Cigarette Demand Analysis: Bangladesh

Estimating Elasticity of Cigarette Smoking in Bangladesh Using GATS Data

Key Contacts and Funding Acknowledgment

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Executive Summary

With 37.8 million adults consuming tobacco products, Bangladesh has one of the largest populations of tobacco users in the world. Although the overall prevalence of tobacco use declined from 43.3 percent to 35.3 percent from 2009 to 2017, it was primarily driven by decreases in smokeless tobacco use and biri smoking. The overall prevalence of cigarette smoking did not change at all over the period (GATS, 2017). Evidence shows that increases in tobacco taxes and prices result in reductions in the prevalence of adult tobacco use. However, the effectiveness of a tax increase depends on how much it translates to a price increase and, more importantly, how much the price increase reduces consumer demand. Therefore, the price responsiveness of demand - or price elasticity - of different tobacco products is an important parameter for developing effective tobacco control policies.

Analyzing cigarette price elasticity is important for understanding the revenue and public health implications of policy changes. The earliest research on cigarette price elasticity in Bangladesh was conducted in 2003. Since then, a total of seven studies have been conducted, with mixed results. These studies use a variety of types of data, models, and estimation techniques—each with its own strengths and limitations. All studies have found that the relationship between cigarette demand and its price to be negative. However, with individual-level data, some studies consistently estimate cigarettes to be price inelastic (price elasticity value of less than 1 in absolute term) while others find them to be price elastic (price elasticity value of greater than 1 in absolute term). Additionally, there has been limited research to distinguish prevalence and intensity elasticity within total price elasticity.

The present study focuses on the price elasticity of cigarette demand using two nationally representative rounds of GATS (2009 and 2017) data. In addition to the estimation of total elasticity for cigarette demand, the study decomposes the estimates into overall prevalence elasticity and intensity elasticity and by region and wealth group.

After controlling for demographic, socioeconomic and tobacco-related factors[1], the total price elasticity of cigarette was estimated as -0.71 (prevalence elasticity as -0.67 and intensity elasticity as -0.04). This implies that a 10 percent increase in the price of each cigarette stick would reduce the overall cigarette demand by 7.1 percent (smoking prevalence and smoking intensity would go down by 6.7 percent and 0.4 percent, respectively). This estimated demand elasticity parameter

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[1] These factors include the following: the price of biri (traditional hand-rolled cigarettes), tobacco user assets (as a proxy for income), socioeconomic and demographic attributes of tobacco users, smoking restrictions in homes and workplaces, smoking-related warnings, promotions, advertising, and perceptions.

does not differ considerably across geographic locations. More specifically, elasticities are estimated to be -0.59 and -0.69, respectively for residents in urban and rural areas. Comparing the estimations across wealth groups, individuals in the low wealth (bottom three quintiles) group are more than twice as responsive to price than their high wealth (top two quintiles) counterparts.

Cigarette demand is price inelastic across various socioeconomic and demographic groups in Bangladesh. The elasticity estimates from different wealth groups indicate that poorer people are more sensitive to price changes. According to GATS 2017, 60 percent of the cigarette smokers belong to low wealth groups. Therefore, increasing the price of cigarettes could help reduce the number of these smokers, which has substantial public health implications. Considering the extensive health benefits, cessation has a much greater positive impact than merely reducing smoking intensity (Nargis et al., 2010). Provided there is sufficient tax pass through in cigarette prices, inelasticity implies that the burden of tax increases falls mainly on smokers. However, differences in responsiveness across wealth groups imply that the burden will be disproportionate. Since the low wealth group is more responsive (more than twice) to price than the high wealth group, the relative tax burden would be more on the smokers with high wealth. Additionally, because they are more responsive to price, the low wealth group experiences the largest public health benefit. The overall number of smokers will decrease, and at the same time, there will be an increase in government revenue (Barkat et al., 2012; Goodchild et al., 2016; Acharya et al., 2016). The effectiveness of cigarette taxation to achieve the policy goal of reducing tobacco use, however, is subject to the efficiency of the tax structure design as well as proper implementation.

The current multi-tiered cigarette tax structure exacerbates variation in prices allowing for a lot of trading down wherein consumers simply switch to a less expensive cigarette rather than quit. In order to achieve the public health goal of reduction in the prevalence of cigarette smoking and revenue goal of increasing tax revenue, the cigarette tax structure in Bangladesh must be simplified. A mixed system with a blend of uniform specific tax and *ad valorem* tax should be implemented. Further, the uniform specific tax must be prioritized in such a way that it constitutes the majority of the total tax burden. Moreover, the tax needs to be annually adjusted for inflation and income growth, in order to maintain its effectiveness in terms of the real value of price.

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1. Introduction

Bangladesh has one of the largest populations of tobacco users in the world, with 37.8 million (35.3 percent) adults consuming tobacco products (Global Adult Tobacco Survey [GATS], 2017). Tobacco is consumed in both smoking and smokeless forms in Bangladesh. Cigarettes and biris (traditional hand-rolled cigarettes) account for the majority of smoking tobacco consumption, while betel quid with tobacco and gul are the popular forms of smokeless tobacco. Although the overall prevalence of tobacco use declined from 43.3 percent to 35.3 percent from 2009 to 2017, it was primarily driven by decreases in smokeless tobacco use and biri smoking. The overall prevalence of cigarette smoking did not change at all over the period (GATS, 2017). Tobacco use in the country also varies according to income group, gender, and location. It is more concentrated in rural areas (37.1 percent) and among persons (combining men and women) with no formal education (58.7 percent) (GATS, 2017). The comparison of data from two rounds of GATS suggests a considerable decline in the prevalence of tobacco use in both rural and urban areas between 2009 and 2017. Despite the downward trend, tobacco consumption remains higher in rural areas.

Taxation is an important price instrument to regulate the consumption of tobacco products (John, 2008; Chaloupka et al., 2014). Evidence suggests that higher tobacco taxes and prices decrease overall smoking prevalence by inducing current users to quit and discouraging initiation of tobacco use, especially among youth; lower the consumption of tobacco products among continuing users; and lead to larger reductions in tobacco use among young people than among adults (Chaloupka et al., 2014).

While increasing the price of tobacco products through taxation helps reduce tobacco use, the magnitude of this response is not uniform. The effectiveness of a tax increase is subject to the increase in price resulting from the tax change as well as the price elasticity of demand (that is, the responsiveness of quantity demanded to a change in price), among other factors.

Currently, Bangladesh follows a complex multi-tiered excise tax structure. There are four price tiers for cigarettes (low, medium, high, and premium) where the *ad valorem* excise tax rates are higher for upper price tiers. Biri tax structure is categorized according to filter status and pack size. In addition, a flat value-added tax (VAT) rate of 15 percent along with a one percent Health Development Surcharge (HDS) is levied on all types of tobacco products. Researchers and academics have recommended Bangladesh to move towards a specific tax structure. Nargis et al. (2019), after critically evaluating a decade of tobacco control measures in Bangladesh, suggested amending the existing tier-based tax system to move towards a specific tax. Similarly, Ahmed et al.

(2019) recommended increasing the existing supplementary duty and introducing a specific excise tax.

To accurately estimate the effectiveness of any tax structure, the price elasticity of tobacco products such as cigarettes is an important parameter. The total price elasticity of cigarettes can be further divided into prevalence elasticity and intensity elasticity. Prevalence elasticity measures the proportionate change in the decision to smoke cigarettes due to the percentage change in cigarette price, while intensity elasticity measures the percentage change in the number of sticks a smoker smokes with respect to the change in price.

Cigarette price elasticity estimates vary across countries and over time. The estimates for price elasticity of cigarettes in low- and middle-income countries (LMICs) fall between –0.50 to –1.05 (Hidayat and Thabrany, 2010; Karki et al., 2003; Mushtaq and Mushtaq, 2011). Kostova et al. (2014) estimated the total cigarette price elasticity for 13 LMICs to be – 0.53, with a prevalence elasticity of - 0.36 and intensity elasticity of – 0.17. Ho et al. (2018) estimated total cigarette price elasticity to be – 0.35 in LMICs in the Asia-Pacific region. Several attempts have also been made to estimate the price elasticity of cigarettes for Bangladesh. Ali et al. (2003), Guindon et al. (2003), and Barkat et al. (2012) used time-series data to estimate the price elasticity of cigarettes. The former two did not find the price to be a statistically significant determinant of cigarette consumption, while the latter estimated the price elasticity as –0.41 and –0.57 in the short run and long run, respectively. Several others have utilized cross-sectional data for this purpose. Such studies include Nargis et al. (2011, 2014); Carmen, Fuchs, and Genoni (2018); and Ahmed et al. (2019). Nargis et al. (2011, 2014) concluded that cigarettes are price inelastic, while the other two studies found them to be price elastic. Unlike the others, Nargis et al. (2011, 2014) separated the price elasticity of cigarettes into prevalence and intensity elasticity.

This study revisits the total price elasticity of cigarette smoking while disentangling it by prevalence and intensity using Global Adult Tobacco Survey (GATS) data from Bangladesh. GATS is a nationally representative survey of men and women aged 15 years and older, which provides self-reported information on price and smoking behavior along with individual and household characteristics. In addition to overall measure of elasticity, this study estimates elasticities of cigarette smoking by region and asset holding.

2. Literature Review

The inverse relationship between cigarette price and cigarette consumption has important policy implications because it implies that policy instruments that increase cigarette prices result in decreased cigarette consumption. Nevertheless, the impact of such an instrument, such as an excise tax on tobacco products, depends on the extent to which it can affect the price and, hence, consumption. Measuring cigarette smoking responsiveness, or cigarette smoking elasticity, is essential to evaluating the potential effectiveness of a cigarette tax increase for improving public health. Over the years, several attempts have been made to empirically estimate the elasticity of cigarette smoking in various countries. There is diversity in terms of the nature of the data, the models used for estimation, and the estimation techniques among these studies.

In Bangladesh, the research for measuring cigarette price elasticity dates back to 2003. Since then a total of seven studies have been conducted. Three of them utilized time-series data while the rest used cross-sectional information. Studies can also be classified by the type of elasticity estimated: total elasticity, prevalence elasticity, and intensity elasticity. The first study was conducted by Ali et al. (2003), where a demand model was estimated using income (per capita GDP) and real price as independent variables. A simple ordinary least squares (OLS) method was used for model estimation, with data spanning from 1983 to 1999. They concluded –0.27 to be the price elasticity of cigarettes; however, the impact was statistically insignificant. Employing data from 1970 to 2000, Guindon et al. (2003) estimated a conventional and myopic addiction demand model for Bangladesh, Indonesia, Nepal, Sri Lanka, and Thailand. Short-run and long-run elasticities for these countries clustered around –0.50 and –0.70, respectively. While only price and income were considered as demand determinants, the researchers also found the price to be insignificant for Bangladesh. Both efforts, however, did not take into account important variables related to tobacco control and time-series properties that might have a significant effect on cigarette consumption[2].

In later research, using time-series data for the period 1984 to 2004 on price, income and cigarette consumption, Barkat et al. (2012) found that the price of cigarettes had a significant effect on consumption. Adjusting the time-series properties of the variables, the study estimated short-run and long-run price elasticities to be –0.41 and –0.57, respectively.

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[2] Prices of substitutes tobacco products, extent of Advertising and warnings and their exposure to the smokers and non-smokers, policy adaptions across the time targeting tobacco control, health awareness and education and demographic characteristics of the country is needed to be controlled for while modelling tobacco demand. In addition, controlling and testing for time series properties of the variables such as "stationarity" is of vital importance for the results being non-spurious.

Using individual-level data generated from the International Tobacco Control (ITC) survey (Wave I, 2009), Nargis et al. (2011) estimated –0.29 and –0.14 as the prevalence and intensity elasticity for cigarettes in Bangladesh. The estimated model controlled for several socioeconomic variables as well as other variables related to smoking behavior, in addition to price and income, as primary variables of interest. ITC survey data (Wave I, 2009 and Wave II, 2010) were used in Nargis et al. (2014). Adapting the instrumental variable (IV) approach in probit regression and using cigarette tax rate as an instrument for price, the authors estimated the elasticity for prevalence and intensity to be – 0.29 and – 0.20 respectively. Cigarette tax rate, however, might be a weak instrumental variable, as it can be correlated with determinants of price as well as cigarette consumption.

Recently, Carmen, Fuchs, and Genoni (2018) and Ahmed et al. (2019) used Household Income and Expenditure Survey (HIES) data to estimate cigarette price elasticity. The former used the Quadratic Almost-Ideal Demand System (QUAIDS), and the latter used the Deaton model for estimation. Analyzing data from HIES 2016, Carmen, Fuchs, and Genoni (2018) found a cigarette price elasticity of –1.3. They also measured the elasticity for different consumption deciles. Ahmed et al. (2019), on the other hand, compared elasticity estimates measuring them from HIES 2010 and HIES 2016 data. They found the magnitude of the elasticity estimate to be –1.13 and –1.03, respectively, for the two data periods. Considering the estimated model characteristics, the estimate provided by Ahmed et al. (2019) would be a measure of total cigarette price elasticity while Carmen, Fuchs, and Genoni (2018) specified an estimate of intensity elasticity. The recent studies, hence, overlooked the estimation of prevalence elasticity of cigarette smoking.

The previous studies in Bangladesh on this topic have provided a range of estimates, each with its own strengths and limitations. The present study focuses on the aspect of total price elasticity of cigarettes and its decomposition to prevalence and intensity which has historically received little attention in Bangladesh. The use of GATS data provides an added advantage since it has smoking-related information that is not included in other datasets that were used in the papers discussed above. Furthermore, two rounds of GATS (2009 and 2017) have been successfully completed in Bangladesh. In this research, both rounds are used to estimate the price elasticity of cigarettes.

3. Methodology

3.1. Econometric Model

The purpose of this research work is to use GATS data to measure and critically analyze the demand for cigarettes and its total elasticity with respect to wealth group and residence status in Bangladesh.

The consumption of cigarettes is considered to have a "mixed distribution". The consumption distribution of cigarette for the smokers is continuous with positive values while that for non-smokers is discrete with a fixed value of zero. Due to such consumption pattern, following Cragg (1971) the cigarette demand and elasticity is estimated with the application of the "two-part model". In the first part cigarette smoking propensity is modelled providing "propensity elasticity" while in the second part conditional cigarette demand is modelled supplying "intensity elasticity". Although the outcome variable is different, the list of covariates in both parts of the model remain the same. Since elasticity is the expected outcome to be measured, logarithmic transformation of smoking intensity is used for the second part.

Part I: Modeling Smoking Propensity (Smoking Decision):

It is well established that the decision to smoke and, hence, cigarette consumption, responds negatively to price increases (Chaloupka et al., 2000; Chaloupka et al., 2011; Kostova, 2014; Selvaraj S et al., 2015; Goodchild et al., 2016; Ho et al., 2018). Accordingly, the price of cigarettes (P_c) is the independent variable of concern for the current study, and cigarette smoking prevalence or propensity to smoke cigarettes is the outcome variable for the first part. The estimates of this part will measure the responsiveness of the cigarette smoking decision to price changes. In addition to cigarette price (P_c), the price of biri (P_B) and socioeconomic and demographic attributes such as income (I), age (A), gender (female) (G_F), residential area (rural) (R_R), educational attainment (EA), employment category (EC), and family size (FS) also play important roles in determining smoking propensity. Furthermore, the significance of smoking regulations in the home (SR_H) and workplace (SR_W) as well as exposure to different warnings (W), advertising (Ad), promotional activities (P_{RM}), and perceptions held by individuals about smoking (SP) cannot be ignored in the analysis of smoking behavior. Alongside price of cigarettes (P_c), controlling the effect of the above covariates is therefore imperative for precise estimation. Smoking probability is estimated using the following probit model:

$$P_r(Cigarette\ Smoking > 0)$$

$$= \Theta(\beta_0 + \beta_1 P_c + \beta_2 P_B + \beta_3 I + \beta_4 A + \beta_5 FS + \beta_6 G_F + \beta_7 R_R + \sum \beta_{8i}\,EA_i + \sum \beta_{9i}\,EC_i$$

$$+ \beta_{10} SR_H + \beta_{11} SR_W + \sum \beta_{12i}\,W_i + \sum \beta_{13i}\,Ad_i + \sum \beta_{14i}\,P_{RMi} + \sum \beta_{15i}\,SP_i + \varepsilon_i)$$

In the above expression, ε_i denotes the disturbance term and $\Theta(.)$ indicates cumulative normal distribution. Except for prices, age and family size, all other factors are categorical. The main coefficient of interest is β_1. The prevalence elasticity of cigarette smoking with respect to price is estimated using the following method:

$$Prevalence\ Elasticity = \theta(.)\beta_1 * \frac{Average\ Consumption\ weighted\ Cigarette\ Price}{Population\ Probability\ of\ Cigarette\ Smoking}$$

Here, $\theta(.)$ is the normal density evaluated at the average values of explanatory variables and the estimated parameters of the above probit model. Details of the probit model and the estimation method are presented in Annex A (Section A.1).

The endogenous nature of independent variables in cross-sectional regression is a common source of bias in estimates. The above model might have two concerns in relation to price. One is the simultaneity that could make the price endogenous, and the other is price determination for non-smokers. Cluster-specific consumption-weighted price is used to address the concerns (the process of measurement is explained below in Section 3.2.3).

Part II: Modeling Smoking Intensity (Smoking Amount):

In part two, conditional on being smoker, the number of cigarettes smoked will be modeled using a stochastic log–linear regression equation. The equation that would be estimated can be written as follows,

$$lny = \alpha_0 + \alpha_1 P_c + \alpha_2 P_B + \alpha_3 I + x'\alpha_4 + \varepsilon, \quad where, y > 0$$

Here, *lny* indicates the natural logarithm of average number of sticks smoked by a person, P_c and P_B is the consumption weighted cigarette and biri price per stick respectively while *x* is vector of other socio economic and demographic covariates that were used in the smoking propensity model. The concerned coefficient is α_1 here. The marginal effect of price on cigarette smoking intensity in the above equation depends on the value of average number of sticks smoked (*y*). Therefore, the smoking intensity elasticity is measured using the following formula:

$$Intensity\ Elasticity = \alpha_1 * Average\ Consumption\ weighted\ Cigarette\ Price$$

Calculating Total Price Elasticity

The total elasticity of cigarette demand with respect to price is the result of summation of elasticities from the models in part one and part two with respect to price.

$$Total\ Price\ Elasticity\ of\ Cigarette \\ = Prevalence\ Elasticity\ of\ Cigarette + Intensity\ Elasticity\ of\ Cigarette$$

3.2. Data and Variable Construction

3.2.1. Data Source

This study uses Global Adult Tobacco Survey (GATS) 2009 and 2017 data from Bangladesh. GATS collects data on smoking and smokeless tobacco use among men and women aged 15 years and older. Since it was launched, GATS has been implemented in more than 25 low- and middle-income countries where the burden of tobacco use is high. In Bangladesh, the first GATS was implemented in 2009 (report published in 2011), and the most recent one was conducted in 2017 (report published in 2020).

GATS 2009 was conducted with a three-stage stratified cluster sample design. Data were collected from 200 urban and 200 rural Primary Sampling Units (PSU) (*mauza* in rural and *mohalla* in urban areas). Among the 11,200 selected households, a total of 10,751 households were screened and 9,629 observations randomly selected from the, then, six administrative divisions. The scope of GATS 2017 was wider as all eight administrative divisions were used as reporting domain. Similar as GATS 2009, it used multistage stratified cluster sampling design. However, a total of 496 PSUs were used in GATS 2017 with an equal distribution for each division (62 PSU in each division). The sample size was larger compared to GATS 2009. Among 14, 880 randomly selected sample of households, a total of 12,783 observations were collected. The broad topics covered by the surveys include: tobacco use prevalence (for smoking and smokeless tobacco products); secondhand tobacco smoke exposure and policies; cessation; knowledge and attitudes related to tobacco use and perceptions about tobacco control initiatives; exposure to media, and economics.

3.2.2. Construction of Variables

The outcome variable i.e. cigarette smoking propensity, was constructed by the responses from two groups: cigarette smokers and non-smokers. The non-smokers group includes the people who report that they do not smoke at all. Conversely, the smokers group includes people who smoke cigarettes daily or less than daily. Cigarette prices were calculated using the information on the last purchased quantity and the amount of expenditure made during the purchase. Prices are

calculated per stick instead of price per pack due to the high availability and use of loose cigarettes in Bangladesh. Since biri is a common smoking tobacco product in addition to cigarettes in Bangladesh, the price of biri is used for the price of related tobacco products. Since individual income was unavailable in the GATS data, available asset holding information was used to construct an asset index. This index is used as a proxy for permanent income.

3.2.3. Endogeneity of Cigarette and Biri Price

The most important concern that arises in estimating a demand model using self-reported prices, as described above, is that price may be simultaneously determined with the decision to smoke, resulting in biased estimates. Additionally, the self-reported prices are only recorded for smokers. To address these concerns, a consumption weighted price is calculated for a geographical area (cluster), which is then assigned to all households/individuals residing in the area. The consumption weight for a smoker is defined as the relative share of his or her cigarette consumption in the total consumption of cigarettes within the cluster to which s/he belongs. The per-stick price of cigarettes for a particular smoker is multiplied by the consumption weight to calculate the weighted price. The cluster average of consumption weighted cigarette price is used for both smokers and non-smokers residing in a specific cluster. For determining the price of biri, a similar procedure is followed.

3.3. Summary Statistics

In Bangladesh, smoking tobacco is available in the form of cigarettes, biris, hukka, and cigars. Respondents of GATS 2009 and GATS 2017 who smoke cigarettes and biris are considered for analysis in this report. Summary statistics on the prevalence of cigarettes and biris and the prices of cigarettes and biris are presented in table 1 to table 4.

Table 1 shows that though there is a significant decline in the prevalence of biri smokers from 9.88 percent in 2009 to 5.32 percent in 2017, the prevalence of cigarette smokers remains similar at around 15 percent. The prevalence of female cigarette smokers is very low, less than 1 percent, which may be due to cultural and social perceptions about female smoking (Bush et al., 2003). The decline in the overall prevalence of biri smokers resulted from declines in the prevalence of biri smokers in both rural and urban areas. But in the case of cigarettes, smoking prevalence in rural areas increased from 12.34 percent in 2009 to 13.94 percent in 2017, whereas smoking prevalence in urban areas decreased from 18.39 percent in 2009 to 16.43 percent in 2017. Interestingly, the prevalence of cigarette smoking for all education categories is high and does not show any pattern whereas the prevalence of biri smoking is lower for respondents with higher

education levels. In both GATS 2009 and GATS 2017, the prevalence of cigarette smoking is higher for middle-aged respondents (age 25-55 years) whereas the prevalence of biri smoking increases with higher age groups. Considering wealth, respondents from lower wealth groups tend to smoke more biris. Though biri smoking prevalence declined for all wealth groups in GATS 2017, the pattern remains similar.

Table 2 and Table 3 present the average daily consumption of cigarettes and biris, respectively. Smoking cigarettes and biris per day remain almost same with on average 8.24 cigarettes and 13.03 biris in 2009 and on average 8.21 cigarettes and 13.16 biris in 2017. Urban cigarette smokers smoked on average 8.91 cigarettes in 2009 and on average 8.55 cigarettes in 2017 which is more than rural cigarette smokers' average consumption of 7.24 cigarettes in 2009 and 7.83 cigarettes in 2017. Unlike cigarette smokers, biri smokers in rural areas tend to smoke more biris on average compared to urban biri smokers. Education plays important role in cigarette and biri smoking. In both 2009 and 2017, the proportion of cigarette and biri smokers decreases with a higher level of education. Also, individuals with higher education tend to smoke fewer biris and cigarettes per day. Respondents of the 25–55-year-old group smoke more cigarettes and biris compared to other age groups' respondents. Average cigarettes and biris consumption per day across all wealth groups did not change significantly in 2017 compared to 2009. Respondents from lower wealth groups tend to smoke more biris (85 percent of smokers from the lowest 60 percentiles in 2009 and 91 percent from the lowest 60 percentiles in 2017) compared to the biri smokers of higher wealth groups. In the case of cigarettes, no such pattern is evident. But cigarette smokers from the higher wealth groups on average smoke more cigarettes per day.

Table 4 presents the prices of cigarettes and biris in 2009 and 2017. In Bangladesh, it is possible to purchase biri and cigarettes in packs and also in sticks (loose purchase). Overall, the average price of a cigarette in 2017 is Taka 4.05 which is more than double the price of a cigarette, Taka 1.78, in 2009. But Table 1 shows that the prevalence of cigarette smoking did not change that much. Over the period of 2009 and 2017, the price changed around 10 percent per year and since people mostly buy loose cigarettes (more than 80 percent in both 2009 and 2017), the amount spent on a single cigarette purchase changed only fractionally. So, the price increases were not high enough to have a significant effect on cigarette smoking. At the same time, over the period of 2009 and 2017, per capita GDP doubled from USD 702 in 2009 to USD 1,564 in 2017 which also affected the consumption of cigarettes. Thus, while the average price of a loose cigarette almost doubled from 2009 to 2017, per capita GDP more than doubled in the same period. In the case of biris, the average price per stick increased almost three times from Taka 0.29 in 2009 to Taka 0.91 in 2017. Table 1 also shows that the prevalence of biri smokers decreased in 2017.

Table 1: Prevalence of Cigarette and Biri Smokers by Demographic Characteristics

Characteristics	GATS 2009			GATS 2017		
	Distribution of Adults in the Sample (N=9629)	Prevalence of Cigarette Smokers* (in %)	Prevalence of Biri Smokers* (in %)	Distribution of Adults in the Sample (N=12783)	Prevalence of Cigarette Smokers* (in %)	Prevalence of Biri Smokers* (in %)
Overall	100.00	15.39	9.88	100.00	15.18	5.32
Gender						
Female	53.60	0.19	1.05	52.44	0.12	0.46
Male	46.40	32.95	20.08	47.56	31.78	10.68
Residence						
Rural	49.56	12.34	14.59	50.28	13.94	8.00
Urban	50.44	18.39	5.25	49.72	16.43	2.61
Education						
No Schooling	36.14	15.03	17.01	28.01	16.22	10.16
Primary	27.02	16.41	9.22	28.40	17.49	6.01
Less than Secondary	20.12	15.38	4.54	21.20	14.02	3.06
Secondary Completed	6.89	13.57	2.56	9.29	11.79	0.93
High School Completed	4.81	12.74	1.94	6.82	9.63	0.46
Bachelor	2.84	20.15	0.73	3.78	16.36	0.00
Post-Graduation	2.19	14.22	1.42	2.50	12.81	0.00
Employment						
Service	9.98	25.29	2.91	9.03	22.79	0.78
Business	10.31	41.49	11.08	11.09	35.75	6.70
Farming/Agriculture	12.46	22.08	39.00	9.20	26.79	23.55
Industrial Worker	2.22	35.05	8.88	1.64	26.67	3.33
Daily Laborer	6.55	36.61	24.72	8.35	39.98	14.89
Self-Employed	3.30	23.58	12.26	4.07	31.54	9.62
Student	4.78	3.26	0.65	6.80	2.76	0.12
Homemaker	41.85	0.22	0.87	42.96	0.09	0.40
Retired/Unemployed	4.38	15.64	10.43	4.74	16.34	7.26
Others	4.15	22.75	12.25	2.12	29.52	5.90
Age (in years)						
15–24	21.53	9.55	2.85	17.32	7.77	0.63
25–34	27.68	16.55	7.20	26.00	16.61	2.89
35–44	23.18	19.22	12.86	24.38	18.74	5.39
45–55	13.80	18.96	14.52	16.43	17.71	8.95
>55	13.81	11.43	15.79	15.87	12.81	10.55
Wealth (in quintiles)						
Very Low	20.67	12.56	17.24	20.07	13.72	10.99
Low	19.59	16.60	13.15	19.94	14.67	8.20
Medium	19.77	14.86	11.55	20.09	17.13	4.95
High	20.54	17.95	5.66	20.04	16.67	2.11
Very High	19.41	15.03	1.50	19.85	13.67	0.32

Source: Authors' calculations from GATS 2009 and 2017 data

Table 2: Prevalence of Cigarette Smoking and Average Daily Consumption of Cigarettes by Demographic Characteristics

	GATS 2009		GATS 2017	
	Cigarette Smokers (in %)	Average Daily Intensity	Cigarette Smokers (in %)	Average Daily Intensity
Overall	15.39	8.24 (0.17)	15.18	8.21 (0.15)
Gender				
Female	0.67	4.01 (0.93)	0.41	3.16 (0.9)
Male	99.33	8.27 (0.18)	99.59	8.24 (0.16)
Residence				
Rural	39.74	7.24 (0.26)	46.19	7.83 (0.21)
Urban	60.26	8.91 (0.23)	53.81	8.55 (0.22)
Education				
No Schooling	35.29	8.83 (0.32)	29.95	8.48 (0.26)
Primary	28.81	8.08 (0.32)	32.73	8.71 (0.31)
Less than Secondary	20.11	8.01 (0.35)	19.59	7.78 (0.31)
Secondary Completed	6.07	8.22 (0.66)	7.22	8.13 (0.59)
High School Completed	3.98	7.04 (0.9)	4.33	7.14 (0.61)
Bachelor	3.71	7.1 (0.71)	4.07	6.46 (0.61)
Post-Graduation	2.02	7.2 (1.3)	2.11	6.77 (0.96)
Employment				
Service	16.40	7.57 (0.4)	13.56	8.06 (0.49)
Business	27.80	9.3 (0.35)	26.13	8.75 (0.29)
Farming/Agriculture	17.88	6.83 (0.4)	16.24	7.04 (0.36)
Industrial Worker	5.06	5.62 (0.5)	2.89	9.24 (0.82)
Daily Laborer	15.59	9.15 (0.44)	22.01	8.59 (0.35)
Self-Employed	5.06	8.97 (0.92)	8.45	8.78 (0.52)
Student	1.01	5.79 (1.4)	1.24	4.74 (0.81)
Homemaker	0.61	5.73 (2.04)	0.26	4.6 (0.93)
Retired/Unemployed	4.45	7.35 (0.8)	5.10	7.32 (0.58)
Others	6.14	9.97 (0.7)	4.12	8.53 (0.75)
Age (in years)				
15–24	13.36	6.65 (0.46)	8.87	6.51 (0.41)
25–34	29.76	7.69 (0.3)	28.45	7.93 (0.27)
35–44	28.95	9.39 (0.33)	30.10	8.88 (0.3)
45–55	17.00	9.07 (0.44)	19.18	9.03 (0.39)
>55	10.93	7.38 (0.53)	13.40	7.28 (0.38)
Wealth (in quintiles)				
Very Low	16.87	7.74 (0.42)	18.14	7.45 (0.32)
Low	21.12	8.66 (0.4)	19.28	8.22 (0.4)
Medium	19.10	8.07 (0.4)	22.68	8.64 (0.36)
High	23.95	8.31 (0.34)	22.01	8.33 (0.3)
Very High	18.96	8.31 (0.41)	17.89	8.31 (0.34)

Source: Authors' calculations from GATS 2009 and 2017 data

Table 3: Prevalence of Biri Smoking and Average Daily Consumption of Biri Demographic Characteristics

	GATS 2009		GATS 2017	
	Biri Smokers (in %)	Average Daily Intensity	Biri Smokers (in %)	Average Daily Intensity
Overall	9.88	13.03 (0.3)	5.32	13.16 (0.47)
Gender				
Female	5.68	6.07 (0.84)	4.56	6.22 (1.07)
Male	94.32	13.45 (0.31)	95.44	13.49 (0.48)
Residence				
Rural	73.19	13.51 (0.33)	75.59	13.17 (0.49)
Urban	26.81	11.75 (0.66)	24.41	13.14 (1.15)
Education				
No Schooling	62.25	13.04 (0.37)	53.53	13.78 (0.74)
Primary	25.24	13.81 (0.58)	32.06	12.55 (0.61)
Less than Secondary	9.25	11.83 (1.16)	12.21	11.53 (0.88)
Secondary Completed	1.79	14.14 (4.17)	1.62	17.22 (6.33)
High School Completed	0.95	8.25 (2.29)	0.59	12.5 (4.21)
Bachelor	0.21	1.14 (0.86)	0.00	. (.)
Post-Graduation	0.32	1.43 (0.57)	0.00	. (.)
Employment				
Service	2.94	11.32 (2.68)	1.32	9.62 (1.11)
Business	11.57	13.26 (0.85)	13.97	13.38 (0.93)
Farming/Agriculture	49.21	14.44 (0.42)	40.74	13.59 (0.9)
Industrial Worker	2.00	9.86 (2.05)	1.03	12.57 (3.54)
Daily Laborer	16.40	12.35 (0.73)	23.38	13.45 (0.74)
Self-Employed	4.10	13.95 (1.4)	7.35	13.59 (1.37)
Student	0.32	0.86 (0.57)	0.15	25 (.)
Homemaker	3.68	5.14 (0.9)	3.24	7.37 (1.39)
Retired/Unemployed	4.63	8.06 (1.18)	6.47	12.15 (1.98)
Others	5.15	13.63 (1.48)	2.35	12.4 (3.07)
Age (in years)				
15–24	6.20	9.71 (0.99)	2.06	12.59 (4.71)
25–34	20.19	13.08 (0.67)	14.12	13.11 (1.78)
35–44	30.18	14.06 (0.53)	24.71	14.14 (0.8)
45–55	20.29	14.73 (0.72)	27.65	13.79 (0.72)
>55	23.13	11.06 (0.63)	31.47	11.9 (0.82)
Wealth (in quintiles)				
Very Low	36.07	12.91 (0.49)	41.47	12.93 (0.84)
Low	26.08	13.86 (0.57)	30.74	13.99 (0.73)
Medium	23.13	13.57 (0.61)	18.68	12.86 (0.85)
High	11.78	11.41 (0.94)	7.94	11.71 (1.66)
Very High	2.94	9.54 (2.76)	1.18	14.39 (4.42)

Source: Authors' calculations from GATS 2009 and 2017 data

Table 4: Summary Statistics of Cigarettes and Biri Prices

	GATS 2009		GATS 2017	
	% of purchases	Average Price Per Stick* (in BDT)	% of purchases	Average Price Per Stick* (in BDT)
Cigarettes:				
Loose Purchases	84.94	1.95 (1.89, 2.01)	80.82	4.41 (4.27, 4.53)
Pack Purchases	15.06	1.08 (0.96, 1.21)	19.18	2.71 (2.48, 2.96)
Overall	100.00	1.78 (1.72, 1.84)	100.00	4.05 (3.94, 4.17)
Biri:				
Loose Purchases	63.31	0.38 (0.25, 0.49)	51.65	1.32 (0.99, 1.64)
Pack Purchases	36.69	0.19 (0.18, 0.21)	48.35	0.52 (0.47, 0.56)
Overall	100.00	0.29 (0.22, 0.37)	100.00	0.91 (0.75, 1.08)

* 95 percent confidence interval in parenthesis
Source: Authors' calculations from GATS 2009 and 2017 data

4. Estimation Results and Discussion

4.1. Overall Data

The price elasticity of cigarette smoking prevalence measures the proportionate change in cigarette smoking participation due to a given change in its price and the price elasticity of cigarette smoking intensity shows the proportionate change in cigarette smoking amount with respect to given change in price. Table 5 presents the estimates of both types of price elasticities for cigarette smoking prevalence using the two rounds of GATS data from Bangladesh. Corresponding marginal effects for the models are presented in Table 9 in Annex A (Section A.2). Estimates are presented for three specifications: in Model 1, cigarette smoking participation and smoking frequency (number of sticks smoked) is modeled with respect to the price of cigarettes, the price of biris, and smokers' asset holdings (as a proxy for income); Model 2 augments this basic model 1 by including demographic (gender, age, family size, and residence type) and other socioeconomic variables (educational attainment and occupational categories); and Model 3 further augments the other two models by including the status of smoking restrictions in homes (self-imposed) and workplaces (legislation or regulation imposed by authority), exposure to smoking warnings, advertising, promotional activities, and perceptions.

The main variable of interest in the estimation model is cigarette price. Estimates of prevalence elasticities in all three models reveal that cigarette price significantly affects the decision to smoke cigarettes. The results for Model 3 show that the prevalence elasticity of cigarette is -0.67. This indicates that a 10 percent increase in the price of each cigarette stick will lead to a decrease in the prevalence of cigarette smoking by approximately 6.7 percent, depending on demographics, socioeconomic status, and exposure to tobacco control tools. The prevalence elasticity is estimated to be -0.44 in Model 1, with only price and assets as the covariates, and -0.66 in Model 2, with price, assets, and demographic and socioeconomic variables as covariates. The estimation results show cigarette smoking intensity (number of sticks smoked) is also affected negatively by cigarette price. In Model 1, the intensity elasticity is estimated as -0.06 which implies a 10 percent increase in price will, on an average, lead to 0.6 percent reduction in smoking intensity. However, although the effect of price on smoking intensity is statistically significant in Model 1, it is statistically insignificant for the other two models.

The sign of prevalence elasticity estimates for biri price is negative. Thus, cigarettes and biris can considered as complementary in the decision to smoke. A portion (2 percent) of smokers are dual users and tend to switch between cigarette and biri frequently (Nargis et. al., 2015). Although the

magnitude is very small the significance of estimates establishes that biri price is an important determinant for the decision to smoke cigarettes. On the contrary, the sign of the intensity elasticity estimates of biri price is positive and hence cigarettes and biris are considered as substitutes for smoking intensity; however, this effect is statistically insignificant, indicating that biri price is not a key determinant in the intensity of cigarette smoking. In other words, biris can be considered as weak substitutes and in response to an increase in cigarette price, most smokers are not switching to biris. The prevalence of overall biri smoking in the country is around 5 percent (GATS, 2017). Table 4 (GATS 2017) shows that a pack of biri with 25 sticks was sold at a price of around 12.50 BDT. It implies that the percentage change in the base price for biris results in an insignificant incremental change in absolute actual price, which, in turn, fails to significantly affect the intensity of cigarette smoking. In addition, although the price gap between cigarette and biri is wide, the high growth of per capita income made biri a less attractive choice for increasing smoking intensity. It can be argued here that biri is the lowest cost substitute though individuals appear to be less interested in them perhaps because of increase in income over the years or the social stigma (as biris are typically consumed by comparatively low-income people) associated with biri smoking.

Affordability, measured in terms of individual income, is considered an important determining factor for smoking. However, due to the unavailability of individual income data for this study, asset holdings were used to construct an asset index, which serves as a proxy for income. The magnitude of asset elasticity is relatively smaller, and it is statistically significant only in Model 1 and Model 2 (for prevalence) and in Model 2 and Model 3 (for intensity).

Table 5: Prevalence and Intensity Elasticity of Cigarette Smoking using GATS Data

Variables	Prevalence Elasticities			Intensity Elasticities		
	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
Average Consumption Weighted Cigarette Price (Per Stick)	-0.44*** (0.08)	-0.66*** (0.13)	-0.67*** (0.14)	-0.06** (0.03)	-0.04 (0.02)	-0.04 (0.03)
Average Consumption Weighted Biri Price (Per Stick)	-0.01* (0.01)	-0.03*** (0.01)	-0.03*** (0.01)	0.01*** (0.00)	0.01 (0.00)	0.00 (0.00)
Asset (Proxy of Permanent Income)	-0.08** (0.03)	-0.08* (0.05)	-0.07 (0.06)	-0.02 (0.01)	-0.04** (0.02)	-0.03* (0.01)
Observations	11,471	11,471	11,471	1,560	1,560	1,560

Note: *, **, and *** indicate significance at 10%, 5%, and 1% levels, respectively. Standard errors are in parentheses. The estimation attempts also controlled for different tobacco-related warnings, advertising, promotional initiatives, and perceptions related to smoking and tobacco taxes. The corresponding marginal effects are given in Table 6 in Annex A (Section A.2).

4.2. Restricting Data by Wealth Group

The smoking decision as well as intensity of smoking cigarettes are expected to vary by wealth status. In this section, the sample is divided into two groups based on wealth status. The high wealth group includes respondents from the top two wealth quintiles, while the low wealth group includes the bottom three. The three models are re-estimated for these groups. The estimated elasticities for prevalence and intensity by wealth group are presented in Table 6, and the marginal effects for the models are presented in Tables 10 and 11 in Annex A (Section A.2).

Table 6: Prevalence and Intensity Elasticity of Cigarette Smoking across Wealth Groups

Variables	Prevalence Elasticities			Intensity Elasticities		
	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
Low Wealth Group (60%)						
Average Consumption Weighted Cigarette Price (Per Stick)	-0.57***	-0.83***	-0.86***	-0.08*	-0.04	-0.04
	(0.09)	(0.18)	(0.17)	(0.04)	(0.05)	(0.05)
Average Consumption Weighted Biri Price (Per Stick)	0.01**	0.01	0.00	0.00	0.00	0.00
	(0.00)	(0.01)	(0.02)	(0.00)	(0.00)	(0.00)
Asset (Proxy of Permanent Income)	-0.17**	-0.04	-0.01	0.02	0.01	0.01
	(0.07)	(0.01)	(0.15)	(0.06)	(0.06)	(0.06)
Observations	7,680	7,680	7,680	961	961	961
High Wealth Group (40%)						
Average Consumption Weighted Cigarette Price (Per Stick)	-0.29***	-0.35***	-0.35***	-0.05*	-0.06**	-0.04
	(0.10)	(0.12)	(0.13)	(0.03)	(0.03)	(0.03)
Average Consumption Weighted Biri Price (Per Stick)	-0.08***	-0.10***	-0.11***	0.01**	0.01	0.01
	(0.02)	(0.04)	(0.04)	(0.01)	(0.01)	(0.01)
Asset (Proxy of Permanent Income)	0.01	0.08	0.01	0.03	0.10*	0.07
	(0.11)	(0.1)	(0.1)	(0.04)	(0.05)	(0.05)
Observations	3,791	2,228	2,228	599	599	599

Note: *, **, and *** indicate significance at 10%, 5%, and 1% levels, respectively. Standard errors are in parenthesis. The estimation attempts also controlled for different tobacco-related warnings, advertising, promotional initiatives, and perceptions related to smoking and tobacco taxes. The corresponding marginal effects are given in Tables 7 and 8 in Annex A (Section A.2).

The results show that cigarette price is an important determinant in the decision to smoke and in the intensity of smoking cigarettes. It negatively affects both smoking participation and smoking intensity across wealth groups. The impact is higher for the low wealth group compared to the high wealth group, irrespective of model choice. The price elasticity of cigarette smoking participation ranges from –0.57 to –0.86 in the low wealth group, while in the high wealth group it spans between –0.29 and – 0.35. Therefore, all other factors remaining constant, respondents in the low wealth group are more than twice as responsive to cigarette price changes as those in the high wealth group. The reason for the lower responsiveness in the high wealth group may reflect their higher ability to pay. As before, the magnitude of intensity elasticity estimates are small and are found to be significant for the low wealth group only in Model 1 and for the high wealth group in Model 1 and 2.

Biri price is statistically insignificant and has a negligible effect in low wealth groups after controlling for demographic, socioeconomic, and other variables. The positive sign of elasticity estimates indicates its substitutability among smokers with low wealth status. In the high wealth group, biri price contains a statistically significant and considerable effect on cigarette smoking decision. The negative sign of prevalence elasticity coefficients implies that biri is complementary for smokers in the high wealth group in the case of deciding to smoke cigarettes. However, biri price has a positive, mostly insignificant and negligible impact on the number of cigarette sticks smoked in the high-income group. Similarly, within each wealth group, asset variation also has a statistically insignificant impact on the probability of cigarette smoking and the number of sticks smoked.

4.3. Restricting Data by Residential Group

The cigarette smoking decision and behavior can also differ across the residential status of the people. Hence, this section estimates the price elasticity of cigarette smoking by region. The data is divided into two groups based on residence type: urban versus rural areas. The estimates of price elasticity are presented in Table 7 (corresponding marginal effects are given in Tables 12 and 13 in Annex A (Section A.2).

Table 7: Prevalence and Intensity Elasticity of Cigarette Smoking across Residential Areas

Variables	Prevalence Elasticities			Intensity Elasticities		
	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
Rural						
Average Consumption Weighted Cigarette Price (Per Stick)	-0.43***	-0.66***	-0.68***	-0.04	-0.02	-0.01
	(0.09)	(0.15)	(0.16)	(0.03)	(0.03)	(0.03)
Average Consumption Weighted Biri Price (Per Stick)	-0.00	-0.02*	-0.03*	0.01**	0.02**	0.01
	(0.01)	(0.01)	(0.02)	(0.01)	(0.01)	(0.01)
Asset (Proxy of Permanent Income)	-0.08***	-0.10	-0.08	-0.03	-0.09***	-0.06**
	(0.03)	(0.06)	(0.07)	(0.03)	(0.03)	(0.03)
Observations	7,139	7,139	7,139	868	868	868
Urban						
Average Consumption Weighted Cigarette Price (Per Stick)	-0.35***	-0.60***	-0.49***	-0.09*	-0.11**	-0.10**
	(0.09)	(0.15)	(0.15)	(0.05)	(0.05)	(0.04)
Average Consumption Weighted Biri Price (Per Stick)	-0.04**	-0.07***	-0.04*	0.00	-0.00	-0.00
	(0.02)	(0.03)	(0.02)	(0.00)	(0.00)	(0.00)
Asset (Proxy of Permanent Income)	-0.01	-0.03	-0.05	0.01	-0.00	0.00
	(0.03)	(0.03)	(0.04)	(0.01)	(0.01)	(0.01)
Observations	4,332	4,332	4,332	692	692	692

Note: *, **, and *** indicate significance at 10%, 5%, and 1% levels, respectively. Standard errors are in parentheses. The estimation attempts also controlled for different tobacco-related warnings, advertising, promotional initiatives, and perceptions related to smoking and tobacco taxes. The corresponding marginal effects are given in Tables 9 and 10 in Annex A (Section A.2).

The estimates show that the price elasticity of cigarette smoking propensity is higher in rural areas, ranging from –0.43 to –0.68. In urban areas, estimates range between –0.35 to –0.49. The underlying reason for this differential impact could be due to the relative income difference of

people residing in respective areas. People living in rural areas generally have lower income and are therefore more responsive to price change compared to those who live in urban areas. Similar to the probability of cigarette smoking, the number of sticks smoked is also negatively affected regardless of areas of residence. However, such a negative impact on cigarette smoking intensity is statistically significant and more prominent among the smokers from urban areas than those from rural areas which might be due to the fact that variation in cigarette prices among urban smokers is higher compared to cigarette prices among rural smokers[3]. Although small in magnitude, biri price has a significant and complementary effect on the cigarette smoking decision in both rural and urban areas. On the contrary, biri price showed negligible effect on cigarette smoking intensity in rural areas. Asset variation is insignificant in urban areas both for cigarette smoking decision as well as the number of cigarette sticks smoked. In rural areas, the same variable is found to be significant occasionally with a small magnitude of effect on both the outcome variables.

4.4. Total Cigarette Price Elasticity

Total price elasticity of cigarette demand measures the percentage change in cigarette demand resulting from the percentage change in cigarette smoking prevalence and intensity due to percentage change in cigarette price. Accordingly, for the total elasticity, estimates of prevalence elasticity and intensity elasticity from respective models are summed. Corresponding results are presented in Table 8 for overall data and also by wealth groups and areas of residence.

Table 8: Total Cigarette Price Elasticity using GATS Data

Total Cigarette Price Elasticity	Model 1	Model 2	Model 3
Overall Data	- 0.50	- 0.70	- 0.71
Low Wealth Group (Lowest 60%)	- 0.65	- 0.87	- 0.90
High Wealth Group (Highest 40%)	- 0.34	- 0.41	- 0.39
Rural Area of Residence	- 0.47	- 0.68	- 0.69
Urban Area of Residence	- 0.44	- 0.71	- 0.59

As the results show, the price elasticity of cigarette demand varies between –0.50 to –0.71 in different model specifications. Estimations in Model 3 can be considered as the most accurate as it controls for tobacco-related factors besides other factors. Therefore, it can be asserted that a 10 percent increase in cigarette price will lead to, on average, a 7.1 percent fall in

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[3]Using GATS 2009 and 2017 data, we found that standard deviation of consumption weighted cigarette price for smokers in rural areas is 0.74 which is lower than 0.83, the standard deviation of consumption weighted cigarette price for smokers in urban areas. The difference is statistically significant. The P-value for a variance difference test, where null hypothesis is no difference between the standard deviations against an alternative hypothesis of some difference between two standard deviations, is almost zero.

cigarette demand in Bangladesh. The cigarette demand hence responds less than proportionately to the cigarette price and can be considered as price inelastic.

Estimation results restricting the individuals with respect to their wealth status reflect that people with low wealth status are more than twice as responsive as those with high wealth status. Additionally, since the magnitude of elasticity remains less than one (in absolute terms) for all models and in both wealth groups, cigarette demand can be considered as inelastic regardless of the wealth status of people. Considering Model 3 for the high wealth group, a 10 percent increase in cigarette price leads to a decrease in cigarette demand by 3.9 percent while the same percentage of price change brings as high as a 9 percent reduction in cigarette demand for the low wealth group. This finding is of crucial importance considering the context of Bangladesh. It is particularly because of the high prevalence of smoking tobacco in the lower wealth quintiles; 48.8 percent and 26.3 percent in the lowest and highest wealth quintile respectively (GATS 2017). Moreover, among adults (aged 15 and above) 22.8 percent in the lowest wealth quintile, 19.5 percent in the low wealth quintile, and 19.2 percent in the medium wealth quintile use any type of smoking products in Bangladesh (GATS 2017). Thus, an increase in cigarette price would be more effective in reducing smoking prevalence in low wealth groups. While elasticity is measured considering the areas of residence, the results reflect that the magnitude of total cigarette price elasticity is marginally higher in rural areas compared to urban. However, cigarette demand is found to be price inelastic regardless of the areas of residence. In rural areas the estimated elasticity varied between –0.47 and –0.69. For urban areas, the results were between –0.44 and –0.59. The difference in elasticity magnitude can be attributed to the underlying income difference of the people living in those two areas. It is necessary to mention here that the cigarette smoking prevalence in urban and rural areas are not different considerably; in rural areas the percentage is 13.94 while in urban areas that stands at 16.43 (GATS 2017).

5. Research Limitations

The current study attempts to measure the total price elasticity of cigarette demand while bifurcating it to the responsiveness in cigarette smoking prevalence and that in cigarette smoking intensity. As a limitation in model construction, the current effort does not include the "price of smokeless tobacco" as a confounding factor. According to GATS 2017, currently, the prevalence of smokeless tobacco use is 20.6 percent with an absolute population of 22 million in Bangladesh and it can be considered as a substitute for smoking tobacco such as cigarettes (Nargis, Hussain and Fong, 2014). Nevertheless because of the unavailability of appropriate price data for smokeless tobacco in both rounds of GATS (2009 and 2017), this important determinant could not be used in the models. None of the GATS rounds have any information regarding the "income" of the individuals. Due to the availability of "household asset holding" information, the study constructed a "household asset index" and tried to control for it instead of "personal income" while modeling the cigarette demand.

Another limitation is the timing of the data collection. Bangladesh has experienced dramatic changes in smoking behaviour over the past decade, which necessitates the use of more recent data as well as documentation of the changes in price elasticity of demand. However, GATS 2009 report was published in 2011 and GATS 2017 data and report were available only by the end of 2020. The launch of novel tobacco products and the re-positioning of a few existing brands along with the out-break of the COVID-19 pandemic might have impacted smokers' price sensitivity in recent years.

Hence, further research is required in future using more recent data. Although the study could estimate the elasticities with respect to wealth groups and areas of residence, age-specific and gender-specific elasticity estimation could not be performed, due to the limited number of observations in some specific age groups. The sample size that is used for conditional cigarette demand estimation is relatively lower and that becomes even lower when restricting the data considering wealth status and areas of residence.

6. Conclusion and Policy Recommendations

The current study analyses cigarette demand elasticity with respect to price using GATS 2009 and GATS 2017 data. In Bangladesh, cigarette smoking prevalence is higher for males, urban residents, those with lower wealth status, and those with lower levels of education. The results reveal that cigarette demand is price inelastic and ranges between –0.50 and –0.71. It is also price inelastic across all socioeconomic and demographic groups in Bangladesh. However, the estimated elasticity parameter does not differ considerably across geographic locations. More specifically, magnitudes are estimated to be –0.59 and –0.69, respectively, for residents in urban versus rural areas. Comparing the estimations across wealth groups, it is evident that individuals in the low wealth (bottom three quintiles) group are more than twice as responsive as their high wealth (top two quintiles) counterparts.

The findings, thus, show a negative relationship between cigarette price and the demand for cigarette smoking across socioeconomic and demographic groups. Regardless of individual characteristics, people refrain from cigarette smoking in response to an increase in price. Most importantly, the greater magnitude of elasticity parameter for the low wealth group implies that when faced with a price increase, members of poorer households are more likely to quit cigarette smoking than the rich.

Therefore, a significant increase in the price of cigarette is very likely to decrease the size of the smoking population in Bangladesh. Reducing the size of the smoking population would have substantial public health implications. Considering the related health benefits, quitting smoking has significantly more potential health impact than simply reducing smoking intensity (Nargis et al., 2010). The negative prevalence elasticity of cigarettes demonstrates that increasing cigarette taxes reduces its smoking prevalence provided there is sufficient pass through of the tax to cigarette prices. Since the low wealth group is more responsive (more than twice) compared to the high wealth group, the relative tax burden would fall more on smokers from the high wealth group. The number of smokers as a result would decrease, and there would also be an increase in government revenue (Barkat et al., 2012; Goodchild et al., 2016; Acharya et al., 2016).

A substantial price increase is important because it discourages both potential smokers from smoking initiation and current smokers from ongoing smoking participation. The estimates of participation elasticity of cigarettes suggest that increasing taxes on cigarettes can have a considerable impact on smoking prevalence in Bangladesh. Around the world there has been substantial number of studies establishing the health benefit measured by number of lives saved through taxation on cigarette assuming it as price inelastic (Kaplan et al., 2001; Levy et al., 2006; John et al., 2010; Barber et al., 2008). Given the price inelasticity of cigarette, there has also been

sufficient evidence that cigarette taxation increases government revenue (Sung et al., 2005, Ross et al., 2008, Van Walbeek, 2002; IARC, 2012). Thus, the findings highlight and reinforce the importance of cigarette taxation for achieving the twin policy goals of improving public health and increasing government revenue.

The effectiveness of cigarette taxation is mainly subject to the efficiency of the tax structure design as well as proper implementation. In Bangladesh, the tobacco tax structure is complex and tiered, prices of cigarettes are comparatively low, and per capita income is increasing and therefore increasing the affordability of cigarettes. Additionally, the complexity of the tax structure poses challenges for proper tax administration. The flaws in tax tier design encourage existing smokers to switch brands rather than to quit and maintain low prices which encourages non-smokers to start smoking. In order to achieve the public health goal of prevalence reduction and the revenue goal of increasing tax revenue, the cigarette tax structure in Bangladesh must be simplified. The tax structure should limit the scope of switching to lower priced brands. A mixed system with a blend of uniform specific and *ad valorem* tax components can be initiated. In order for taxation to effectively reduce prevalence, the tax structure design should prioritize the uniform specific tax such that it constitutes the majority of the total tax incidence. Moreover, the tax must be annually adjusted for inflation and income growth to maintain its effectiveness with regard to real value of price.

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Annex A

A.1 Technical Details: Probit Estimation

A.1.1 Conceptual Framework

Although cigarettes have addictive features, by now it is well established that cigarette demand follows the basic law of demand in economics (Chaloupka and Warner, 2000; IARC, 2012; WHO, 2010). Estimation of the cigarette demand function requires assumed specification of a utility function for the consumer, which would be augmented with cigarettes and other goods. The corresponding consumer would maximize utility subject to the budget constraint, while the budget is comprised of the consumer's income along with the price of cigarettes and other goods.

$$Utility\ Function, U = f(C, OG, T) ---(1)$$
$$Budget\ Constraint, I = P_C * C + P_O * OG ---(2)$$

Here, *C* denotes *Cigarettes*; *OG* denotes *Other Goods*; P_c and P_o denote the prices of cigarettes and other goods, respectively; *T* denotes taste; and *I* denotes the income of the consumer.

Following the procedure developed in calculus the solution of the above optimization problem would lead to the following demand function for cigarettes:

$$Demand\ Function, C = f(P_C, I, P_O, T) ---(3)$$

This study models the above basic cigarette consumption behavior while also controlling for the impacts of Gender (G), Age (A), Education (E), Employment Status (ES), Family Size (FS), Smoking Regulations in the Home and Workplace (SR), Advertising and Promotional Activities of Tobacco Companies (AP), and Smoking Perceptions (SP). Thus, the generalized cigarette demand function that would be estimated is as follows:

$$C = f(P_C, I, G, A, E, ES, FS, SR, AP, SP) ---(4)$$

A.1.2 Modeling Smoking Propensity (Smoking Decision)

Implementing the above generalized regression model, a probit regression technique would be adopted for modeling the individual's decision to smoke cigarettes. For ease of expression, assume that the dependent variable *y* denotes decision to smoke, which takes the value of 1 if the person is a smoker and 0 if otherwise. All individuals in the observation set are different from each other in terms of their characteristics including Cigarette Price, Income, Age, Gender, Education,

Employment Status, Family Size, Smoking Regulation in the Home and Workplace, Advertising and Promotional Activities of Tobacco Companies, and Smoking Perceptions, which is denoted as *x*. The purpose is to identify along with prices how individual characteristics affect the probability of the decision to smoke. Considering the necessary restriction for the binary dependent variable, i.e., decision to smoke, assume that the probability of an individual being a smoker or non-smoker, respectively, would be modeled as follows:

$$P(y = 1|x, \beta) = 1 - F(-x'\beta)$$
$$P(y = 0|x, \beta) = F(-x'\beta)$$

Here *F* is a strictly increasing continuous function, which conceives a value ranging from 0 to 1 against any real value. The parameters of the model would be estimated by maximizing the following likelihood function:

$$l(\beta) = \sum_{x,y=1}^{n} ylog\big(1 - F(-x'\beta)\big) + (1 - y)\log\big(F(-x'\beta)\big)$$

The decision about the functional form of *F* would determine the type of binary specification, i.e., probit or logit.

A.1.3 Probit Specification

In the probit specification, the binary dependent variable, i.e., the decision to smoke, would be considered with respect to a latent variable, for instance y*. Assume that this latent variable is stochastic and linear in its relation to the individual characteristics, *x*, in the following way:

$$y^* = x'\beta + \varepsilon$$

Here, ε is the stochastic disturbance term and $\varepsilon \sim N(0, \sigma^2)$. The observed decision to smoke would be determined whenever the latent variable shifts the threshold:

$$y = \begin{cases} 1 \; if \; y^* > 0 \\ 0 \; if \; Otherwise \end{cases}$$

As long as there is a constant term, the choice of the threshold would remain arbitrary. Since it is assumed that ε is normally distributed, the response probability about the decision to smoke would be derived as follows:

$P(y = 1|x, \beta) = P(y^* > 0|x, \beta)$

$= P(x'\beta + \varepsilon > 0|x, \beta)$

$= P(\varepsilon > -x'\beta|x, \beta)$

$= 1 - F(-x'\beta)$

$= \Phi(x'\beta), As\ distribution\ is\ symmetrical$

So, $P(y = 0|x, \beta) = P(y^* \leq 0|x, \beta) = 1 - \Phi(x'\beta).$

Here, assuming a standard normal cumulative distribution function,

$$\Phi(x'\beta) = \int_{-\infty}^{x'\beta} \frac{1}{\sqrt{2\pi}} exp\left(-\frac{1}{2}(x'\beta)^2\right)dx'\beta$$

The expected value of the decision to smoke would be represented by the conditional probability as follows:

$$E(y|\ x, \beta) = 1 * P(y = 1|x, \beta) + 0 * P(y = 0|x, \beta) = P(y = 1|x, \beta) = \Phi(x'\beta)$$

In the above binary model, primary interest is in the marginal effect of different individual characteristics on the probability of an individual becoming a smoker. Such effect of *k*th characteristics would be measured by the following:

$$\frac{\partial E(y|x, \beta)}{\partial x_k} = \beta_k \frac{1}{\sqrt{2\pi}} exp\left(-\frac{1}{2}(x'\beta)^2\right)$$

Since the marginal effect varies with each of the individual characteristics, these effects are usually evaluated at the average value of all the characteristics. The elasticity with respect to the *k*th characteristics would be given as follows:

$$\frac{\partial E(y|x, \beta)}{\partial x_k} * \frac{\bar{x}_k}{E(y|x, \beta)} = \beta_k \frac{1}{\sqrt{2\pi}} exp\left(-\frac{1}{2}(x'\beta)^2\right)\frac{\bar{x}_k}{E(y|x, \beta)}$$

A.2 Estimation Results

Table 9: Probit (Part I) and Conditional Demand (Part II) Estimation for Cigarette Smoking

Variables	Part 1			Part 2		
	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
Dependent Variable	Smoking Status, 1 = Smoker and 0 = Non-Smoker			Ln(Cigarette Consumption)		
Consumption Weighted Cigarette Price (Per Sticks)	-0.05***	-0.04***	-0.03***	-0.08**	-0.06	-0.05
Consumption Weighted Bidi Price (Per Sticks)	-0.00*	-0.00***	-0.00***	0.01***	0.01	0.01
Asset (Proxy of Permanent Income)	0.01***	0.00*	0.00	0.02	0.04**	0.03*
Year (2017=1, 2009=0)	0.04***	0.03***	0.03***	0.04	0.04	0.10
Female		-0.31***	-0.27***		-0.58	-0.59
Age		0.00	0.00***		0.00**	0.01***
Rural		-0.01	-0.01		-0.17***	-0.16**
Family Size		-0.00	-0.00		0.01	0.01
Education (Base Category: No Formal Education)						
Primary		-0.02**	-0.02**		-0.07	-0.04
Less than Secondary		-0.03***	-0.04***		-0.11	-0.09
Secondary Completed		-0.04**	-0.05***		-0.45***	-0.41***
High School Completed		-0.03	-0.03*		-0.55***	-0.57***
Bachelor		-0.00	-0.01		-0.45**	-0.42**
Post Graduation		-0.09**	-0.09***		-1.02***	-0.92**
Employment (Base Category: Retired and Unemployed)						
Service		0.03	0.02		0.19	0.18
Business		0.05***	0.04**		0.39***	0.39***
Farming and Agricultural Worker		0.01	0.01		0.08	0.08
Industrial Worker		0.05**	0.06**		0.07	0.12
Daily Laborer		0.04**	0.03*		0.21	0.22
Self Employed		0.08***	0.07***		0.36**	0.32**
Student		-0.13***	-0.12***		-0.30	-0.23
Homemaker		0.01	0.01		0.01	0.18
Others		0.04*	0.03		0.30	0.32*
Household Smoking Not Allowed			-0.05***			-0.34***
Workplace Smoking Not Allowed			-0.01			-0.02
Warning						
Have Seen Newspaper Warning			0.01			0.08
Have Seen Magazine Warning			-0.04			-0.12
Have Seen TV Warning			0.00			-0.01
Have Listened to Radio Warning			0.00			0.02
Have Seen Billboard Warning			0.01			0.01
Have Seen Poster Warning			-0.02**			0.03
Have Seen Pack Warning			0.11***			0.23
Advertising						
Have Seen Store Advertising			0.01			0.13**
Have Seen TV Advertising			-0.01			0.08
Have Listened to Radio Advertising			0.07*			-0.26
Have Seen Billboard Advertising			0.01			0.00
Have Seen Poster Advertising			0.01			-0.08
Have Seen Newspaper Advertising			0.00			-0.18
Have Seen Magazine Advertising			0.10			-1.59***
Have Seen Cinema Advertising			-0.06**			-0.04
Have Seen Internet Advertising			-0.03			0.48
Have Seen Public Transport Advertising			0.00			0.06
Have Seen Public Walls Advertising			-0.03**			-0.09
Promotional Activities						
Have Seen Promotion through Sports			-0.06			-0.45
Have Seen Promotion through Arts and Culture Activities			-0.04			0.17
Have Seen Promotion through Movies			0.02**			0.12**
Have seen Free Sample Distribution			0.02			0.05
Have Seen Sold at Sale			0.02			0.12
Have Seen Coupon Distribution			-0.03*			0.06
Have Seen Special Discount			0.01			0.12
Have Seen Branding through Cloth			0.01			0.21**
Have Seen Promotion through Internet			-0.09			0.
Perception						
Second Hand Smoking Cause Illness			-0.03*			0.11
Smoking Causes Serious Illness			0.00			-0.29**
Smoking is Addictive			-0.01			0.08
In Favor of Tobacco Tax Increase			-0.04***			-0.07
Observations	11,471	11,471	11,471	1,560	1,560	1,560

Note: *, **, and *** indicate significance at 10%, 5%, and 1% levels, respectively.

Table 10: Probit (Part I) and Conditional Demand (Part II) Estimation of Cigarette Smoking for Low Wealth Group (Low 60%)

Variables	Part 1			Part 2		
	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
Dependent Variable	Smoking Status, 1 = Smoker and 0 = Non-Smoker			Ln(Cigarette Consumption)		
Consumption Weighted Cigarette Price (Per Sticks)	-0.06***	-0.04***	-0.04***	-0.12*	-0.07	-0.06
Consumption Weighted Bidi Price (Per Sticks)	0.00**	0.00	-0.00	0.01	0.01	0.01
Asset (Proxy of Permanent Income)	0.01**	0.00	0.00	-0.01	-0.00	-0.01
Year (2017=1, 2009=0)	0.04***	0.03***	0.03***	-0.01	0.02	0.09
Female		-0.29***	-0.26***		0.10	-0.09
Age		0.00	0.00**		0.00	0.00
Rural		-0.02*	-0.01		-0.26***	-0.20***
Family Size		-0.00	-0.00		0.02	0.01
Education (Base Category: No Formal Education)						
Primary		-0.02**	-0.02**		-0.11	-0.10
Less than Secondary		-0.02*	-0.03**		-0.13	-0.12
Secondary Completed		-0.07***	-0.07***		-0.54**	-0.50**
High School Completed		-0.03	-0.01		-1.26***	-1.22***
Bachelor		-0.01	-0.04		-0.18	-0.32
Post Graduation		-0.17***	-0.16***		-1.29***	-1.30***
Employment (Base Category: Retired and Unemployed)						
Service		0.06**	0.06**		0.29	0.27
Business		0.08***	0.07***		0.53**	0.56***
Farming and Agricultural Worker		0.03	0.04*		0.16	0.18
Industrial Worker		0.09***	0.10***		0.24	0.32
Daily Laborer		0.05**	0.05**		0.28	0.30
Self Employed		0.10***	0.10***		0.58***	0.61***
Student		-0.15***	-0.13***		-0.59	-0.80*
Homemaker		0.05	0.05		-0.42	-0.17
Others		0.04	0.05		0.45*	0.47**
Household Smoking Not Allowed			-0.05***			-0.25***
Workplace Smoking Not Allowed			-0.01			-0.05
Warning						
Have Seen Newspaper Warning			0.01			0.02
Have Seen Magazine Warning			-0.07**			0.01
Have Seen TV Warning			0.01			0.02
Have Listened to Radio Warning			-0.01			-0.06
Have Seen Billboard Warning			0.00			0.08
Have Seen Poster Warning			-0.02*			0.05
Have Seen Pack Warning			0.09***			0.19
Advertising						
Have Seen Store Advertising			-0.00			0.09
Have Seen TV Advertising			-0.00			0.37*
Have Listened to Radio Advertising			0.07			0.22
Have Seen Billboard Advertising			0.00			0.18
Have Seen Poster Advertising			0.03**			-0.02
Have Seen Newspaper Advertising			-0.04			-1.65***
Have Seen Magazine Advertising			0.11			1.18
Have Seen Cinema Advertising			-0.07***			0.10
Have Seen Internet Advertising			-0.02			-0.16
Have Seen Public Transport Advertising			-0.02			-0.09
Have Seen Public Walls Advertising			-0.02			-0.24
Promotional Activities						
Have Seen Promotion through Sports			-0.15***			-0.40
Have Seen Promotion through Arts and Culture Activities			-0.00			0.18
Have Seen Promotion through Movies			0.02*			0.16**
Have seen Free Sample Distribution			0.03**			0.03
Have Seen Sold at Sale			-0.02			0.13
Have Seen Coupon Distribution			-0.01			0.02
Have Seen Special Discount			0.03*			0.15
Have Seen Branding through Cloth			0.03*			0.42***
Have Seen Promotion through Internet			0.03			-0.06
Perception						
Second Hand Smoking Cause Illness			-0.02			0.03
Smoking Causes Serious Illness			0.00			-0.28*
Smoking is Addictive			0.00			0.26**
In Favor of Tobacco Tax Increase			-0.04***			-0.11
Observations	7,680	7,680	7,680	961	961	961

Note: *, **, and *** indicate significance at 10%, 5%, and 1% levels, respectively.

Table 11: Probit (Part I) and Conditional Demand (Part II) Estimation of Cigarette Smoking for High Wealth Group (High 40%)

Variables	Part 1			Part 2		
	Model 1	Model 2	Model 3	Model 1	Model 2	Model
Dependent Variable	Smoking Status, 1 = Smoker and 0 = Non-Smoker			Ln(Cigarette Consumption)		
Consumption Weighted Cigarette Price (Per Sticks)	-0.04***	-0.05***	-0.04***	-0.07*	-0.08**	-0.05
Consumption Weighted Bidi Price (Per Sticks)	-0.02***	-0.02***	-0.02***	0.03**	0.03	0.02
Asset (Proxy of Permanent Income)	0.00	0.01	0.00	0.03	0.11*	0.08
Year (2017=1, 2009=0)	0.04**	0.04	0.04	0.13	0.11	0.18*
Female		-0.55***	-0.50***		-1.98***	-
Age		0.00	0.00		0.01**	0.01**
Rural		-0.01	-0.02		-0.01	-0.06
Family Size		-0.00	-0.00		0.00	-0.00
Education (Base Category: No Formal Education)						
Primary		-0.03	-0.04		0.09	0.05
Less than Secondary		-0.07**	-0.10***		-0.02	0.00
Secondary Completed		-0.03	-0.07*		-0.37**	-0.35*
High School Completed		-0.06	-0.08**		-0.32	-0.36*
Bachelor		-0.00	-0.04		-0.45*	-0.35*
Post Graduation		-0.15**	-0.18***		-0.89**	-0.70
Employment (Base Category: Retired and Unemployed)						
Service		-0.00	-0.05		0.22	0.17
Business		0.03	-0.03		0.39*	0.38*
Farming and Agricultural Worker		0.00	-0.04		0.27	0.28
Industrial Worker		-0.03	-0.07		0.00	-0.06
Daily Laborer		0.13**	0.04		0.33	0.31
Self Employed		0.09	0.01		0.02	-0.29
Student		-0.22***	-0.22***		-0.15	0.00
Homemaker		-	-		-	-
Others		0.07	0.01		0.13	0.14
Household Smoking Not Allowed			-0.09***			-
Workplace Smoking Not Allowed			-0.03			-0.07
Warning						
Have Seen Newspaper Warning			0.02			0.16
Have Seen Magazine Warning			-0.05			-0.30
Have Seen TV Warning			-0.01			-0.15
Have Listened to Radio Warning			0.04			0.11
Have Seen Billboard Warning			0.02			-0.03
Have Seen Poster Warning			-0.04*			0.02
Have Seen Pack Warning			0.30***			0.39*
Advertising						
Have Seen Store Advertising			0.05**			0.19*
Have Seen TV Advertising			-0.01			-0.25
Have Listened to Radio Advertising			0.08			-0.75
Have Seen Billboard Advertising			0.03			-0.12
Have Seen Poster Advertising			-0.02			-0.23*
Have Seen Newspaper Advertising			0.03			0.61**
Have Seen Magazine Advertising			0.05			-
Have Seen Cinema Advertising			-0.10			-0.26
Have Seen Internet Advertising			-0.10			0.87***
Have Seen Public Transport Advertising			0.07**			0.36**
Have Seen Public Walls Advertising			-0.07**			-0.04
Promotional Activities						
Have Seen Promotion through Sports			0.23*			-0.23
Have Seen Promotion through Arts and Culture Activities			-0.12			0.12
Have Seen Promotion through Movies			0.02			0.06
Have seen Free Sample Distribution			-0.01			0.06
Have Seen Sold at Sale			0.10			-0.04
Have Seen Coupon Distribution			-0.08*			0.15
Have Seen Special Discount			0.01			0.17
Have Seen Branding through Cloth			-0.03			-0.17
Have Seen Promotion through Internet			-0.28**			0.48
Perception						
Second Hand Smoking Cause Illness			-0.11*			0.04
Smoking Causes Serious Illness			0.06			-0.45*
Smoking is Addictive			-0.08*			-0.18
In Favor of Tobacco Tax Increase			-0.06***			-0.02
Observations	3,791	2,228	2,228	599	599	599

Note: *, **, and *** indicate significance at 10%, 5%, and 1% levels, respectively.

Table 12: Probit (Part I) and Conditional Demand (Part II) Estimation of Cigarette Smoking in Rural Areas

Variables	Part 1			Part 2		
	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
Dependent Variable	Smoking Status, 1 = Smoker and 0 = Non-Smoker			Ln(Cigarette Consumption)		
Consumption Weighted Cigarette Price (Per Sticks)	-0.04***	-0.03***	-0.03***	-0.05	-0.03	-0.02
Consumption Weighted Bidi Price (Per Sticks)	-0.00	-0.00*	-0.00**	0.03**	0.04**	0.02
Asset (Proxy of Permanent Income)	0.01***	0.00*	0.00	0.03	0.08***	0.06**
Year (2017=1, 2009=0)	0.04***	0.03***	0.03***	0.02	-0.01	0.02
Female		-0.29***	-0.25***		-0.69	-0.67
Age		0.00	0.00**		0.00	0.00
Family Size		-0.00	-0.00		0.02	0.01
Education (Base Category: No Formal Education)						
Primary		-0.02	-0.02**		-0.11	-0.08
Less than Secondary		-0.04***	-0.04***		-0.24**	-0.24**
Secondary Completed		-0.04*	-0.04***		-0.57***	-0.55***
High School Completed		-0.05**	-0.04**		-0.53***	-0.65***
Bachelor		-0.01	-0.02		-0.74***	-0.82***
Post Graduation		-0.08*	-0.08**		-0.61	-0.24
Employment (Base Category: Retired and Unemployed)						
Service		0.03	0.02		0.12	0.12
Business		0.03*	0.02		0.46**	0.46**
Farming and Agricultural Worker		-0.00	0.00		0.09	0.09
Industrial Worker		0.03	0.03		0.03	0.12
Daily Laborer		0.02	0.01		0.26	0.27
Self Employed		0.05*	0.04**		0.55***	0.60***
Student		-0.14***	-0.13***		-0.62	-0.43
Homemaker		-0.02	-0.01		-0.32	-0.09
Others		0.02	0.01		0.37	0.45**
Household Smoking Not Allowed			-0.05***			-0.34***
Workplace Smoking Not Allowed			-0.02*			-0.01
Warning						
Have Seen Newspaper Warning			0.00			0.21*
Have Seen Magazine Warning			-0.04			0.42
Have Seen TV Warning			0.01			-0.03
Have Listened to Radio Warning			0.00			-0.12
Have Seen Billboard Warning			0.00			-0.09
Have Seen Poster Warning			-0.02**			0.12
Have Seen Pack Warning			0.11***			0.52**
Advertising						
Have Seen Store Advertising			0.02*			0.19**
Have Seen TV Advertising			-0.01			-0.14
Have Listened to Radio Advertising			0.08**			-0.09
Have Seen Billboard Advertising			0.00			0.07
Have Seen Poster Advertising			0.01			-0.05
Have Seen Newspaper Advertising			0.00			-1.50*
Have Seen Magazine Advertising			0.23***			0.38
Have Seen Cinema Advertising			-0.08**			0.32
Have Seen Internet Advertising			-0.07			0.17
Have Seen Public Transport Advertising			0.01			-0.04
Have Seen Public Walls Advertising			-0.04**			-0.29
Promotional Activities						
Have Seen Promotion through Sports			-0.12***			-2.04***
Have Seen Promotion through Arts and Culture Activities			-0.03			1.21**
Have Seen Promotion through Movies			0.02*			0.06
Have seen Free Sample Distribution			0.03**			0.04
Have Seen Sold at Sale			-0.04			0.09
Have Seen Coupon Distribution			-0.02			0.09
Have Seen Special Discount			0.01			0.03
Have Seen Branding through Cloth			0.03			0.51***
Have Seen Promotion through Internet			-0.02			0.01
Perception						
Second Hand Smoking Cause Illness			-0.04*			0.08
Smoking Causes Serious Illness			-0.00			-0.51***
Smoking is Addictive			-0.01			0.06
In Favor of Tobacco Tax Increase			-0.04***			-0.07
Observations	7,139	7,139	7,139	868	868	868

Note: *, **, and *** indicate significance at 10%, 5%, and 1% levels, respectively.

Estimating Elasticity of Cigarette Smoking in Bangladesh Using GATS Data

Table 13: Probit (Part I) and Conditional Demand (Part II) Estimation of Cigarette Smoking in Urban Areas

Variables	Part 1			Part 2		
	Model 1	Model 2	Model 3	Model 1	Model 2	Model
Dependent Variable	Smoking Status, 1 = Smoker and 0 = Non-Smoker			Ln(Cigarette Consumption)		
Consumption Weighted Cigarette Price (Per Sticks)	-0.08***	-0.06***	-0.04***	-0.15*	-0.18**	-0.16**
Consumption Weighted Bidi Price (Per Sticks)	-0.01**	-0.01***	-0.00**	0.00	-0.00	-0.00
Asset (Proxy of Permanent Income)	0.01	0.00	0.01	-0.02	0.00	-0.01
Year (2017=1, 2009=0)	0.06	0.04	0.00	0.13	0.14	0.22**
Female		-0.45***	-0.40***		0.11	-0.07
Age		0.00	0.00*		0.01**	0.01**
Family Size		0.00	0.00		0.01	0.00
Education (Base Category: No Formal Education)						
Primary			-0.03	-0.03*		-0.02	0.04
Less than Secondary			-0.01	-0.02		0.05	0.09
Secondary Completed			-0.04	-0.05		-0.31*	-0.20
High School Completed			-0.01	-0.05		-0.58**	-0.56*
Bachelor			0.02	0.02		-0.16	-0.11
Post Graduation			-0.13***	-0.12***		-1.21**	-1.05*
Employment (Base Category: Retired and Unemployed)						
Service			0.08***	0.06**		0.23	0.34
Business			0.13***	0.10***		0.35	0.44*
Farming and Agricultural Worker			0.08**	0.06**		0.19	0.29
Industrial Worker			0.18***	0.17***		0.16	0.18
Daily Laborer			0.17***	0.14***		0.15	0.25
Self Employed			0.23***	0.16***		0.16	0.15
Student			-0.07*	-0.08**		0.13	0.09
Homemaker			0.16***	0.14***			
Others			0.14***	0.12**		0.25	0.32
Household Smoking Not Allowed				-0.07***			-0.30***
Workplace Smoking Not Allowed				0.01			-0.04
Warning						
Have Seen Newspaper Warning				-0.00			-0.00
Have Seen Magazine Warning				-0.01			-0.46*
Have Seen TV Warning				-0.02			0.05
Have Listened to Radio Warning				-0.03			0.19
Have Seen Billboard Warning				0.02			0.07
Have Seen Poster Warning				-0.00			-0.07
Have Seen Pack Warning				0.14***			-0.10
Advertising						
Have Seen Store Advertising				-0.02			0.05
Have Seen TV Advertising				0.01			0.22
Have Listened to Radio Advertising				0.05			0.49
Have Seen Billboard Advertising				0.07***			-0.05
Have Seen Poster Advertising				-0.01			-0.11
Have Seen Newspaper Advertising				-0.03			0.27
Have Seen Magazine Advertising				-0.16**			-1.81***
Have Seen Cinema Advertising				-0.07*			-0.10
Have Seen Internet Advertising				-0.01			0.87***
Have Seen Public Transport Advertising				-0.04			0.11
Have Seen Public Walls Advertising				0.01			0.07
Promotional Activities						
Have Seen Promotion through Sports				0.09			0.28
Have Seen Promotion through Arts and Culture Activities				-0.00			0.03
Have Seen Promotion through Movies				0.02			0.19**
Have seen Free Sample Distribution				0.02			0.11
Have Seen Sold at Sale				0.13***			0.09
Have Seen Coupon Distribution				-0.03			0.05
Have Seen Special Discount				0.03			0.24**
Have Seen Branding through Cloth				-0.04*			-0.02
Have Seen Promotion through Internet				-0.20**			0.64*
Perception						
Second Hand Smoking Cause Illness				-0.01			0.10
Smoking Causes Serious Illness				0.06			-0.09
Smoking is Addictive				-0.03			0.12
In Favor of Tobacco Tax Increase				-0.04***			-0.06
Observations	4,332	4,332	4,332	692	692	692

Note: *, **, and *** indicate significance at 10%, 5%, and 1% levels, respectively.