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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 merely 38% in 2009 and 45% in 2010 of the average retail price of cigarettes. It is 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.

Objective—The objective of the paper is 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 estimate the overall impact of a price change on cigarette demand

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using a two-part model. The total price elasticity of cigarettes is 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 are used in a simulation model to predict changes in cigarette consumption and tax revenue from tax and price increases.

Findings—The total price elasticity of demand for cigarettes is estimated at −0.49. The elasticity of smoking prevalence accounts for 59% of the total price elasticity. The price elasticity of cigarette consumption is higher for people belonging to lower socio-economic status. Increases in taxes would result in significant reduction in cigarette consumption while tax revenue increases.

Conclusion—Raising cigarette price 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 socio-economic inequities.

Keywords

cigarette; price elasticity; tobacco tax revenue

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 die a year of tobacco use[2], this 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 is below 15 years) [3], widespread illiteracy, and poverty (31.5% of the total population lives below the poverty line)[4]. By any standard, then, tobacco use represents a critical threat to the health and welfare of the Bangladeshi people and strong action must be taken to avert the 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 has experienced an alarming increase in tobacco consumption over 2004–2009.

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

Existing studies on the price responsiveness of cigarette demand in Bangladesh are very few. Using time series data from 1983 to 1999, Ali and colleagues (2003) estimated statistically insignificant price elasticity of −0.27 and statistically significant income elasticity of 0.62 for cigarettes[7]. Similarly, Guindon and colleagues (2003) 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 and colleagues (2012) 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 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. 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 surveys conducted in 2009 and 2010 respectively. The Wave 1 Survey consisted of a nationally representative probability sample of 2,510 adult cigarette and bidi smokers and 2,116 adult non-smokers aged 15 years and older selected through a multi-stage 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 re-contacted to answer follow-up surveys in 2010 with the attrition rate of 8.3%. The smokers were oversampled for the purpose of generating sufficiently large sample size of smokers. For the present analysis, we have limited the sample to cigarette smokers and nonsmokers and excluded the bidi smokers. Thus the final full sample size of pooled observations of cigarette smokers and nonsmokers is 8,507 and of cigarette smokers is 3,652.

BANGLADESH HAS AMPLE ROOM TO RAISE CIGARETTE TAX

The current cigarette tax in Bangladesh is composed of two 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 one 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 comes to a definite advantage of the producers because they pay tax rate corresponding to the lower tier until the retail price reaches the upper tier, while enjoying higher price and profit.

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 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 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 its 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 construct a two-part model following Cragg (1971)[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 do not use panel data techniques to estimate the effect of price on cigarette demand that would hold unobserved individual level heterogeneity constant. When we run sensitivity analysis using fixed effects model, the

effect of price becomes statistically insignificant, which is attributable to lack of sufficient variation in the price of cigarettes within observations for the same smoker over the two years. However, we expect significant cross-sectional variation in price by geographic area (village), source of purchase and mode/volume of purchase (e.g., pack or loose). So, we undertake pooled cross-sectional analysis of the Wave 1 and Wave 2 survey data. We take into account the within-person correlation of observations by correcting the standard errors for repeated observations on the same individual using the cluster correction technique.

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

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

where Φ(.) 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 φ(.) 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:

Equation

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

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

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 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 is constructed by averaging the prices reported by smokers in a specific geographic area of residence (village) for each wave. This price is then assigned to both smokers and non-smokers in that area.

In order to address the endogeneity problem, we also estimate 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 is regressed on the tax variable given by the sum of the supplementary duty and the value added tax 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 is then used in the second stage estimation of smoking participation and daily consumption.

As the supplementary duty is ad valorem with four tiers corresponding to four price bands and the rates differ between the two survey years (Table 1), we can identify the price variable in two waves with eight different supplementary duty 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 supplementary duty 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 (Table A3). The statistically significant coefficient of the tax variable indicates that it is highly correlated with price. This tax variables is also tested as a valid instrumental for price as we find very large F-statistic (greater than 10) in the reduced form regression for price. According to Stock and Watson (2003), 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 are estimated for the tertiles of individuals stratified on the basis of the housing index representing their socio-economic status (low, medium, and high). Thus we obtain the price and income elasticity estimates for the overall population and for population sub-groups by socio-economic 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 (Table A1), the reduced form equation for price used in instrumental variable probit model (Table A2) and the reduced form equation for price used in the 2SLS model (Table A3).

In the instrumental probit regression, the Wald test of exogeneity of regressors is 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 is tested in the two-stage least squares regression for the conditional demand function for all smokers. In this regression, the exogeneity of regressors is 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 two-stage least squares regression (reported in Table A2 and A3 respectively). The large value of the robust F statistic (greater than 10) in Table A3 also shows that the tax variable is not a weak instrument for self-reported price. Thus we accept the instrumental variables estimates of the coefficients of the price variable in both the smoking prevalence and the 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 use 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 is −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- and middle-income countries range from −0.5 to −1.0 while those for high-income countries tend to fall in the range from −0.25 to −0.5[19]. The present estimate is on the lower side of this range and lies in 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 obtain 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 simulate tax increases and different tax structure to assess the effect of these changes on overall cigarette consumption and tax revenue. The results are reported in Table 8. The baseline year is set in the fiscal year 2012–13 with the existing four-tiered tax structure and the projection is made for 2013–14. The SD rates are higher in 2012–13 than those prevailing in the survey years 2009 and 2010 shown in Table 1.

Three alternative tax structures are 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 2012–13 prices) per pack of 10 cigarettes; and
3. Uniform specific tax of 22 Taka (in 2012–13 prices) per pack of 10 cigarettes. These alternatives are 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 is multiplied with the cigarette smoking prevalence rate to estimate the number of cigarettes smokers in Bangladesh in 2012–13. We project the negative impact of the tax policy changes on both 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 are used to project the positive impact of income growth on the number of smokers and conditional demand for cigarettes respectively. In addition, we take into account the growth in the number of adult smokers driven by population growth at the annual rate of 1.24%. The price increases are 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 can be reduced and cigarette tax revenue can be increased significantly by the simulated changes in the tax rates and structure. The highest price increase and decreases in the number of smokers and annual cigarette consumption result under the uniform specific tax system, while the highest revenue gain and tax share in the retail price occur under the uniform ad valorem tax system. Thus it appears that the revenue goal is better served with *ad valorem* tax system while the public health outcome is improved under specific tax system. The ad valorem with a specific minimum can achieve greater reduction in consumption than the uniform ad valorem excise system and can also narrow the price gap between the lowest and the upper price bands.

DISCUSSION

The negative price elasticities of smoking prevalence and smoking intensity show that increasing the price of cigarettes in Bangladesh could significantly lower both 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 realized 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 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, estimating the cigarette demand function for three groups of low, medium and high socio-economic status, we observe that the price elasticity of smoking prevalence and smoking intensity are higher the lower the SES. The instrumental variable estimates of the price elasticity of smoking prevalence vary from −0.50 (probit) for low SES population to −0.31 for medium SES group to −0.15 for 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 low SES group, −0.40 for medium SES group and −0.36 for high SES group. These estimates suggest that the poorer people are more price sensitive than the rich and can thus reap greater health gain from increased tax and prices of cigarettes, revealing a behavioral 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 disproportionate burden of tobacco expenditure on the poor. The price elasticity estimates by SES, however, reveals 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 decreasing 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- 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 of continued 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 thus 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 tax and price can increase government revenue. At the same time, the greater price sensitivity of cigarette consumption among the poorer people leads us to conclude that the poorer would be more benefitted from a given cigarette price increase. This would result in reducing the inequities of the burden of tobacco consumption that currently exist in Bangladesh, with negative health and economic impact of tobacco use being experienced to a much greater extent among the poor. These findings

suggest that raising cigarette price 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 socio-economic inequities.

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References

1. ITC Project. ITC Bangladesh National Report. University of Waterloo; Waterloo, Ontario, Canada: University of Dhaka; Bangladesh: Apr. 2010
2. World Health Organization. Impact of Tobacco-Related Illnesses in Bangladesh. World Health Organization; South East Asia Region, New Delhi, India: 2007.
3. Bangladesh Population and Housing Census. Bangladesh Bureau of Statistics; 2011.
4. Household Income and Expenditure Survey. Bangladesh Bureau of Statistics; 2010.
5. World Health Organization. Global Adult Tobacco Survey: Bangladesh Report. 2009.
6. Effectiveness of Tax and Price Policies for Tobacco Control. Vol. 14. International Agency for Research on Cancer; 2011. IARC Handbooks of Cancer Prevention in Tobacco Control.
7. Ali, Z.; Rahman, A.; Rahaman, T. HNP Discussion Paper. Washington DC: The World Bank; 2003. An Economic Analysis of Tobacco Control in Bangladesh.
8. Guindon, GE.; Perucic, AM.; Boisclair, D. HNP Discussion Paper. Washington DC: The World Bank; 2003. Higher Tobacco Prices and Taxes in South-East Asia: An Effective Tool to Reduce Tobacco Use, Save Lives, and Generate Revenue.
9. Barkat, A.; Chowdhury, AU.; Nargis, N., et al. The Economics of Tobacco and Tobacco Taxation in Bangladesh. Paris: International Union Against Tuberculosis and Lung Disease; 2012.
10. Nargis, N.; Ruthbah, UH.; Fong, GT. Taxation of Tobacco Products in Bangladesh: Findings from the 2009 ITC Bangladesh Survey. Waterloo, Ontario, Canada: University of Waterloo; 2010. ITC Project Working Paper Series
11. Nargis, N.; Ruthbah, UH.; Hussain, AKMG., et al. Pricing and Taxation of Tobacco Products in Bangladesh: Findings from Wave 1 (2009) and Wave 2 (2010) of the ITC Bangladesh Survey. Waterloo, Ontario, Canada: University of Waterloo; 2011. ITC Project Working Paper Series
12. World Economic Outlook. International Monetary Organization; 2012.
13. World Health Organization. WHO Technical Manual on Tobacco Tax Administration. World Health Organization; 2010.
14. Cragg JG. Some statistical models for limited dependent variables with applications to the demand for durable goods. Econometrica. 1971; 39:829–844.
15. Ramsey JB. Tests for Specification Errors in Classical Linear Least Squares Regression Analysis. Journal of the Royal Statistical Society. 1969; 31(2):350–371. Series B.
16. Deaton, A. The Analysis of Household Surveys: A Microeconomic Approach to Development Policy. Baltimore: John Hopkins University Press; 1997.
17. Stock, J.; Watson, MW. Introduction to Econometrics. New York: Prentice Hall; 2003.
18. Wooldridge, J. Econometric Analysis of Cross Section and Panel Data. MIT Press; 2002.

19. Chaloupka, FJ.; Hu, T.; Warner, KE., et al. The taxation of tobacco products. In: Jha, P.; Chaloupka, FJ., editors. Tobacco Control in Developing Countries. Oxford: Oxford University Press; 2000. p. 237-72.

20. Hu T, Qui-Fang R, Keeler TE, et al. The Demand for Cigarettes in California and Behavioral Risk Factors. Health Economics. 1995; 4:7–14. [PubMed: 7780529]

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 prediction of reduction in cigarette smoking prevalence and daily use and increase in government revenue. These results are useful for the informed decision making by the government in tobacco control through taxation.

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)	Excise tax (% of retail price)	% 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.

Table 2

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

	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

Note: 2010 prices are discounted by 8% to adjust for inflation during 2009–2010.

Source: ITC Bangladesh Survey, 2009, 2010.

Table 3

Probit estimates for prevalence of cigarette smoking (dependent variable 1 if cigarette smoker, 0 if nonsmoker)

	(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)
SSC (9–10 years)	0.0968 (1.32)	0.185 (1.47)	0.258* (1.96)	−0.396* (−2.41)
HSC (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 laborer	0.101 (1.20)	0.0290 (0.24)	0.107 (0.69)	0.664** (3.09)
Non-farm agricultural wage laborer	−0.176 (−0.86)	−0.348 (−0.77)	−0.394 (−0.88)	0.447 (1.35)
Non-agricultural wage laborer	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)

	(1) All	(2) Low	(3) Medium	(4) High
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

Notes:

1. Columns 1, 2,3 and 4 report results for all, low, medium and high socio-economic status groups respectively.

2. The coefficients are marginal effects. For dummy variable, the marginal effect refer to effect of discrete change in the dummy variable from 0 to 1. 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 4

Instrumental variable probit estimates for prevalence of cigarette smoking (dependent variable 1 if cigarette smoker, 0 if nonsmoker)

	(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)
HSC (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 laborer	0.0859 (1.04)	0.0117 (0.10)	0.0674 (0.44)	0.668** (3.24)
Non-farm agricultural wage laborer	−0.166 (−0.78)	−0.210 (−0.48)	−0.453 (−1.01)	0.461 (1.39)
Non-agricultural wage laborer	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)

	(1) All	(2) Low	(3) Medium	(4) High
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

Notes:

1. Columns 1, 2,3 and 4 report results for all, low, medium and high socio-economic status groups respectively.

2. The coefficients are marginal effects. For dummy variable, the marginal effect refer to effect of discrete change in the dummy variable from 0 to 1. 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.

4. The reduced form estimate of the price equation is reported in Appendix in Table A2.

Table 5

OLS estimates of conditional demand for cigarette.

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)
SSC (9–10 years)	0.0573 (1.16)	0.0880 (1.04)	0.0310 (0.42)	−0.0390 (−0.38)
HSC (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 laborer	0.177** (2.72)	0.0873 (0.92)	0.266** (2.61)	0.284 (1.91)
Non-farm agricultural wage laborer	0.175 (0.95)	−0.434 (−1.17)	0.363 (1.91)	0.342 (1.88)
Non-agricultural wage laborer	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)

Dependent variable: ln(daily consumption)	(1) All	(2) Low	(3) Medium	(4) High
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

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.

Table 6

Instrumental variable 2SLS estimates of conditional demand for cigarette.

	(1) All	(2) Low	(3) Medium	(4) High
ln (Predicted price of Cigarette-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)
SSC (9–10 years)	0.0889 (1.81)	0.103 (1.24)	0.0500 (0.70)	−0.00190 (−0.02)
HSC (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 laborer	0.163* (2.52)	0.0624 (0.65)	0.261** (2.58)	0.286* (2.02)
Non-farm agricultural wage laborer	0.208 (1.08)	−0.462 (−1.25)	0.352 (1.77)	0.405* (2.25)
Non-agricultural wage laborer	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)

	(1) All	(2) Low	(3) Medium	(4) High
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

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.

4. The reduced form estimate of the price equation is reported in Appendix in Table A3.

Table 7

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

	PRICE ELASTICITY				INCOME ELASTICITY			
	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

Notes:

1. ‘Low’, ‘Medium’ and ‘High’ refer to the socio-economic status of respondents based on housing index.

2. The total price elasticity is obtained by summing the IV probit estimates in row B and the 2SLS estimates in row D.

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Table 8

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

	Baseline	Simulation A	Simulation B	Simulation C
	Tiered ad valorem (Low-39%, Medium-56%, High- 59%, Premium- 61% of retail price)	**Uniform ad valorem at 61% of retail price**	**Uniform *ad valorem* at 61% of retail price with a specific minimum of 20 Taka (in 2012 prices) per pack of 10 sticks**	**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
% 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)	7,603	5,490	5,388	5,125
% change in annual consumption		−27.8%	−29.1%	−32.6%
Revenue (million in 2012 Taka)	116,045	154,372	153,497	142,376
% change in real revenue		33.0%	32.3%	22.7%

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