labourer	0.342** (3.15)	0.371* (2.12)	0.197 (1.03)	0.801** (3.28)
Professional	−0.625*** (−4.88)	−0.907*** (−3.44)	−0.973** (−3.27)	−0.140 (−0.67)
Managerial/administrative/clerking	−0.116 (−1.16)	−0.322 (−1.96)	−0.209 (−1.14)	0.283 (1.46)
Student	−1.036*** (−10.01)	−1.403*** (−7.21)	−1.394*** (−6.55)	−0.538** (−2.77)
Unemployed	0.0671 (0.84)	0.0120 (0.10)	−0.0517 (−0.37)	0.445** (2.59)
Homemaker	−0.743*** (−6.19)	−0.656*** (−3.54)	−0.843*** (−4.06)	−0.813** (−3.25)
Others	0.215** (2.77)	0.314** (2.64)	0.165 (1.20)	0.314 (1.96)
Indoor smoking restriction (1 yes, 0 no)	−0.0912* (−2.41)	−0.0227 (−0.40)	−0.119 (−1.70)	−0.258** (−3.16)
Workplace smoking restriction (1 yes, 0 no)	0.0277 (0.39)	0.300* (2.13)	−0.0345 (−0.25)	−0.136 (−1.29)
Urban area of residence	0.341*** (6.28)	0.277** (2.90)	0.264** (2.82)	0.356** (3.21)
Wave 2	−0.178*** (−5.11)	−0.266*** (−4.42)	−0.190** (−2.83)	0.0717 (0.95)
Observations	8507	3484	2540	2477
Wald test of exogeneity				
χ^2	45.88	19.52	11.87	32.67
p Value	0.00	0.00	0.00	0.00

Coefficients are marginal effects. For dummy variables, the marginal effect refers to effect of discrete change in the dummy variable from 0 to 1. The *z* statistics of the coefficients are in parentheses. Omitted categories include male gender, illiterate, owner farmers (occupation), the time effect of wave 1 and rural area of residence. The reduced form estimate of the price equation is reported in online appendix in table A2.
*p<0.05, **p<0.01, ***p<0.001.

(reported in online supplementary tables A2 and A3, respectively). The large value of the robust F statistic (greater than 10) in online supplementary table A3 also shows that the tax variable is not a weak instrument for self-reported price. Therefore, we accepted the instrumental variables estimates of the coefficients of the price variable for smoking prevalence and conditional demand functions for the purpose of estimating the price elasticity of demand for cigarettes.

Given the statistical significance and negative sign of the estimates of the price coefficient and the validity of the instrument used in the instrumental variable probit and 2SLS regressions, we used the corresponding estimated coefficients of price and income to calculate the price and income elasticity at the mean price level (table 7). The total price elasticity was −0.49 for the full sample indicating that a 10% increase in the price of cigarettes is expected to lead to 4.9% reduction in cigarette consumption. Most estimates of price elasticity of cigarette demand in low-income and middle-income countries range from −0.5 to −1.0, while those for high-income countries tend to fall in the range of −0.25 to −0.5.[19] The present estimate is on the lower side of this range and lies between the short run price elasticity of −0.41 and long run price elasticity of −0.57 obtained in a previous study in Bangladesh.[9] Further, we obtained the instrumental variable estimate of the total income elasticity at 0.23 (table 7), which implies that 10% increase in household income is expected to lead to 2.3% growth in cigarette consumption

IMPACT OF TAX INCREASES AND CHANGES IN TAX STRUCTURE ON CIGARETTE CONSUMPTION AND REVENUE

Using the price and income elasticity estimates for cigarette smoking prevalence and conditional cigarette demand, we simulated tax increases and different tax structures to assess the effect of those changes on overall cigarette consumption and tax revenue. The results are reported in table 8. The baseline year was set in the fiscal year 2012–2013 with the existing four-tiered tax structure and the projection was made for 2013–

Table 5 OLS estimates of conditional demand for cigarettes

	Socioeconomic status group			
Dependent variable, Ln (daily consumption)	**(1) All**	**(2) Low**	**(3) Medium**	**(4) High**
Cigarette price, 2009 Taka/pack	−0.0118*** (−4.85)	−0.0276*** (−4.75)	−0.00420 (−0.99)	−0.00602 (−1.47)
Monthly household income (2009 Taka)	0.00000889*** (3.31)	0.0000247*** (4.12)	0.00000506 (1.06)	0.00000235 (0.60)
Female	0.0140 (0.12)	−0.174 (−1.40)	0.0393 (0.14)	0.212 (1.05)
Age	−0.00116 (−1.13)	−0.000754 (−0.45)	−0.00386* (−2.43)	0.000757 (0.42)
Married	0.0839** (2.65)	0.0114 (0.20)	0.110* (2.11)	0.134* (2.48)
Household size	−0.00893 (−1.02)	−0.0231 (−1.24)	0.0280* (2.14)	−0.0285* (−2.24)
Education				
Primary (1–5 years)	0.0983* (2.46)	0.114 (1.92)	0.0636 (1.11)	0.0695 (0.77)
Secondary (6–8 years)	0.0722 (1.72)	0.215*** (3.37)	−0.0104 (−0.16)	−0.0665 (−0.73)
Secondary School Certificate (9–10 years)	0.0573 (1.16)	0.0880 (1.04)	0.0310 (0.42)	−0.0390 (−0.38)
Higher Secondary Certificate (11–12 years)	0.0108 (0.19)	0.0608 (0.43)	−0.163 (−1.63)	−0.0147 (−0.15)
Bachelor's (14–16 years)	0.0824 (1.22)	−0.167 (−0.91)	0.0347 (0.25)	0.0630 (0.61)
Master's (15–17 years)	−0.149 (−0.92)	0.289 (0.84)	−0.307 (−1.13)	−0.183 (−0.95)
Above Master's	0.0216 (0.11)	−0.150 (−0.48)	–	−0.0984 (−0.44)
Occupation				
Tenant farmer	0.204** (3.01)	0.288** (2.61)	0.187 (1.76)	0.173 (1.15)
Self-employed in non-farm agriculture	0.170* (2.16)	0.174 (1.64)	0.291* (2.05)	0.0517 (0.33)
Self-employed in non-agricultural activity	0.275*** (4.09)	0.201 (1.75)	0.311** (3.06)	0.250 (1.83)
Farm wage labourer	0.177** (2.72)	0.0873 (0.92)	0.266** (2.61)	0.284 (1.91)
Non-farm agricultural wage labourer	0.175 (0.95)	−0.434 (−1.17)	0.363 (1.91)	0.342 (1.88)
Non-agricultural wage labourer	0.274*** (3.80)	0.312** (2.95)	0.378*** (3.51)	0.109 (0.67)
Professional	0.174 (1.62)	0.596*** (3.40)	0.0234 (0.10)	0.168 (1.07)
Managerial/administrative/clerking	0.236** (3.05)	0.194 (1.52)	0.301** (2.62)	0.107 (0.68)
Student	0.0857 (0.69)	0.0264 (0.09)	0.393 (1.45)	−0.0420 (−0.22)
Unemployed	0.260*** (4.06)	0.258** (2.77)	0.341** (3.28)	0.172 (1.21)
Homemaker	0.0948 (0.68)	0.0377 (0.15)	0.207 (0.83)	0.0990 (0.43)
Others	0.236*** (3.92)	0.251** (2.78)	0.331*** (3.38)	0.105 (0.80)
Indoor smoking restriction (1 yes, 0 no)	−0.0405 (−1.52)	0.0119 (0.28)	−0.0547 (−1.27)	−0.147** (−3.17)
Workplace smoking restriction (1 yes, 0 no)	−0.0612 (−1.65)	0.0418 (0.63)	−0.0393 (−0.59)	−0.113* (−1.97)
Urban area of residence	0.0482 (1.53)	0.112* (2.08)	−0.00815 (−0.18)	−0.0159 (−0.25)
Wave 2	0.0851** (2.81)	0.103* (1.98)	0.0507 (1.02)	0.157* (2.48)
Observations	3652	1311	1134	1207
Adjusted R^2	0.030	0.061	0.042	0.057

The *t* statistics of the coefficients are in parentheses. Omitted categories include male gender, illiterate, owner farmers (occupation), the time effect of wave 1 and rural area of residence.
*p<0.05, **p<0.01, ***p<0.001.
OLS, ordinary least squares.

2014. The SD rates are higher in 2012–2013 than those prevailing in the survey years 2009 and 2010 shown in table 1.

Three alternative tax structures were simulated to assess the possible impact of tax policy changes on cigarette consumption and revenue: (1) uniform ad valorem tax at the rate of 61% of retail price of cigarettes; (2) uniform ad valorem tax at the rate of 61% of retail price of cigarettes with a specific minimum of 20 Taka (in 2012–2013 prices) per pack of 10 cigarettes; and (3) uniform specific tax of 22 Taka (in 2012–2013 prices) per pack of 10 cigarettes.

These alternatives were chosen so that the average excise tax per pack of cigarettes is comparable across the three options as shown in the first row of table 8.

The baseline population size is 152 518 015 as projected for 2012 in the Bangladesh Population and Housing Census 2011 and the adult population constitutes 69% of the total population.[3] The adult population size was multiplied with the cigarette smoking prevalence rate to estimate the number of cigarettes smokers in Bangladesh in 2012–2013. We projected the negative impact of the tax policy changes onto the number of adult smokers and the annual cigarette consumption using the price elasticities of smoking participation and conditional demand for cigarettes, respectively.

The annual rate of per capita GDP growth is 4.9% in 2013, according to the projection of the IMF.[12] The income elasticities of cigarette smoking participation and daily cigarette consumption were used to project the positive impact of income growth on the number of smokers and conditional demand for cigarettes, respectively. In addition, we took into account the growth in the number of adult smokers driven by population growth at the annual rate of 1.24%. The price increases were adjusted for inflation at the annual rate of 8%.

The net changes caused by price and income growth in the number of smokers, annual cigarette consumption and tax revenue are presented in table 8. Overall, the annual projection reveals that cigarette consumption could be reduced and cigarette tax revenue increased significantly by the simulated changes in the tax rates and structure. The highest price increases and decreases in the number of smokers and annual cigarette consumption occur under the uniform specific tax system, while the

Table 6 Instrumental variable 2SLS estimates of conditional demand for cigarettes

	Socioeconomic status group			
Demographic	**(1) All**	**(2) Low**	**(3) Medium**	**(4) High**
ln (predicted price of cigarettes, 2009 Taka/pack)	−0.0110*** (−5.67)	−0.0161*** (−3.69)	−0.00543 (−1.91)	−0.00923** (−3.05)
Monthly household income (2009 Taka)	0.0000116*** (4.19)	0.0000267*** (4.50)	0.00000529 (1.15)	0.00000707 (1.65)
Female	0.0193 (0.16)	−0.181 (−1.38)	0.0227 (0.08)	0.237 (1.09)
Age	−0.00212* (−2.03)	−0.00175 (−1.03)	−0.00442** (−2.82)	−0.000407 (−0.21)
Married	0.0815* (2.57)	0.0132 (0.24)	0.108* (2.09)	0.134* (2.45)
Household size	−0.0102 (−1.17)	−0.0224 (−1.21)	0.0286* (2.25)	−0.0321** (−2.59)
Education				
Primary (1–5 years)	0.0972* (2.45)	0.0991 (1.67)	0.0641 (1.14)	0.0786 (0.90)
Secondary (6–8 years)	0.0949* (2.26)	0.189** (2.99)	0.0230 (0.34)	−0.0387 (−0.44)
Secondary School Certificate (9–10 years)	0.0889 (1.81)	0.103 (1.24)	0.0500 (0.70)	−0.00190 (−0.02)
Higher Secondary Certificate (11–12 years)	0.0656 (1.11)	0.109 (0.86)	−0.120 (−1.14)	0.0345 (0.35)
Bachelor's (14–16 years)	0.154* (2.25)	−0.0570 (−0.31)	0.0883 (0.64)	0.126 (1.19)
Master's (15–17 years)	−0.0158 (−0.09)	0.475 (1.82)	−0.218 (−0.75)	−0.0661 (−0.33)
Above Master's	0.0668 (0.34)	−0.106 (−0.39)	–	−0.0165 (−0.07)
Occupation				
Tenant farmer	0.202** (3.01)	0.274* (2.49)	0.182 (1.73)	0.198 (1.36)
Self-employed in non-farm agriculture	0.150 (1.95)	0.174 (1.64)	0.274 (1.94)	0.0201 (0.13)
Self-employed in non-agricultural activity	0.263*** (3.97)	0.178 (1.54)	0.308** (3.08)	0.259* (1.98)
Farm wage labourer	0.163* (2.52)	0.0624 (0.65)	0.261** (2.58)	0.286* (2.02)
Non-farm agricultural wage labourer	0.208 (1.08)	−0.462 (−1.25)	0.352 (1.77)	0.405* (2.25)
Non-agricultural wage labourer	0.243*** (3.41)	0.278** (2.64)	0.364*** (3.45)	0.0884 (0.57)
Professional	0.154 (1.41)	0.516** (2.58)	0.0301 (0.13)	0.153 (1.01)
Managerial/administrative/clerking	0.228** (3.02)	0.191 (1.52)	0.303** (2.73)	0.121 (0.80)
Student	0.0859 (0.70)	0.148 (0.56)	0.370 (1.44)	−0.0244 (−0.13)
Unemployed	0.248*** (3.91)	0.263** (2.76)	0.338** (3.29)	0.148 (1.12)
Homemaker	0.0735 (0.52)	0.0334 (0.14)	0.206 (0.84)	0.0787 (0.35)
Others	0.238*** (3.96)	0.227* (2.49)	0.340*** (3.55)	0.118 (0.93)
Indoor smoking restriction (1 yes, 0 no)	−0.0345 (−1.29)	0.0242 (0.57)	−0.0538 (−1.25)	−0.134** (−2.92)
Workplace smoking restriction (1 yes, 0 no)	−0.0595 (−1.61)	0.00811 (0.13)	−0.0415 (−0.63)	−0.102 (−1.80)
Urban area of residence	0.0158 (0.55)	0.0740 (1.34)	−0.0216 (−0.51)	−0.0162 (−0.31)
Wave 2	0.0813** (2.68)	0.0975 (1.89)	0.0560 (1.14)	0.158* (2.44)
Observations	3652	1311	1134	1207
Adjusted R^2	0.022	0.051	0.046	0.043
Test of endogeneity: H0: variables are exogenous				
Robust regression F	11.73	2.62	0.53	5.41
p Value	0.00	0.11	0.46	0.02

The *z* statistics of the coefficients are in parentheses. Omitted categories include male gender, illiterate, owner farmers (occupation), the time effect of wave 1 and rural area of residence. The reduced form estimate of the price equation is reported in online appendix in table A3.
*p<0.05, **p<0.01, ***p<0.001.
2SLS, two-stage least squares.

highest revenue gain and tax share in the retail price occur under the uniform ad valorem tax system. Therefore, it appears that the revenue goal is better served with an ad valorem tax system while the public health outcome is improved under specific tax system. The ad valorem tax with a specific minimum could achieve greater reduction in consumption than the uniform ad valorem excise system and could also narrow the price gap between the lowest and the upper price bands.

Table 7 The estimates of price and income elasticity of demand for cigarettes in Bangladesh

	Price elasticity				Income elasticity			
Factor	**All**	**Low**	**Medium**	**High**	**All**	**Low**	**Medium**	**High**
Smoking prevalence: Probit (A)	0.04	0.01	−0.00	0.13	0.09	0.13	0.08	0.07
Smoking prevalence: IV Probit (B)	−0.29	−0.50	−0.31	−0.15	0.13	0.14	0.10	0.09
Conditional demand: OLS (C)	−0.21	−0.43	−0.07	−0.14	0.08	0.17	0.04	0.03
Conditional demand: 2SLS (D)	−0.20	−0.25	−0.09	−0.21	0.10	0.18	0.04	0.09
Total (B+D)	−0.49	−0.75	−0.40	−0.36	0.23	0.33	0.15	0.18

'Low', 'Medium' and 'High' refers to the socioeconomic status of respondents based on housing index. The total price elasticity is obtained by summing the IV probit estimates in row B and the 2SLS estimates in row D.
OLS, ordinary least squares; 2SLS, two-stage least squares.

Table 8 The simulated impact of increase in cigarette tax on cigarette consumption and revenue in Bangladesh

Factor	Baseline: Tiered ad valorem (low: 39%, medium: 56%, high: 59%, premium: 61% of retail price)	Simulation A: uniform ad valorem at 61% of retail price	Simulation B: uniform ad valorem at 61% of retail price with a specific minimum of 20 Taka (in 2012 prices) per pack of 10 sticks	Simulation C: uniform specific tax of 22 Taka (in 2012 prices) per pack of 10 sticks
Average excise tax per pack of 10 sticks (2012 Taka)	11.89	20.90	21.18	21.57
Average excise tax share in retail price (%)	53%	61%	61%	57%
Average total tax (excise tax and VAT) share in retail price (%)	68%	76%	76%	72%
Average price per pack of 10 sticks (in 2012 Taka)	22.46	34.26	34.65	35.67
Percentage change in real price		53%	54%	59%
Number of cigarette smokers (million)	19.9	16.4	16.2	15.7
Annual consumption (million packs of 10 sticks)	7603	5490	5388	5125
Percentage change in annual consumption		−27.8%	−29.1%	−32.6%
Revenue (million in 2012 Taka)	116 045	154 372	153 497	142 376
Percentage change in real revenue		33.0%	32.3%	22.7%

DISCUSSION

The negative price elasticities of smoking prevalence and smoking intensity show that increasing the price of cigarettes in Bangladesh could significantly lower the number of smokers and their daily cigarette consumption. These findings of price elasticity of demand for cigarettes have important implications for public health. For a smoker, positive health benefits are realised to a greater extent for quitting than for reducing consumption. Thus, the proportion of the total price elasticity that is accounted for by elasticity of smoking prevalence is relevant to an understanding of the impact of increasing price on quitting. For high-income countries, the proportion of the total price elasticity that is accounted for by elasticity of smoking prevalence is about 50%.[6 20] From our analysis of ITC Bangladesh Survey data, the proportion is 0.29/0.49=59%. Thus, if taxes were increased on cigarettes in Bangladesh, there would be a greater impact on reducing the prevalence rate (leading to greater gains in enhancing health at the population level) than would be the case in most other countries.

Furthermore, on estimating the cigarette demand function for three groups (low, medium and high socioeconomic status), we observed that the price elasticity of smoking prevalence and smoking intensity were higher the lower the socioeconomic status (SES). The instrumental variable estimates of the price elasticity of smoking prevalence vary from −0.50 (probit) for the low SES population to −0.31 for the medium SES group to −0.15 for the high SES group (table 7). The 2SLS estimates of the price elasticity of smoking intensity vary from −0.25 for low SES group to −0.09 for medium SES group to −0.21 for high SES group (table 7). The total price elasticity is thus measured at −0.75 for the low SES group, −0.40 for the medium SES group and −0.36 for the high SES group. These estimates suggest that poorer people are more price sensitive than the rich and can thus reap greater health gains from increased tax and prices of cigarettes, revealing a behavioural response pattern consistent with the global evidence.[6]

The finding that the overall price elasticity of cigarette demand is less than 1 (−0.49) implies that a given percentage increase in cigarette price leads to a less than proportionate decrease in cigarette consumption, resulting in greater tobacco expenditure and greater tax revenue for the government. Many would contemplate that this would create a disproportionate burden of tobacco expenditure on the poor. The price elasticity estimates by SES, however, reveal that the price elasticity is higher for low SES, which implies that if prices increased, the poor would cut down cigarette consumption at higher rates than the rich, which would lower the burden of tobacco expenditure and the adverse health consequences on the poor. Ultimately, tax increases that would raise prices would lead to a decrease in the existing inequities in health in Bangladesh.

CONCLUSION

The analysis of the ITC Bangladesh Survey across two waves affirms analyses conducted in high-income countries as well as in a growing number of low-income and middle-income countries that increasing cigarette tax and price can significantly reduce consumption of cigarettes through reduced smoking prevalence and through lower smoking intensity in continuing smokers. Moreover, in Bangladesh, as in other countries, the impact of increasing price is higher among lower SES people. Whereas in other countries the impact of increasing price on reducing prevalence is about the same as the impact on reducing consumption among smokers, in Bangladesh, the impact on reducing prevalence is about 1.5 times that of reduced consumption, and therefore in Bangladesh the impact of increasing price through taxation would have a considerably greater impact on reducing health harms of tobacco use than in other countries.

We also conclude that raising cigarette taxes and prices can increase government revenue. At the same time, the greater price sensitivity of cigarette consumption among poorer people leads us to conclude that the poor would benefit more from a given cigarette price increase. This would result in a reduction in the inequities of the burden of tobacco consumption that currently exist in Bangladesh, with the negative health and economic impacts of tobacco use being experienced to a much greater extent among the poor. These findings suggest that raising cigarette prices through increased taxation can lead to a win-win-win situation in Bangladesh: it will reduce cigarette consumption, increase tobacco tax revenue and potentially decrease socioeconomic inequities.

What this paper adds

- This is the first cigarette demand analysis based on nationally representative individual level survey data collected in Bangladesh.
- Using the price elasticity estimates obtained from the study itself, this paper generates a prediction of reduction in cigarette smoking prevalence and daily use and an increase in government revenue.
- These results may be useful for informed decision making by government in tobacco control through taxation.

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Contributors NN is the lead author of the paper. UHR conducted the econometric estimation of the price elasticity of cigarette demand. AKMGH ran the simulation to evaluate the impact of tax increase on cigarette consumption and revenue. GTF is the chief investigator of the ITC Project and a coauthor of the paper. IH is the project manager of the ITC Bangladesh Project. SMA is the principal investigator of the ITC Bangladesh Project and a coauthor of the paper.

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Patient consent Obtained.

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Appendix

Table A1: Summary statistics (mean and standard error) for full sample and by socio-economic status (SES) in pooled cross-section data.

Variables	All	Low	Medium	High
Cigarette smokers (%)	40.0	35.4	41.8	44.4
	(0.51)	(0.78)	(0.94)	(0.95)
Cigarette price per pack (2009 Taka)	18.82	13.97	16.96	26.06
	(0.22)	(0.24)	(0.38)	(0.45)
Monthly household income (2009 Taka)	9,189	6,902	8,558	12,943
	(56.29)	(61.94)	(85.53)	(116.26)
Female (%)	36.9	39.8	35.6	34.1
	(0.50)	(0.80)	(0.92)	(0.91)
Age	37.4	37.4	37.6	37.2
	(0.16)	(0.26)	(0.30)	(0.28)
Married (%)	78.7	80.9	79.1	75.3
	(0.44)	(0.66)	(0.80)	(0.86)
Household size	4.01	3.67	4.13	4.35
	(0.02)	(0.03)	(0.03)	(0.03)
Education (%):				
Illiterate	27.1	39.6	26.0	10.6
	(0.48)	(0.82)	(0.86)	(0.61)
Primary (1-5 years)	30.3	35.4	34.6	18.5
	(0.50)	(0.81)	(0.94)	(0.78)
Secondary (6-8 years)	19.8	16.6	21.9	22.3
	(0.43)	(0.63)	(0.81)	(0.83)
SSC (9-10 years)	10.7	6.0	11.6	16.5
	(0.33)	(0.40)	(0.63)	(0.74)
HSC (11-12 years)	5.9	1.9	4.1	13.3
	(0.25)	(0.23)	(0.39)	(0.68)
Bachelor's (14-16 years)	4.7	0.4	1.7	13.8
	(0.23)	(0.10)	(0.26)	(0.69)
Master's (15-17 years)	1.5	0.1	0.2	4.8
	(0.13)	(0.06)	(0.08)	(0.43)
Above Master's	0.1	0.1	0.0	0.3
	(0.03)	(0.04)	(0.00)	(0.10)
Occupation (%):				
Owner farmer	5.8	6.1	7.6	3.6
	(0.24)	(0.39)	(0.51)	(0.36)
Tenant farmer	7.2	6.1	7.4	8.6
	(0.27)	(0.39)	(0.50)	(0.54)
Self-employed in non-farm agriculture	3.0	5.0	2.2	1.2
	(0.18)	(0.36)	(0.28)	(0.21)
Self-employed in non-agricultural activity	4.9	3.8	6.5	5.0
	(0.23)	(0.31)	(0.47)	(0.42)
Variables	All	Low	Medium	High

Farm wage laborer	8.8	10.4	8.6	6.7
	(0.30)	(0.50)	(0.54)	(0.48)
Non-farm agricultural wage laborer	0.8	0.4	0.4	1.6
	(0.09)	(0.31)	(0.13)	(0.24)
Non-agricultural wage laborer	3.9	3.6	4.0	4.2
	(0.20)	(0.31)	(0.38)	(0.38)
Professional	3.0	1.5	2.1	6.1
	(0.18)	(0.20)	(0.28)	(0.46)
Managerial/administrative/clerking	4.5	3.7	4.7	5.7
	(0.22)	(0.31)	(0.41)	(0.44)
Student	15.0	15.6	14.1	15.1
	(0.37)	(0.60)	(0.67)	(0.69)
Unemployed	10.8	12.0	11.0	9.0
	(0.32)	(0.53)	(0.60)	(0.55)
Homemaker	17.2	18.8	16.9	15.3
	(0.40)	(0.64)	(0.72)	(0.69)
Others	15.0	13.1	14.4	18.1
	(0.37)	(0.56)	(0.68)	(0.74)
Indoor smoking restriction (%)	59.4	52.2	59.4	69.2
	(0.51)	(0.82)	(0.94)	(0.88)
Workplace smoking restriction (%)	7.4	4.0	6.7	12.8
	(0.27)	(0.32)	(0.48)	(0.64)
Urban area of residence (%)	36.3	17.2	33.4	65.2
	(0.50)	(0.62)	(0.90)	(0.91)

Note: The standard errors of mean values are in parentheses.

Table A2: Estimates of the reduced form equation for cigarette price in Table 4.

Dependent variable: Price of cigarette-2009 Taka/pack	(1) All	(2) Low	(3) Medium	(4) High
Tax (%)	43.98***	26.35***	43.19***	51.96***
	(62.88)	(40.06)	(30.20)	(39.42)
Monthly household income (2009 Taka)	0.000145***	0.00000760	0.0000674**	0.000151***
	(9.85)	(0.45)	(3.22)	(5.70)
Female	-0.473*	-0.483**	-0.203	-1.151*
	(-2.37)	(-2.66)	(-0.63)	(-2.47)
Age	-0.00570	0.0148***	-0.0144*	-0.00331
	(-1.51)	(3.86)	(-2.24)	(-0.35)
Married	-0.125	-0.143	0.280	-0.443
	(-0.82)	(-0.85)	(1.02)	(-1.31)
Household size	-0.0800*	-0.0277	-0.0167	-0.177*
	(-2.10)	(-0.76)	(-0.26)	(-2.16)
Education:				
Primary (1-5 years)	0.0778	0.457***	0.260	-0.533
	(0.65)	(3.95)	(1.21)	(-1.32)
Secondary (6-8 years)	0.485**	0.636***	0.903**	0.0349
	(3.05)	(4.01)	(2.82)	(0.08)
SSC (9-10 years)	0.846***	0.609**	0.558	0.251
	(4.02)	(2.88)	(1.36)	(0.55)
HSC (11-12 years)	2.573***	1.494**	2.543***	1.160*
	(8.57)	(2.64)	(4.26)	(2.29)
Bachelor's (14-16 years)	4.305***	-1.339	2.423*	2.305***
	(8.60)	(-1.15)	(2.32)	(3.60)
Master's (15-17 years)	8.987***	2.025	.	5.982***
	(6.77)	(0.74)	.	(4.78)
Above Master's	3.416	.	.	0.934
	(1.79)	.	.	(0.50)
Occupation:				
Tenant farmer	0.190	0.127	-1.023*	1.493*
	(0.64)	(0.45)	(-2.21)	(2.00)
Self-employed in non-farm agriculture	-0.354	-0.437	-1.012*	0.666
	(-1.26)	(-1.54)	(-2.02)	(0.58)
Self-employed in non-agricultural activity	-0.217	-0.000790	-0.785	1.319
	(-0.67)	(-0.00)	(-1.38)	(1.93)
Farm wage laborer	-0.336	0.00212	-0.863	-0.235
	(-1.27)	(0.01)	(-1.47)	(-0.30)
Non-farm agricultural wage laborer	0.193	2.561*	-2.947	2.778
	(0.18)	(2.04)	(-1.83)	(1.60)
Non-agricultural wage laborer	-0.0178	0.241	-1.346*	2.326*
	(-0.04)	(0.56)	(-2.55)	(2.04)

	(1) All	(2) Low	(3) Medium	(4) High
Non-agricultural	-0.820	0.157	-1.061	0.225
wage laborer	(-1.69)	(0.27)	(-1.27)	(0.27)
Professional	-0.334	-0.564	-0.527	0.415
	(-1.02)	(-1.54)	(-0.87)	(0.61)
Managerial/administrati-	-0.300	0.0757	-0.988*	0.318
ve/clerking	(-1.03)	(0.26)	(-1.98)	(0.47)
Student	-0.707**	-0.631*	-1.014*	0.0732
	(-2.71)	(-2.46)	(-2.30)	(0.12)
Unemployed	0.440	0.649*	-0.266	1.637*
	(1.64)	(2.26)	(-0.60)	(2.55)
Homemaker	0.246	-0.0588	-0.000141	1.268*
	(0.84)	(-0.24)	(-0.00)	(2.13)
Others	-0.820	0.157	-1.061	0.225
	(-1.69)	(0.27)	(-1.27)	(0.27)
Indoor smoking	0.316**	-0.0628	0.188	0.296
restriction (1 yes, 0 no)	(2.84)	(-0.65)	(0.90)	(0.99)
Workplace smoking	0.605*	1.394***	0.871	0.277
restriction (1 yes, 0 no)	(1.96)	(3.87)	(1.83)	(0.51)
Urban area of	2.666***	1.635***	1.291***	3.763***
Residence	(18.17)	(8.32)	(5.04)	(11.70)
Wave 2	-1.471***	-0.166	-1.518***	-1.631***
	(-10.27)	(-1.09)	(-6.51)	(-5.00)
Observations	8507	3484	2540	2477

Notes:
1. Columns 1, 2 ,3 and 4 report results for all, low, medium and high socio-economic status groups respectively.
2. The z statistics of the coefficients are in parentheses. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$
3. Omitted categories include male, illiterate, owner farmers (occupation), the time effect of wave 1, and rural area of residence.

Table A3: Estimates of the reduced form equation for cigarette price in Table 6.

Dependent variable: cigarette price-2009 Taka	(1) All	(2) Low	(3) Medium	(4) High
Supplementary duty	75.18***	62.14***	77.37***	82.53***
	(25.73)	(14.94)	(11.08)	(25.67)
Monthly household	0.00***	0.00	0.00	0.00***
income (Taka)	(5.21)	(0.68)	(0.26)	(5.41)
Female	1.01	-0.30	-1.40	3.28
	(0.81)	(-0.46)	(-1.14)	(1.05)
Age	-0.04***	-0.01	-0.05*	-0.06**
	(-3.60)	(-1.20)	(-1.98)	(-2.33)
Married	0.32	-0.15	0.71	0.51
	(0.72)	(-0.49)	(0.67)	(0.55)
Household size	-0.10	-0.12	0.31	-0.23
	(-0.84)	(-1.24)	(0.98)	(-1.27)
Education:				
Primary (1-5 years)	0.17	0.05	1.01*	-0.44
	(0.51)	(0.13)	(2.09)	(-0.40)
Secondary (6-8 years)	1.19	-0.30	3.67*	-0.33
	(1.85)	(-0.69)	(2.09)	(-0.33)
SSC (9-10 years)	0.89	0.71	1.43	-0.28
	(1.70)	(1.09)	(1.81)	(-0.24)
HSC (11-12 years)	2.67***	1.46	4.12**	0.79
	(3.64)	(0.94)	(3.48)	(0.66)
Bachelor's (14-16 years)	3.57***	3.29	4.26	1.38
	(3.72)	(1.60)	(1.73)	(1.05)
Master's (15-17 years)	11.00**	2.67**	3.87	9.11
	(2.57)	(2.76)	(0.92)	(1.87)
Above Master's	5.23*	3.47***	-	4.15
	(2.22)	(4.03)		(1.15)
Occupation:				
Tenant farmer	0.77	-0.35	-0.35	2.62**
	(1.79)	(-0.76)	(-0.46)	(2.31)
Self-employed in non-farm agriculture	0.06	-0.28	0.19	-1.57
	(0.13)	(-0.55)	(0.22)	(-1.30)
Self-employed in non-agricultural activity	1.14*	0.19	-0.10	3.10**
	(2.09)	(0.35)	(-0.11)	(2.52)
Farm wage laborer	0.53	0.12	0.06	0.55
	(1.18)	(0.28)	(0.06)	(0.45)
Non-farm agricultural wage laborer	1.18	-0.09	-5.71**	4.06
	(0.64)	(-0.10)	(-2.34)	(1.40)
Non-agricultural	-0.54	0.67	-0.47	-2.29

wage laborer	(-0.97)	(1.20)	(-0.53)	(-1.62)
	(1)	(2)	(3)	(4)
	All	Low	Medium	High
Professional	-1.93	-0.37	-1.61	-2.36
	(-1.36)	(-0.22)	(-0.56)	(-1.08)
Managerial/administrati-	0.51	-0.95	0.46	1.98
ve/clerking	(0.69)	(-1.46)	(0.32)	(1.27)
Student	1.90	2.37	-1.96	3.02
	(1.10)	(0.75)	(-0.45)	(1.25)
Unemployed	0.44	0.79	-0.04	-0.39
	(0.85)	(1.05)	(-0.05)	(-0.37)
Homemaker	1.17	-0.95	1.39	3.31
	(1.08)	(-1.28)	(0.48)	(1.61)
Others	1.20	0.31	1.88	1.82
	(1.81)	(0.72)	(1.06)	(1.54)
Indoor smoking	0.30	0.17	-0.56	0.68
restriction (1 yes, 0 no)	(0.66)	(0.52)	(-0.40)	(0.85)
Workplace smoking	0.31	1.14*	-0.29	-0.12
restriction (1 yes, 0 no)	(0.61)	(2.12)	(-0.32)	(-0.13)
Urban area of	1.65***	1.08**	0.08	2.93***
Residence	(4.16)	(2.28)	(0.10)	(4.16)
Wave 2	-3.94***	-4.02***	-4.24***	-3.75***
	(-11.69)	(-8.27)	(-7.07)	(-5.34)
Constant	-25.21***	-16.81***	-25.49***	-30.65***
	(-15.68)	(-9.28)	(-6.80)	(-10.02)
Observations	3652	1311	1134	1207
Adjusted R^2	0.52	0.49	0.37	0.51
Robust F statistic	661.96	222.95	122.80	658.42

Notes:

1. Columns 1, 2 ,3 and 4 report results for all, low, medium and high socio-economic status groups respectively.
2. The *t* statistics of the coefficients are in parentheses. $^{*}\ p < 0.05$, $^{**}\ p < 0.01$, $^{***}\ p < 0.001$
3. Omitted categories include male, illiterate, owner farmers (occupation), the time effect of wave 1, and rural area of residence.

孟加拉卷烟消费的价格敏感度：源自国际烟草控制政策评估项目（ITC）在孟加拉的第一轮（2009）和第二轮（2010）调查的证据

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▶ 更多材料仅于网上公布。如需参考请浏览在线杂志。(http://dx.doi.org/10.1136/tobacco-control-2012-050835)

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摘要

背景 孟加拉2009年平均卷烟消费税仅占平均卷烟零售价格的38%，而2010年也只占45%。这两个比例都远低于WHO所推荐的至少占平均零售价格的70%。因此，在孟加拉卷烟税还有很大的提升空间。本研究的目的就是估算卷烟的需求价格弹性以及提高卷烟税对孟加拉卷烟消费和税收的的影响。

方法 我们采用ITC孟加拉调查的第一轮（2009）和第二轮调查（2010）数据，使用一个包含两个部分的模型来估计价格改变对卷烟需求的总影响。卷烟总价格弹性分为吸烟率总弹性和基于吸烟参与程度的日均卷烟消费量弹性两个部分。此价格弹性估计应用于模拟模型中来预测卷烟税和烟草价格增加对卷烟消费和税收的影响。

结果 模型估计的卷烟的需求价格弹性约为-0.49。其中，吸烟率的弹性占总价格弹性的59%。处于较低社会经济地位的人群的卷烟消费量对价格变化更加敏感。提高卷烟税有助于卷烟消费的显著下降和税收收入的增加。

结论 通过提高卷烟税来提高卷烟价格将在孟加拉形成一个“三赢”局面：减少卷烟消费量，增加卷烟税收收入，并可能缓解社会经济上的不平等。

前言

在世界范围内，烟草是导致死亡和残疾的主要原因之一。目前，在孟加拉有4110万人使用烟草，其中2090万人吸烟[1]。据估计每年有57000人死于烟草使用[2]，然而这个数目在不远的将来还将大幅攀升。由于其梨形的人口结构（15岁以下的烟草使用者占全部烟草使用者的1/3）[3]，普遍的贫困和缺乏教育（31.5%的人口生活在贫困线以下）[4]，孟加拉的烟草消费甚至会提高到一个更高的水平。因此，无论以哪种标准来看，烟草使用已成为孟加拉人民的身体健康和社会繁荣的巨大威胁，它所带来的严重后果必须依靠有力的举措来缓解和避免。

孟加拉一直以来都致力于烟草控制。它是第一个签署WHO《烟草控制框架公约》（FCTC）的国家，也是首批40个缔约国之一。孟加拉于2005年颁布了烟草控制法案（TCA），并在2006年实行了相应的规章制度。然而，由2009年度两个具有全国代表性的调查（全球成人烟草调查（GATS）[5]和国际烟草控制政策评估项目（ITC）孟加拉调查[1]）提供的最新证据显示，尽管颁布了TCA法案，孟加拉的烟草消费在2004至2009的5年间依然持续大幅增长。

在某种程度上，TCA法案之所以没能限制孟加拉的烟草消费和流行，部分原因可能是由于TCA法案中的非税收措施（例如禁止吸烟广告和公共场所禁烟）的执行力度较低，以及警示标识的相对低水平应用（依据最新的11条指导方针，警示标识不应该仅有警示文字，还应包括警示图片）。然而，提高烟草消费税已被证明是总体减少烟草使用的一种有效手段[6]。本文描述了ITC孟加拉调查项目（2009年和2010年）的调查结果。这些结果提供证据支持了通过提高消费税来减少孟加拉卷烟消费的潜在有效性。

为了研究卷烟税和卷烟价格增加对吸烟率（是否吸烟）和吸烟量（吸烟者日均卷烟消费量）的影响，我们估算了卷烟需求的价格弹性和收入弹性。通过这些结果，我们估算了提高孟加拉卷烟税将造成的影响。

目前，只有为数不多的研究关注了孟加拉的卷烟需求对价格变化的响应。Ali等人使用1983年至1999年的时间序列数据估算出卷烟的价格弹性为-0.27（不显著），收入弹性为0.62（显著）[7]。相似的，Guindon等人使用了1970年至2000年的时间序列数据进行分析，没有发现价格变化对卷烟需求有任何显著性的影响[8]。Barkat 等人利用孟加拉1984年至2004年的时间序列数据，得到了卷烟负向显著的价格弹性和正向显著的收入弹性[9]。这些研究在估算中只考虑了价格和收入因素而忽略了其他影响卷烟需求的因素的变化，缺乏个体水平横向数据，因而所得到的结果具有一定局限性。而且，这些研究无法区分卷烟价格对吸烟率和吸烟量的影响。

本文应用更高质量的数据和更完善的方法，估算了孟加拉卷烟税和卷烟价格的提高对烟草消费的影响。本研究的初步结果已作为加拿大滑铁卢大学的工作论文发表[10,11]。

数据

ITC孟加拉调查始于2008年，是为了评估孟加拉烟草控制立法的影响而建立的。ITC孟加拉调查由孟加拉达卡大学经济学系的调查员执行，所有调查员都经过事先培训。调查以面对面的方式进行，并由孟加拉达卡大学经济学系和加拿大滑铁卢大学的ITC项目组合作完成。

本文中的数据分别来自于2009年和2010年进行的第一轮和第二轮调查。第一轮调查由具有全国代表性的样本组成，其中有2510名成年吸烟者（包括吸卷烟者和吸Bidi者）和2116名15岁及以上的成年非吸烟者。这些样本通过多阶段分组抽样获取（在行政单位水平上，如县、分县和村/区，采用与人口规模成比例的概率进行抽样）。这些受访者作为一个同期组群，并于2010年再次列入随访调查。其中，失访率为8.3%。

为了得到一个足够多的吸烟人群的样本，我们对吸烟者进行了过度的抽样。出于本文的分析目的，在抽样中我们只考虑了卷烟吸烟者和非吸烟者，排除了吸Bidi者。最后我们得到了包含8507个卷烟吸烟者或非吸烟者的完整样本，其中卷烟吸烟者样本占了3652个。

孟加拉的卷烟税尚有充足的提升空间

目前，孟加拉的烟草税由两部分构成，它们都是在烟草的生产层面予以征收的。这两个部分分别是占零售价格15%的增值税（VAT）和一种消费税，其中消费税是一种按照零售价的一定比例予以征收的附加税（SD），而这一比例依10支装卷烟价格的不同而不同。卷烟按其价格被分为4个价格等级，同一等级中的卷烟按零售价格的相同比例征收附加税（SD）。2009到2010年，四个等级的卷烟价格上涨，每一等级的附加税（SD）也随之上涨了1%（见表1）。然而，不同等级的价格范围是不连续的。两个相邻价格等级之间的价格差显示在每个等级的下一行，同时表格还包含了每个等级中报告了该等级价格范围的吸烟者比例。鉴于吸烟者报告的卷烟价格大多位于价格等级之间的中空带，为了计算平均附加税（SD），每个价格等级的附加税率被用于充当位于该等级和更高一个等级之间中空带的附加税率（见表1最后一列）。显然，把零售价格定在价格等级之间的中空带对于生产者来说是一个优势，因为他们可以以较高的零售价格销售，却只需要按相对较低的税率纳税。如此，生产者享受着更高价格带来的更大利润。

表2 2009–2010年卷烟价格、消费税、增值税和消费情况

详细说明	2009年	2010年
平均卷烟价格(2009 Taka 10支每包的卷烟)	17.4	19.3
平均消费税率 (%，占零售价的百分比)	37.9	45.1
增值税率 (%，占零售价的百分比)	15.0	15.0
平均每日吸烟数量	10.2	10.5

注：2010 价格以8%为贴现率，以适合2009–2010的通货膨胀。
来源：ITC 孟加拉调查, 2009, 2010。
ITC, 国际烟草控制政策评估项目; VAT,增值税。

表1 2009–2010年每个卷烟价格等级的烟草税和吸烟者分布（以平均每日吸烟量加权）

观察年	卷烟价格带	价格等级 (Taka/10支每包的卷烟)	消费税(占零售价的百分比)	吸烟者百分比
第一轮调查(2009)	低	等级 1: 7.25 – 8.75	32	10.1
		等级间隔: 8.75 – 16.25		63.6
	中	等级 2: 16.25 – 17.25	52	0.0
		等级间隔: 17.25 – 23.25		6.1
	高	等级 3: 23.25 – 29.25	55	5.3
		等级间隔: 29.25 – 46.25		12.0
	昂贵	等级4: 46.25 +	57	2.8
第二轮调查 (2010)	低	等级 1: 8.40 – 9.15	33	10.0
		等级间隔: 9.15 – 18.40		32.9
	中	等级 2: 18.40 – 19.00	53	1.0
		等级间隔: 19.00 – 27.00		32.7
	高	等级3: 27.00 – 32.00	56	14.7
		等级间隔: 32.00 – 52.00		7.6
	昂贵	等级 4: 52.00+	58	1.1

来源：孟加拉政府，国家财政部；ITC孟加拉调查, 2009, 2010。

在依据吸烟者自报的的日均吸烟量加权后，我们发现平均附加税（SD）占零售价格的比例从2009年的38%增加到2010年的45%，并且，以2009年的Taka货币价值为准，每包10支装的卷烟的平均实际价格从17.4Taka增加到19.3Taka（见表2）。由于位于最低的两个价格等级的卷烟吸引了多数吸烟者（其比例在2009和2010年分别为79.8%和76.6%），平均附加税和平均卷烟价格因此被拉低。

尽管卷烟的实际价格在2009年和2010年之间增加了，但是与此同时人均国内生产总值（GDP）也显著增加了5.2%[12]。在这段时期中，日均卷烟消费量几乎维持在同样的水平：2009年的每天10.2支和2010年的每天10.5支（见表2）。这可能是由于在孟加拉卷烟需求的价格弹性较弱而收入弹性较强，价格小幅增长对卷烟需求的负面影响被收入增加所带来的正面影响所抵消。

附加税（SD）在卷烟价格中所占份额的微小增长，以及几乎没有变化的卷烟平均消费水平，说明孟加拉政府尚未对卷烟价格和消费取得控制。鉴于目前的卷烟附加税率（SD），附加税在卷烟零售价格中所占的比例仍然远低于WHO所建议的70%[13]。因此孟加拉的卷烟消费税尚有充足的提升空间。

卷烟需求的计量经济模型

为了从降低吸烟率和吸烟强度两个方面来估计价格变化带来的整体影响，我们依据Cragg的方法构建了一个二部分模型[14]。卷烟的总价格弹性用吸烟率弹性和吸烟强度弹性的总和来估计。尽管我们的数据具有队列数据的特点，我们没有采用面板数据技术来估计价格对卷烟需求的影响，因为该技术把个体层面未观测到的异质性设定为常数。当我们运用固定效应模型进行敏感性分析时，得到的价格的影响不显著，这是由于2年间同一吸烟者的观测值中，卷烟的价格缺乏足够的变化。然而，我们预期价格在地理区域（农村）、购买源和购买模式/购买量（如，购买整包或购买散烟）上有显著的横断面变异。因此，我们对第一轮和第二轮的调查数据进行了混合横断面分析，并通过对同一个体的重复观测值采用集群校正技术来校正标准误差 (SEs)，进而考虑了观测值个体内的相关性。

第一步，我们将吸烟概率作为价格、人口学特征、个体的社会经济状态指标和农村/城市居住面积的函数进行估计同时应用加权回归来调整调查中吸烟者的代表性；18.9%的成年人群是卷烟吸烟者，然而他们在样本中所占比例是41.8%。我们运用probit模型来估计吸烟概率。

$$\begin{aligned}&\Pr(\text{吸卷烟}=1)\\&=\Phi(\beta_0+\beta_1\,\text{价格}+\beta_2\,\text{家庭收入}+\beta_3\,\text{女性}\\&+\beta_4\,\text{年龄}+\beta_5\,\text{已婚}+\beta_6\,\text{家庭规模}+\Sigma\beta_{7i}\,\text{教育}_i\\&+\Sigma\beta_{8j}\,\text{职业}_j+\beta_9\,\text{家庭对室内吸烟的限制}\\&+\beta_{10}\,\text{工作场所吸烟限制}+\beta_{11}\,\text{第二轮调查}\\&+\beta_{12}\,\text{城市居住面积}+u)\end{aligned}\qquad(1)$$

这里 Φ(.)是累积正态分布，u是随机误差。

吸烟参与度的价格弹性(b_P)由以下公式获得：

$$b_P=\varphi(.)\beta_1 * \text{卷烟的平均价格/人群的吸烟概率}$$

这里φ(.)是解释变量和方程（1）的估计参数在均值水平的正态密度取值。β_1 从方程（1）估计。同样地，吸烟参与的收入弹性(b_I)由以下函数获得：

$$b_I=\varphi(.)\beta_2 * \text{平均家庭收入/吸烟的人口概率}$$

第二步，用如下的加权普通最小二乘回归，我们估计了在吸烟参与的条件下卷烟的消费方程。

$$\begin{aligned}&\ln(C)=\alpha_0+\alpha_1\text{价格}+\alpha_2\text{家庭收入}+\alpha_3\text{女性}\\&+\alpha_4\text{年龄}+\alpha_5\text{已婚}+\alpha_6\text{家庭规模}\\&+\Sigma\alpha_{7i}\text{教育}_i+\Sigma\alpha_{8j}\text{职业}_j\\&+\alpha_9\text{家庭对室内吸烟的限制}\\&+\alpha_{10}\text{工作场所吸烟限制}\\&+\alpha_{11}\text{第二轮调查}+\alpha_{12}\text{城市居住面积}+e\end{aligned}\qquad(2)$$

这里ln是自然对数函数，e是随机误差项。这个条件需求函数的对数线性形式是通过拉姆齐模型设定误差检验法(RESET)[15] 来确定的。从方程（2）估计的价格和家庭收入的系数α_1和α_2必须分别乘以平均价格和平均收入水平，来估算对于卷烟消费的条件需求的价格弹性和收入弹性。总的价格弹性为$b_P+\alpha_1$*价格，总的收入弹性为 $b_I+\alpha_2$*收入。

由于消费者的消费决定和自报价格具有同时性，自报价格是一个内生变量，这成为需求等式估计经常遭到质疑的原因之一[16]。自报价格的内生性可能导致在估计价格对个体的吸烟决定和日常卷烟消费时产生偏误。为了解决这个问题，我们通过对每次调查中居住在某个特定居住地（村庄）的吸烟者所报告的卷烟价格取平均值来构造价格变量。然后，这一平均价格被分配给该地区的吸烟者和非吸烟者。

为了解决内生性的问题，我们应用基于辅助变量的probit模型来估计吸烟参与度，然后应用两阶段最小二乘模型来估计日常卷烟消费量。在第一阶段，我们将附加税率和增值税率求和以构建税收变量，然后以价格作为因变量，税收变量和出现在等式（1）和等式（2）中的其他社会经济或人口学特征变量作为自变量，进行回归分析。从第一阶段的回归中得到的价格变量预测随之被运用于第二阶段对吸烟参与度和日均消费量的估计中。

由于附加税是一种从价税，并且在调查的两年间，相关的四个价格等级及其税率都不同（表1），我们可以用两次调查中的8个不同的附加税税率来确定价格变量。例如，假设在2009年某个个体面对的卷烟价格是每包8 Taka，该个体的卷烟税变量的值是相应的32%的附加税税率和15%的增值税的总和，即47%。

在对价格的简化型回归中，卷烟税变量的系数是75.18。这说明如果税率增加1%，那么每包10支装卷烟的平均价格增加0.75Taka（参考在线补充表A3）。卷烟税变量的系数是统计显著的，表明卷烟税和卷烟价格高度相关。同时，我们对价格的简化型回归模型进行F检验，得到了一个很大的F统计量（大于10），说明卷烟税变量可以作为价格的一个有效的辅助变量。依据Stock和Watson的研究， 如果存在一个内生自变量，那么，在第一阶段回归的F统计量大于10的情况下，这个F统计量可以用来检验辅助变量的显著性[17]。

以代表个体的社会经济地位的房屋指数为依据，我们将所有个体划分为三个层次（低，中，高），所有的等式都在这三个层次上分别进行估计。因此，我们得到了整个人群和依据社会经济状况分组的亚人群的价格弹性和收入弹性的估 计值。

估计结果

表3和表4分别记录了通过probit模型和辅助变量probit模型所得到的吸烟参与度方程。通过OLS和2SLS估计得到的吸烟者每日卷烟消费量的条件需求方程，结果分别见表5和表6。附录中的表记录了在估计中使用的变量均值（参考在线补充表A1），在辅助变量probit模型中运用的价格简化型方程（参考在线补充表A2），以及在2SLS模型中使用的价格简化型方程（参考在线补充表A3）。

在辅助变量probit回归模型中，用于检验自变量外生性的Wald检验被用来检验在吸烟决定和价格方程中未被观测的扰动项的正交性[18]。表4中报告的Wald χ^2统计量拒绝了吸烟率方程中自变量外生性假设，表明自报的卷烟价格具有内生性。类似地，我们对每日卷烟消费量和价格的方程未观测的扰动项的正交性在对所有吸烟者的条件需求函数的2SLS回归中进行了检验，得到的稳健回归F统计量是统计显著的（见表6），因此检验拒绝了自变量外生性的原假设。

由于在辅助变量probit回归和2SLS回归（分别参考在线补充表A2和A3）的相应的价格简化模型中，卷烟税变量的系数估计值都是统计上显著不为0的，这表明了卷烟税作为自报价格的辅助变量的有效性。在线补充表A3中，稳健F统计量（大于10）具有较大的值，这也显示卷烟税变量是自报价格的一个有效的辅助变量。因此，为了估计卷烟需求的价格弹性，我们将价格变量系数的辅助变量估计值用于吸烟率和吸烟强度的估计中。

表3 吸烟率的probit模型估计（吸烟者，因变量为1，非吸烟者，因变量为0）

	社会经济状况分组			
人口学特征	**(1) 合计**	**(2) 低**	**(3) 中**	**(4) 高**
卷烟价格/包 (2009 Taka)	0.00312 (0.73)	0.000595 (0.07)	-0.000291 (-0.04)	0.0103 (1.36)
每月家庭收入 (2009 Taka)	0.00312 (0.73)	0.000595 (0.07)	-0.000291 (-0.04)	0.0103 (1.36)
女性	-1.719*** (-21.86)	-1.477*** (-12.13)	-1.822*** (-11.69)	-1.965*** (-12.92)
年龄	-0.00863*** (-5.75)	-0.00852*** (-3.82)	-0.00783** (-2.80)	-0.0111*** (-3.58)
已婚	0.243*** (4.53)	0.251** (2.93)	0.413*** (4.21)	0.155 (1.49)
家庭规模	0.0502*** (3.55)	0.0369 (1.57)	0.0535* (1.96)	0.0557* (2.15)
教育				
小学(1-5 年)	0.177*** (3.42)	0.243*** (3.46)	0.148 (1.60)	-0.211 (-1.38)
中学 (6-8 年)	0.207*** (3.37)	0.214* (2.40)	0.253* (2.23)	-0.138 (-0.86)
中学毕业 (9-10 年)	0.0968 (1.32)	0.185 (1.47)	0.258* (1.96)	-0.396* (-2.41)
高中毕业(11-12 年)	0.259** (2.68)	0.303 (1.23)	0.648*** (3.38)	-0.283 (-1.62)
学士 (14-16 年)	0.368** (3.15)	1.888*** (5.97)	0.731** (2.64)	-0.164 (-0.92)
硕士 (15-17 年)	0.404* (2.25)	-0.119 (-0.18)	-	-0.0791 (-0.33)
硕士以上	-0.0255 (-0.05)	-	-	-0.932 (-1.83)
职业				
佃农	0.144 (1.60)	0.0244 (0.17)	0.267 (1.67)	0.426* (2.17)
从事非农场农业的个体户	-0.221* (-2.07)	-0.165 (-1.14)	-0.601** (-2.94)	0.302 (0.90)
从事非农业活动的个体户	0.191 (1.91)	0.367* (2.23)	0.0903 (0.55)	0.197 (0.95)
农场打工的劳工	0.101 (1.20)	0.0290 (0.24)	0.107 (0.69)	0.664** (3.09)
非农场农业打工的劳工	-0.176 (-0.86)	-0.348 (-0.77)	-0.394 (-0.88)	0.447 (1.35)
非农业打工的劳工	0.339** (3.08)	0.385* (2.22)	0.230 (1.18)	0.699** (2.80)
专业人员	-0.625*** (-4.91)	-0.924*** (-3.53)	-0.953** (-3.25)	-0.212 (-0.97)
管理的/行政的/职员	-0.111 (-1.10)	-0.281 (-1.69)	-0.210 (-1.13)	0.237 (1.16)
学生	-1.054*** (-10.08)	-1.449*** (-7.33)	-1.383*** (-6.44)	-0.586** (-2.93)
失业	0.0884 (1.09)	0.0471 (0.39)	-0.0234 (-0.16)	0.445* (2.42)
家庭主妇	-0.775*** (-6.31)	-0.702*** (-3.74)	-0.826*** (-3.91)	-0.914*** (-3.54)
其他	0.196* (2.51)	0.320** (2.67)	0.161 (1.16)	0.254 (1.52)
室内吸烟限制 (1 是, 0 否)	-0.109** (-2.83)	-0.0200 (-0.35)	-0.130 (-1.84)	-0.312*** (-3.68)
工作场所吸烟限制(1 是, 0 否)	-0.000261 (-0.00)	0.237 (1.72)	-0.0826 (-0.61)	-0.122 (-1.14)
城市居住地区	0.218*** (3.82)	0.193* (2.06)	0.188 (1.87)	0.208 (1.70)
第二轮调查	-0.182*** (-5.14)	-0.302*** (-5.04)	-0.192** (-2.83)	0.0600 (0.77)
观察值	8507	3484	2540	2477

系数有边际效应。对于0-1变量，边际效应是指0-1变量从0到1变化时离散变化的效应。系数的z统计量在括号中。省略的分类包括男性, 文盲, 有土地的农民 (职业), 第一轮调查的时间效应以及农村居住地区。

*p<0.05, **p<0.01, ***p<0.001。

表4 吸烟率的辅助变量probit模型估计（吸烟者，因变量为1，非吸烟者，因变量为0）

	社会经济状况分组			
人口学特征	**(1) 合计**	**(2) 低**	**(3) 中**	**(4) 高**
卷烟的预测价格/包 (2009 Taka)	-0.0217*** (-4.83)	-0.0384** (-3.24)	-0.0252** (-3.15)	-0.0104 (-1.29)
每月家庭收入 (2009 Taka)	0.0000192*** (4.14)	0.0000252** (2.76)	0.0000165 (1.85)	0.0000116 (1.60)
女性	-1.680*** (-21.63)	-1.488*** (-12.32)	-1.783*** (-11.65)	-1.887*** (-12.57)
年龄	-0.00823*** (-5.61)	-0.00760*** (-3.41)	-0.00811** (-2.96)	-0.00947** (-3.19)
已婚	0.222*** (4.16)	0.235** (2.72)	0.388*** (4.00)	0.111 (1.10)
家庭规模	0.0474*** (3.38)	0.0340 (1.46)	0.0516 (1.93)	0.0554* (2.19)
教育				
小学(1-5 年)	0.187*** (3.71)	0.269*** (3.83)	0.158 (1.74)	-0.220 (-1.50)
中学 (6-8 年)	0.236*** (3.89)	0.253** (2.85)	0.283* (2.51)	-0.123 (-0.80)
中学毕业 (9-10 年)	0.142 (1.94)	0.231 (1.82)	0.280* (2.13)	-0.365* (-2.28)
高中毕业(11-12 年)	0.372*** (3.81)	0.422 (1.73)	0.727*** (3.66)	-0.209 (-1.22)
学士 (14-16 年)	0.538*** (4.43)	1.865*** (5.78)	0.848** (2.98)	-0.0831 (-0.46)
硕士 (15-17 年)	0.701*** (3.54)	0.0194 (0.03)	-	0.108 (0.43)
硕士以上	0.128 (0.26)	-	-	-0.784 (-1.63)
职业				
佃农	0.154 (1.73)	0.0352 (0.25)	0.217 (1.38)	0.458* (2.43)
从事非农场农业的个体户	-0.240* (-2.30)	-0.198 (-1.38)	-0.634** (-3.13)	0.321 (1.02)
从事非农业活动的个体户	0.194* (1.96)	0.361* (2.18)	0.0802 (0.49)	0.253 (1.28)
农场打工的劳工	0.0859 (1.04)	0.0117 (0.10)	0.0674 (0.44)	0.668** (3.24)
非农场农业打工的劳工	-0.166 (-0.78)	-0.210 (-0.48)	-0.453 (-1.01)	0.461 (1.39)
非农业打工的劳工	0.342** (3.15)	0.371* (2.12)	0.197 (1.03)	0.801** (3.28)
专业人员	-0.625*** (-4.88)	-0.907*** (-3.44)	-0.973** (-3.27)	-0.140 (-0.67)
管理的/行政的/职员	-0.116 (-1.16)	-0.322 (-1.96)	-0.209 (-1.14)	0.283 (1.46)
学生	-1.036*** (-10.01)	-1.403*** (-7.21)	-1.394*** (-6.55)	-0.538** (-2.77)
失业	0.0671 (0.84)	0.0120 (0.10)	-0.0517 (-0.37)	0.445** (2.59)
家庭主妇	-0.743*** (-6.19)	-0.656*** (-3.54)	-0.843*** (-4.06)	-0.813** (-3.25)
其他	0.215** (2.77)	0.314** (2.64)	0.165 (1.20)	0.314 (1.96)
室内吸烟限制 (1 是, 0 否)	-0.0912* (-2.41)	-0.0227 (-0.40)	-0.119 (-1.70)	-0.258** (-3.16)
工作场所吸烟限制(1 是, 0 否)	0.0277 (0.39)	0.300* (2.13)	-0.0345 (-0.25)	-0.136 (-1.29)
城市居住地区	0.341*** (6.28)	0.277** (2.90)	0.264** (2.82)	0.356** (3.21)
第轮次调查	-0.178*** (-5.11)	-0.266*** (-4.42)	-0.190** (-2.83)	0.0717 (0.95)
观察值	8507	3484	2540	2477
外生性Wald 检验:				
χ2	45.88	19.52	11.87	32.67
p-值	0.00	0.00	0.00	0.00

系数有边际效应。对于0-1变量，边际效应是指0-1变量从0到1变化时离散变化的效应。系数的z统计量在括号中。省略的分类包括男性, 文盲, 有土地的农民 (职业), 第一轮调查的时间效应以及农村居住地区。
价格方程的简化型估计可参考在线补充资料表 A2。
*p<0.05, **p<0.01, ***p<0.001。

通过模型，我们得到了价格的负向显著的系数估计值，由于我们已经证实了辅助变量在probit回归模型和2SLS回归模型中的有效性，我们运用相应的价格和收入的系数估计值来计算当卷烟价格处于平均水平（表7）时的价格弹性和收入弹性。使用所有样本建立模型，得到的总价格弹性是-0.49，表明卷烟价格每增加10%，卷烟消费就会降低4.9%。在低收入国家和中等收入国家大多数卷烟的需求价格弹性的估计值在-0.5到-1.0之间，然而在高收入国家则一般在-0.25到-0.5之间[19]。孟加拉的估计值处于高收入国家卷烟需求价格弹性范围的下界，而且该估计值位于先前在孟加拉的研究中获得的-0.41的短期价格弹性和-0.57的长期价格弹性之间[9]。同时，我们得到了总收入弹性的估计值，为0.23（表7），这表明家庭收入每增加10%，会导致卷烟消费增加2.3%。

表5 卷烟条件需求的OLS估计

因变量, Ln (每日消费量)	社会经济状况分组			
	(1) 合计	(2) 低	(3) 中	(4) 高
卷烟价格/包 (2009 Taka)	-0.0118*** (-4.85)	-0.0276*** (-4.75)	-0.00420 (-0.99)	-0.00602 (-1.47)
每月家庭收入 (2009 Taka)	0.00000889*** (3.31)	0.0000247*** (4.12)	0.00000506 (1.06)	0.00000235 (0.60)
女性	0.0140 (0.12)	-0.174 (-1.40)	0.0393 (0.14)	0.212 (1.05)
年龄	-0.00116 (-1.13)	-0.000754 (-0.45)	-0.00386* (-2.43)	0.000757 (0.42)
已婚	0.0839** (2.65)	0.0114 (0.20)	0.110* (2.11)	0.134* (2.48)
家庭规模	-0.00893 (-1.02)	-0.0231 (-1.24)	0.0280* (2.14)	-0.0285* (-2.24)
教育				
小学(1-5 年)	0.0983* (2.46)	0.114 (1.92)	0.0636 (1.11)	0.0695 (0.77)
中学 (6-8 年)	0.0722 (1.72)	0.215*** (3.37)	-0.0104 (-0.16)	-0.0665 (-0.73)
中学毕业 (9-10 年)	0.0573 (1.16)	0.0880 (1.04)	0.0310 (0.42)	-0.0390 (-0.38)
高中毕业(11-12 年)	0.0108 (0.19)	0.0608 (0.43)	-0.163 (-1.63)	-0.0147 (-0.15)
学士 (14-16 年)	0.0824 (1.22)	-0.167 (-0.91)	0.0347 (0.25)	0.0630 (0.61)
硕士 (15-17 年)	-0.149 (-0.92)	0.289 (0.84)	-0.307 (-1.13)	-0.183 (-0.95)
硕士以上	0.0216 (0.11)	-0.150 (-0.48)	-	-0.0984 (-0.44)
职业				
佃农	0.204** (3.01)	0.288** (2.61)	0.187 (1.76)	0.173 (1.15)
从事非农场农业的个体户	0.170* (2.16)	0.174 (1.64)	0.291* (2.05)	0.0517 (0.33)
从事非农业活动的个体户	0.275*** (4.09)	0.201 (1.75)	0.311** (3.06)	0.250 (1.83)
农场打工的劳工	0.177** (2.72)	0.0873 (0.92)	0.266** (2.61)	0.284 (1.91)
非农场农业打工的劳工	0.175 (0.95)	-0.434 (-1.17)	0.363 (1.91)	0.342 (1.88)
非农业打工的劳工	0.274*** (3.80)	0.312** (2.95)	0.378*** (3.51)	0.109 (0.67)
专业人员	0.174 (1.62)	0.596*** (3.40)	0.0234 (0.10)	0.168 (1.07)
管理的/行政的/职员	0.236** (3.05)	0.194 (1.52)	0.301** (2.62)	0.107 (0.68)
学生	0.0857 (0.69)	0.0264 (0.09)	0.393 (1.45)	-0.0420 (-0.22)
失业	0.260*** (4.06)	0.258** (2.77)	0.341** (3.28)	0.172 (1.21)
家庭主妇	0.0948 (0.68)	0.0377 (0.15)	0.207 (0.83)	0.0990 (0.43)
其他	0.236*** (3.92)	0.251** (2.78)	0.331*** (3.38)	0.105 (0.80)
室内吸烟限制 (1 是, 0 否)	-0.0405 (-1.52)	0.0119 (0.28)	-0.0547 (-1.27)	-0.147** (-3.17)
工作场所吸烟限制(1 是, 0 否)	-0.0612 (-1.65)	0.0418 (0.63)	-0.0393 (-0.59)	-0.113* (-1.97)
城市居住地区	0.0482 (1.53)	0.112* (2.08)	-0.00815 (-0.18)	-0.0159 (-0.25)
第二轮调查	0.0851** (2.81)	0.103* (1.98)	0.0507 (1.02)	0.157* (2.48)
观察量	3652	1311	1134	1207
调整 R2	0.030	0.061	0.042	0.057

系数的t统计量在括号中。省略的分类包括男性, 文盲, 有土地的农民 (职业), 第一轮调查的时间效应以及农村居住地区。
*p<0.05, **p<0.01, ***p<0.001。
OLS, 普通最小二乘法。

增加卷烟税和卷烟税结构的改变对卷烟消费和税收的影响

运用对吸烟率和条件卷烟需求的价格弹性和收入弹性的估计值，我们模拟了卷烟税增加和不同的卷烟税结构以评估这些改变对整体卷烟消费和税收收入的影响。结果参见表8。基准年设定在2012-2013财政年，利用具有和实际相符的四级税收结构，对2013-2014年的情况进行预测。2012-2013年的附加税率高于2009年和2010年调查时的税率，见表1。

我们模拟了三个可选的税收结构来评估卷烟税政策改变对卷烟消费和税收收入的可能影响：（1）税率为卷烟零售价61%的统一从价税；（2）税率为卷烟零售价61%的统一的从价税，和最低每包10支装的卷烟20Taka（2012–2013的价格）的从量税；（3）每包10支装的卷烟22 Taka（2012–2013的价格）的统一从量税。

这些税收结构方案中，每包卷烟的平均消费税具有可比性，见表8第一行。

依据2011年孟加拉人口和住房普查预测，2012年的人口规模为152518015，而且成年人的比例占总人口的69%[3]。成年人口数量乘以吸烟率可以用来估计2012—2013年孟加拉卷烟吸烟者的数量。我们分别运用吸烟参与和卷烟条件需求的价格弹性预测了卷烟税政策变化对成年吸烟者的数量和卷烟年消费量的负向效应。

依据IMF的预测，2013年人均GDP增长率为4.9%[12]。吸烟参与和每日卷烟消费量的收入弹性被用于推测收入增加对吸烟者数量和卷烟的条件需求的正向影响。此外，我们考虑了人口增长（年增长率1.24%）导致的成年吸烟者数量的增长。同时，我们按照每年8%的通货膨胀率对价格增幅做了调整。

由卷烟价格和收入增长导致的吸烟者数量，卷烟年消费量和税收收入的净变化被列在表8。整体而言，通过模拟卷烟税税率及其结构的变化，年度预测表明可以通过卷烟税的调整来使卷烟消费减少并且显著增加卷烟税税收。在统一从量税系统下，烟草价格增长最多，吸烟者数量和年度卷烟消费量降低幅度最大。而在统一的从价税系统下，税收收入增加最多，零售价中的税收份额所占比例最高。因此，这表明从价税系统能更多的增加税收收入，而从量税系统则更有利于提高国民健康。带有最低从量税的从价税比统一的从价税系统能更大幅度的减少卷烟消费量，同时也能缩小卷烟低价格带和高价格带之间的价格差。

表6 卷烟的条件需求的辅助变量2SLS估计值

	社会经济地位分组			
人口学特征	**(1) 合计**	**(2) 低**	**(3) 中**	**(4) 高**
ln (预测的卷烟价格, 2009 Taka/包)	-0.0110*** (-5.67)	-0.0161*** (-3.69)	-0.00543 (-1.91)	-0.00923** (-3.05)
每月家庭收入(2009 Taka)	0.0000116*** (4.19)	0.0000267*** (4.50)	0.00000529 (1.15)	0.00000707 (1.65)
女性	0.0193 (0.16)	-0.181 (-1.38)	0.0227 (0.08)	0.237 (1.09)
年龄	-0.00212* (-2.03)	-0.00175 (-1.03)	-0.00442** (-2.82)	-0.000407 (-0.21)
已婚	0.0815* (2.57)	0.0132 (0.24)	0.108* (2.09)	0.134* (2.45)
家庭规模	-0.0102 (-1.17)	-0.0224 (-1.21)	0.0286* (2.25)	-0.0321** (-2.59)
教育				
小学(1-5 年)	0.0972* (2.45)	0.0991 (1.67)	0.0641 (1.14)	0.0786 (0.90)
中学 (6-8 年)	0.0949* (2.26)	0.189** (2.99)	0.0230 (0.34)	-0.0387 (-0.44)
中学毕业 (9-10 年)	0.0889 (1.81)	0.103 (1.24)	0.0500 (0.70)	-0.00190 (-0.02)
高中毕业(11-12 年)	0.0656 (1.11)	0.109 (0.86)	-0.120 (-1.14)	0.0345 (0.35)
学士 (14-16 年)	0.154* (2.25)	-0.0570 (-0.31)	0.0883 (0.64)	0.126 (1.19)
硕士 (15-17 年)	-0.0158 (−0.09)	0.475 (1.82)	-0.218 (-0.75)	-0.0661 (-0.33)
硕士以上	0.0668 (0.34)	-0.106 (-0.39)	-	-0.0165 (-0.07)
职业				
职业	0.202** (3.01)	0.274* (2.49)	0.182 (1.73)	0.198 (1.36)
佃农	0.150 (1.95)	0.174 (1.64)	0.274 (1.94)	0.0201 (0.13)
从事非农场农业的个体户	0.263*** (3.97)	0.178 (1.54)	0.308** (3.08)	0.259* (1.98)
从事非农业活动的个体户	0.163* (2.52)	0.0624 (0.65)	0.261** (2.58)	0.286* (2.02)
农场打工的劳工	0.208 (1.08)	-0.462 (-1.25)	0.352 (1.77)	0.405* (2.25)
非农场农业打工的劳工	0.243*** (3.41)	0.278** (2.64)	0.364*** (3.45)	0.0884 (0.57)
非农业打工的劳工	0.154 (1.41)	0.516** (2.58)	0.0301 (0.13)	0.153 (1.01)
专业人员	0.228** (3.02)	0.191 (1.52)	0.303** (2.73)	0.121 (0.80)
管理的/行政的/职员	0.0859 (0.70)	0.148 (0.56)	0.370 (1.44)	-0.0244 (-0.13)
学生	0.248*** (3.91)	0.263** (2.76)	0.338** (3.29)	0.148 (1.12)
失业	0.0735 (0.52)	0.0334 (0.14)	0.206 (0.84)	0.0787 (0.35)
家庭主妇	0.238*** (3.96)	0.227* (2.49)	0.340*** (3.55)	0.118 (0.93)
其他	-0.0345 (-1.29)	0.0242 (0.57)	-0.0538 (-1.25)	-0.134** (-2.92)
室内吸烟限制 (1 是, 0 否)	-0.0595 (-1.61)	0.00811 (0.13)	-0.0415 (-0.63)	-0.102 (-1.80)
工作场所吸烟限制(1 是, 0 否)	0.0158 (0.55)	0.0740 (1.34)	-0.0216 (-0.51)	-0.0162 (-0.31)
城市居住地区	0.0813** (2.68)	0.0975 (1.89)	0.0560 (1.14)	0.158* (2.44)
观察值	3652	1311	1134	1207
调整 R2	0.022	0.051	0.046	0.043
内生性检验: H0: 变量是外生性的				
稳健回归 F值	11.73	2.62	0.53	5.41
P 值	0.00	0.11	0.46	0.02

系数的z统计量在括号中。省略的分类包括男性, 文盲, 有土地的农民 (职业), 第一轮调查的时间效应以及农村居住地区。价格方程的简化型估计值参考在线附录中的表 A3。

*p<0.05, **p<0.01, ***p<0.001。

2SLS, 两阶段最小二乘法。

表7 孟加拉卷烟需求的价格弹性和收入弹性的估计值

	价格弹性				收入弹性			
因素	合计	低	中	高	合计	低	中	高
吸烟率: Probit (A)	0.04	0.01	-0.00	0.13	0.09	0.13	0.08	0.07
吸烟率: IV Probit (B)	-0.29	-0.50	-0.31	-0.15	0.13	0.14	0.10	0.09
条件需求: OLS (C)	-0.21	-0.43	-0.07	-0.14	0.08	0.17	0.04	0.03
条件需求: 2SLS (D)	-0.20	-0.25	-0.09	-0.21	0.10	0.18	0.04	0.09
总计 (B+D)	-0.49	-0.75	-0.40	-0.36	0.23	0.33	0.15	0.18

'低', '中' 和'高'指基于房屋指数的受访者的社会经济状况。通过合计在B行的IV probit 的估计值以及D行的2SLS 估计值获得总的价格弹性。

OLS, 普通最小二乘法; 2SLS,两阶段最小二乘法。

表8 卷烟税增加对孟加拉的卷烟消费和税收的模拟影响

因素	基准: 分层从价 税 (低: 实际价格的39%, 中: 实际价格的56%, 高: 实际价格的59%, 特高: 实际价格的61%)	模拟分析 A: 统一从价税，按实际价格的61% 征收	模拟分析 B: 每包10只装卷烟按照实际价格的61% 正手统一从价税 以及最少20 Taka 的从量税 (按2012 的 价格)	模拟分析 C: 每包10只装卷烟的征收22Taka 的统一从量税 (按2012 的价格)
每包10支装的卷烟的平均消费税(2012 Taka)	11.89	20.90	21.18	21.57
零售价中消费税平均所占的比例 (%)	53%	61%	61%	57%
零售价中总的卷烟税平均所占的比例(消费税 和 VAT) (%)	68%	76%	76%	72%
每包10支装的卷烟的平均价格(按2012 Taka的价值)	22.46	34.26	34.65	35.67
实际价格的变化		53%	54%	59%
卷烟吸烟者的人数变化(百万)	19.9	16.4	16.2	15.7
年度消费量 (百万，每包10支装的卷烟)	7603	5490	5388	5125
年度消费量的变化		-27.8%	-29.1%	-32.6%
税收 (百万，按2012 Taka的价值)	116 045	154 372	153 497	142 376
实际税收的变化百分比		33.0%	32.3%	22.7%

讨论

吸烟率和吸烟强度的负价格弹性表明，在孟加拉，提高卷烟价格能大幅降低吸烟者数量和他们的每日卷烟消费量。这些发现对于国民健康有重要的意义。对于吸烟者来说，与仅仅减少卷烟消费量相比，戒烟无疑对健康更加有利。因此，总价格弹性中，吸烟率的价格弹性所占的比例与通过提高卷烟价格来推动戒烟的办法相关联。对高收入国家来说，由吸烟率导致的价格弹性约占总的价格弹性的50%[6,20]。基于我们对ITC孟加拉调查数据的分析，在孟加拉该比例是0.29/0.49=59%。因此，相比大部分其它国家，提高孟加拉的卷烟税，对于降低吸烟率（进而提高国民健康水平）有更明显的效果。

另外，在对三个分组（低，中和高社会经济地位）分别进行卷烟需求函数的估计时，我们观察到吸烟率价格弹性和吸烟强度的价格弹性在较低的社会经济地位（SES）的分组中更高。吸烟率的价格弹性的辅助变量估计值在处于低社会经济地位的人群中是-0.50(probit)，而在中等社会经济地位和高社会经济地位人群中分别是-0.31和-0.15（表7）。吸烟强度价格弹性的2SLS估计值在三个分组中分别是-0.25（低社会经济地位人群），-0.09（中等社会经济地位人群），和-0.21（高社会经济地位人群）（表7）。因此，总的价格弹性在低社会经济地位人群分组中是-0.75，在中等社会经济地位人群分组中是-0.40，在高社会经济地位人群分组中是-0.36。这些估计值表明穷人比富人对价格更敏感，也因此能从提高卷烟税和卷烟价格中获得更大的健康收益。这一响应模式与来自全球各地的证据相一致[6]。

由于卷烟的总需求价格弹性小于1（-0.49），这表明如果卷烟价格提高一定比例，卷烟消费的减少要低于这一比例，这就导致了更多的烟草开支和更多的政府税收收入。很多人认为由此产生的烟草开支将更多地转移到穷人身上。

然而，依据价格弹性的分组估计值，在低社会经济地位人群中，卷烟价格弹性更高。这一结果意味着，如价格增加，相比富人而言，穷人将更大比例的减少卷烟消费。这也

就降低了穷人的烟草支出负担以及吸烟给健康带来的不利影响。最终，通过提高卷烟税来提高卷烟价格，也将缓解孟加拉现有的健康不平等现象。

结论

对ITC两轮孟加拉调查的分析，证实了在高收入国家以及越来越多的在低收入和中等收入国家进行的研究结果，即提高卷烟税和卷烟价格能降低吸烟率，并降低长期吸烟者的吸烟强度，从而带来显著的卷烟消费的减少。而且，和其他国家一样，孟加拉的低社会经济地位人群比高社会经济地位人群更容易受到卷烟价格变化的影响。在其他国家，提高卷烟价格对降低吸烟率的影响和对降低卷烟消费量的影响基本相同；而在孟加拉，提高卷烟价格对降低吸烟率的影响大约是其对降低卷烟消费量的影响的1.5倍。因此，与其它国家相比，在孟加拉通过提高卷烟税来提高卷烟价格，将获得更大的国民健康的收益。

我们也得出结论：提高卷烟税和卷烟价格能增加政府的税收收入。同时，由于穷人对卷烟价格更敏感，穷人可能会从卷烟价格的提升中受益更多。这将缓解孟加拉现有的卷烟消费负担不平等的问题。在孟加拉，这种不平等性使穷人在健康和经济两方面遭受了更大的不利影响。这些发现表明在孟加拉通过提高卷烟税来提高卷烟价格能形成一个“三赢”的局面：减少卷烟消费量，增加卷烟税收收入，并可能缓解社会经济的不平等。

本文贡献

- ▶ 这是孟加拉第一个采用的有全国代表性的个体水平的调查数据进行的卷烟需求分析。
- ▶ 通过使用来源于研究本身的价格弹性估计，本文预测吸烟率和日均卷烟消费量的降低，和政府税收收入的增加。
- ▶ 这些结果有助于政府在通过税收来控制烟草方面做出知情决策。

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贡献

NN是本文的第一作者。UHR运用计量经济学的方法对卷烟的需求价格弹性进行估计。AKMGH通过模拟来分析评估卷烟税增加对卷烟消费和税收的影响。GTF是ITC项目的首席调查员，也是本文的合著者。IH是ITC孟加拉项目的项目管理员。SMA是ITC孟加拉项目的主要调查员，以及本文的合著者。

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利益冲突 无

知情同意 已获得

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出处和同行审查 未开展；外部同行已评审。

数据共享声明 本研究中其它的未发表的数据可从参与了孟加拉调查项目的ITC负责人处获得。

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