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PRICES AND CIGARETTE DEMAND:  
EVIDENCE FROM YOUTH TOBACCO USE IN DEVELOPING COUNTRIES

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**ABSTRACT**

This paper estimates the impact of cigarette prices on youth smoking in lower-income countries using data from the Global Youth Tobacco Survey (GYTS). Country-level heterogeneity is addressed with fixed effects and by directly controlling for confounding environmental factors such as local anti-smoking sentiment, cigarette advertising, anti-smoking media messages, and compliance with youth access restrictions. We find that cigarette price is an important determinant of both smoking participation and conditional demand. The estimated price elasticity of participation is -0.63. The likelihood of participation decreases with anti-smoking sentiment and increases with exposure to cigarette advertising. The estimated price elasticity of conditional cigarette demand is approximately -1.2. Neither anti-smoking sentiment, cigarette advertising, nor access restrictions have an impact on the intensity of smoking among current smokers, but exposure to anti-smoking media may reduce the number of cigarettes smoked.

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## **1. Introduction**

Tobacco consumption has been long established as a leading cause of preventable death, with 100 million deaths attributed to it during the 20<sup>th</sup> century, and nearly one billion deaths projected for the 21<sup>st</sup> century (World Health Organization, 2008).

Adolescents are a group of special interest to the global anti-tobacco effort because smoking habits are primarily established in youth. It is estimated that, worldwide, one in seven teenagers smokes, and a quarter of them have tried their first cigarette before the age of 10 (The Tobacco Atlas, 2006).

The regional variation in youth smoking patterns worldwide is substantial and corresponds to variations in market characteristics including accessibility of tobacco to youth, media influences, and cultural perceptions of smoking. There are multiple and often conflicting factors that come together in shaping global youth smoking patterns. Separating and evaluating their individual effects is important in determining the best way to target this public health challenge, and is the goal of this study.

Although tobacco use is among the major health problems in lower-income countries, most of the evidence on what determines youth smoking comes from a few industrialized countries and from the U.S. in particular. There is a wealth of research on the impact of U.S. cigarette prices or taxes but many studies have trouble identifying a causal price effect due to inability to address state-level heterogeneity. Only recently has work emerged which controls for regional variations in the public attitude toward smoking, either indirectly through state fixed effects (DeCicca et al. 2002, Carpenter and Cook 2008), or through direct inclusion of a state anti-smoking sentiment variable (DeCicca et al. 2008, Carpenter and Cook 2008). Among the first to employ individual fixed effects, Tauras et al. (2005) find significant price effects, as do Carpenter and Cook (2008) in their state fixed effects models. However, these conclusions are not supported by DeCicca et al. (2002, 2008) who determine that anti-smoking sentiment dominates the effect of price. This mixed evidence hinders extrapolation of U.S.-based results to other countries. Even if uniform evidence on U.S. price effects had been available, U.S. results may not be easily generalizable to other countries due to differences in income, cultural environment, and individual behavior.

This study is the first to estimate the effect of cigarette prices on youth smoking using micro-level data from multiple low- and mid-income countries, and as such is the first to have a global scope. Nelson (2003) uses similar data to evaluate the effect of advertising bans on cigarette demand among youth in developing countries but does not control for cigarette price. He finds that advertising bans do not affect youth smoking. Lance et al. (2004) estimate the effect of price on smoking among adult males in China and Russia. They find very weak responsiveness of smoking to cigarette prices in these two countries. Other studies that focus on developing countries rely on aggregate data (Chapman and Richardson 1990) which raises econometric concerns about simultaneity.

Our study fills a substantial gap in the existing literature by using micro-level data from the Global Youth Tobacco Survey (GYTS). GYTS employs a standardized questionnaire in multiple countries and across multiple years, providing information on youths' smoking behavior and their environments. Until this study, GYTS data have been used mostly for descriptive purposes rather than for vigorous policy evaluation due to the lack of exogenous cigarette price measures for most GYTS countries and years. We overcome this limitation by merging GYTS with cigarette price data from the Economist Intelligence Unit (EIU) World Cost of Living Survey.

The effect of cigarette prices in the presence of unobserved country-specific heterogeneity is identified by 1) using country fixed effects, and 2) including a measure of local anti-smoking sentiment. We further reduce unobserved heterogeneity by controlling for confounding environmental factors such as the prevalence of cigarette advertising, anti-tobacco media outreach, and compliance with youth access restrictions.

## **2. Data**

The GYTS is a survey developed by the World Health Organization (WHO) and Centers for Disease Control and Prevention (CDC) to track tobacco use of young people across countries with a common methodology. It has been conducted in 135 low-to-mid-income countries from the six WHO world regions (Africa, Europe, Americas, Southeast Asia, Middle East, and Western Pacific) in various years from 1999 to 2006. It captures prevalence, access, media exposure and attitudes related to tobacco use among

individuals in school grades corresponding to ages 13 to 15, although in practice the age range of the survey is wider and covers individuals between the ages of 11 and 19.

Our final dataset contains data on 349,930 individuals from 20 countries corresponding to 118 local sites (i.e. cities/provinces). The countries included in this study were surveyed in multiple years and provide repeated cross-sections, allowing the use of country fixed effects. A descriptive summary of the data in this study is shown in Tables 1a and 1b. A list of the final set of countries and survey years is shown in Table 2.

The outcome variables in this research are smoking participation and smoking intensity. Smoking participation is a binary variable equal to 1 if the individual describes himself as a smoker and has smoked at least one cigarette in the past month. The highest smoking prevalence rates are observed in Eastern Europe (16%) and Latin America (12%). Smoking intensity among smokers is based on the average number of days that smoking occurred in the past month multiplied by the average number of cigarettes smoked daily, both calculated as the midpoints. In this sample, the average cigarette consumption ranges from 1.5 to 630 cigarettes per month. Individual-level explanatory variables include age, gender, parental smoking status, and availability of pocket money. The average age of the sample is 14 years. Availability of pocket money is captured by a binary indicator equal to 1 if the subject receives pocket money or personal income at the time of the interview. Although the pocket money variable provides a proxy for personal and family income, the data are limited in terms of actual income measures.

Data on the price of cigarettes over time is obtained from the EIU World Cost of Living Survey. This survey collects retail price data for a wide range of consumer products on a bi-annual basis from multiple cities worldwide. Cigarette prices are available for two different brands, a local brand and a foreign brand, usually Marlboro. Prices are collected from one or more cities in each country. If for a particular country cigarette price data come from multiple cities, we use the average national price. Where the GYTS city survey site matches the EIU city survey site, local city prices are used instead of the nationally averaged price. Prices are expressed in real 2000 U.S. dollars and are adjusted using purchasing power parities (PPP) obtained from the World Bank's World Development Indicators database. The PPP adjusts prices for the local standard of

living and allows for more accurate price comparison between countries. In the primary analysis of smoking demand, we use local-brand cigarette prices, but a sensitivity analysis using Marlboro prices is performed as well.

Variables that describe the local environment of each subject include the level of anti-smoking sentiment (*Sentiment*), the prevalence of cigarette advertising (*Cigarette Advertising*), the prevalence of anti-tobacco media messages (*Anti-tobacco Media*), and the observed effectiveness of minimum-age tobacco purchase policies (*Youth Access Restrictions*). All of these are constructed from individual survey responses which are then used to produce aggregate measures at the site level.

Anti-smoking sentiment has been recognized in the U.S. literature as an important predictor of attitudes toward smoking and of the smoking pattern itself. Omitting anti-smoking sentiment from a model of smoking demand can be problematic as it may cause the error term to be correlated with both smoking status and cigarette prices. In this paper *Anti-Smoking Sentiment* is defined as the percentage of non-smokers in the survey who favor bans on smoking in public places. We base this measure on non-smokers only (as opposed to all survey participants including smokers) in order to eliminate the potential for endogeneity bias when smokers' attitudes are included. In the case of smokers, it is not clear if sentiment affects smoking or smoking affects sentiment, so sentiment would be endogenous to smoking. Excluding the attitudes of smokers from the measure of anti-smoking sentiment helps ensure that the relationship between sentiment and smoking is one-directional.

The prevalence of cigarette advertising is determined by the proportion of survey participants who have been recently exposed to cigarette ads on billboards, newspapers or magazines. It describes the likelihood of exposure to print media advertising and contains information on how effective local advertising is in reaching an audience. The heaviest exposure to cigarette advertising is observed in Poland, Indonesia, and Argentina, where almost all participants (96%) recently had seen print media cigarette promotions. The high advertising exposure in Poland is surprising given the existence of a complete ban on cigarette advertising there, and illustrates the disparity between policy presence and policy compliance that may take place in some countries.

The outreach of anti-tobacco media campaigns can be interpreted as a proxy for the enthusiasm of local efforts to reduce smoking. *Anti-Tobacco Media* is determined by the proportion of respondents who have been recently exposed to anti-smoking messages in broadcast and print media. The observed effectiveness of policies against cigarette sales to minors (*Youth Access Restrictions*) controls for ease of access to cigarettes, and is calculated as the proportion of survey participants who recently tried to buy cigarettes but were turned away by vendors due to age. Although there is substantial variability in this variable across countries, the average proportion of minors in our sample unable to buy cigarettes during their most recent attempt is 35%. This means that youth access restrictions may have relatively weak enforcement in lower-income countries.

It is important to highlight the fact that the area-level variables *Cigarette Advertising*, *Anti-Tobacco Media*, and *Youth Access Restrictions* are constructed from aggregating individual GYTS response data. They are continuous variables intended to represent the varying levels of policy effectiveness and compliance, and are not merely binary indicators of policy presence. This is an important distinction since the nominal presence of tobacco policies like advertising bans or minors sale bans does not provide information on how well these policies are enforced in different countries. Using variables that describe levels of policy effectiveness is a considerable methodological improvement over binary policy indicator variables.

Country and year fixed effects in the form of country and year dummies are used to account for any remaining unobserved environmental heterogeneity and for a secular time trend in smoking. Missing responses for the individual characteristics *Age*, *Male*, *Parental Smoking*, and *Pocket Money* are imputed.<sup>1</sup> Summary statistics and descriptions of all variables are listed in Table 1a.

### 3. Methods

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<sup>1</sup> Missing observations present a nontrivial problem since they add up to 20 percent of the total number of observations. To fill in missing values, we use the method of iterative imputation. This method has an advantage over alternatives like substitution of missing values by sample means or regression methods, both of which can lead to underestimation of the standard errors and erroneously significant results (Schafer & Olsen 1998).

Since roughly 90% of the survey participants in our sample are current nonsmokers, we use a two-part model to reflect the prevalence of zero outcomes in our dataset. This model allows for independence between the decision to smoke and the decision how much to smoke. The first part of the two-part model estimates the probability of smoking participation with a logit model. The second part of the two-part model estimates the amount of cigarettes smoked by smokers with a generalized linear model (GLM) with a normal distribution and a log link.<sup>2</sup>

In the first part of our cigarette demand model, smoking participation is a function of cigarette price (*Price*), a vector of individual characteristics ( $X_1$ ), a vector of observed environmental characteristics ( $X_2$ ) which vary over time, country fixed effects (*Country*) which are fixed over time, and year fixed effects (*Year*).

$$\Pr(Y_{ijt} > 0) = f(\alpha_0 + \alpha_1 Price_{jt} + \alpha_2 X_{1ijt} + \alpha_3 X_{2jt} + \alpha_4 Year_t + \alpha_5 Country_j) \quad (1)$$

In the second part of the two-part model, cigarette demand conditional on participation is expressed as

$$(Y_{ijt} | Y_{ijt} > 0) = f(\beta_0 + \beta_1 Price_{jt} + \beta_2 X_{1ijt} + \beta_3 X_{2jt} + \beta_4 Year_t + \beta_5 Country_j) \quad (2)$$

where  $i$  denotes individual,  $j$  denotes country/geographic location, and  $t$  denotes year.  $X_1$  is a vector of individual-level variables which include *Age*, *Male*, *Parental Smoking*, and *Pocket Money*.  $X_2$  is a vector of area-level characteristics which include *Cigarette Advertising*, *Anti-Tobacco Media*, *Anti-Smoking Sentiment*, and *Youth Access Restrictions*.

One econometric concern is the potential multicollinearity between some of the macro variables, namely *Price*, *Anti-Smoking Sentiment*, *Cigarette Advertising*, *Anti-*

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<sup>2</sup> In general notation, the GLM model can be expressed as  $g(E(y)) = x\beta$  where the link function  $g(\cdot) = \ln(\cdot)$  and  $y \sim \text{Normal}$ . Specifying a normal distribution in a log-link GLM is similar to but not equivalent to an ordinary least squares (OLS) regression on  $\ln(y)$  because it produces more consistent and less biased elasticity estimates in the presence of heteroskedasticity (Manning and Mullahy 2001, Mullahy 1998, Tauras 2005, 2006). Tauras (2005) estimates that the bias from using OLS instead of GLM in the estimation of conditional cigarette demand for U.S. adults can be substantial and can result in more-than-double overestimation of price elasticity.



*Tobacco Media*, and *Youth Access Restrictions*. We use the variance inflation factor (VIF) to check for multicollinearity and find that it is not an estimation problem, even though we also find that *Sentiment* may be slightly collinear to the other macro variables. To remove any doubt about validity problems from potential multicollinearity, we present estimates where *Sentiment* is both included and excluded. In either case, the results are very similar, suggesting that the minor correlation between anti-smoking sentiment and the other country characteristics does not interfere with the estimation.

We address another possible identification concern due to endogeneity of the price variable, which can potentially arise from both unobserved country heterogeneity and simultaneity. In the first case, unobserved country characteristics such as harsher cultural attitudes on smoking may result in lower cigarette demand as well as more aggressive cigarette taxation and higher prices. Not accounting for such unobservables may lead to a false or overestimated statement of a causal link between prices and demand. We minimize the possibility of omitted variable bias by directly controlling for anti-smoking sentiment and other time-varying environmental characteristics that may influence smoking such as the intensity of cigarette advertising, anti-tobacco campaigns, and ease of buying cigarettes. Any remaining country heterogeneity that does not vary with time is addressed with country fixed effects.

In the second case, cigarette prices and cigarette demand could be simultaneously determined. The use of micro-level data in this study considerably reduces this danger because the smoking decision of a single individual would not affect market demand enough to change the price level. To further address this concern, we also estimate models which substitute foreign-brand cigarette prices for local-brand prices. Local-brand prices are used in our primary models because they are typically less expensive and are more likely to be purchased when the average individual decides to consume cigarettes. However, foreign-brand prices are likely to be more exogenous to cigarette demand for two reasons. First, foreign-brand cigarettes are often imported which means that their price contains a larger exogenous (not determined by market demand) component such as transportation costs and import duties. Second, in the event that foreign-brand cigarettes are produced domestically and are not imported, their prices are set more or less exogenously by the foreign company which owns the brand. Should a

simultaneity bias exist, using foreign-brand prices (which are presumably more exogenous) instead of local-brand prices should reduce the price effect by removing some of the simultaneity bias. A comparison between models using foreign versus local-brand prices shows that neither the statistical significance nor the size of the price effect is reduced by switching the analysis from local to foreign brands. We interpret this as evidence that the risk of simultaneity bias in the price estimate is low.

## 4. Results

### 4.1. Smoking participation

Table 3a presents results from the models of smoking participation as a function of local-brand cigarette prices. We show four specifications that vary based on the included right-hand side variables. The baseline specification (Model 1) looks at the effect of *Price* without controlling for either anti-smoking sentiment, media effects, or enforcement of youth access restrictions. Model 2 includes policy variables such as media effects (*Cigarette Advertising* and *Anti-Tobacco Media*) and youth access (*Youth Access Restrictions*) but does not control for sentiment. Models 3 and 4 mirror Models 1 and 2, but also control for *Sentiment*. Our preferred specification is Model 4 which accounts both for both smoking-related policy influences and local anti-smoking sentiment.

We find that cigarette price is a statistically significant determinant of smoking participation across all specifications. The effect of cigarette price does not disappear or become smaller once *Sentiment* is controlled for. This is in contrast to the some of the recent findings from U.S.-based studies which find that anti-smoking sentiment dominates the effect of price on smoking participation (DeCicca et al. 2008). Perhaps unsurprisingly, accounting for media effects and access restrictions somewhat reduces the magnitude of the price effect. However, it still does not reduce its statistical significance. The estimated price elasticity of participation is -0.63 in the preferred specification and ranges from -0.56 to -0.96 across different models.

*Sentiment* is shown to be a significant predictor of participation and has the expected negative sign, confirming that higher area-level anti-smoking sentiment is indeed associated with lower individual participation. However, unlike DeCicca et al. (2002, 2008), and more in line with Carpenter and Cook (2008) we find that *Sentiment* is not the most influential factor determining smoking participation.

Another major determinant of smoking participation is *Cigarette Advertising*. The local prevalence of cigarette advertising increases the probability of participation, most likely through higher advertising exposure. We estimate that if cigarette advertising succeeded in reaching every single individual (so that the proportion of youth exposed to advertising approached 100% from the current mean of 86%), then the average smoking prevalence rate would increase by up to 1.8 percentage points, from 10% to almost 12%. In terms of elasticity, we estimate that the advertising elasticity of participation ranges from 1.1 to 1.9, implying that a 10% increase in the proportion of people who observe cigarette advertising is associated with up to 19% increase in the prevalence of smoking.

We also find that *Youth Access Restrictions* have a sizeable and statistically significant effect on smoking participation. If bans against selling cigarettes to youth were implemented everywhere as well as fully enforced (i.e., if the proportion of underage youth unable to buy cigarettes increased from the observed mean of 35% to 100%), the smoking participation rate would go down by 6.5 percentage points based on the estimate from Model 4. This finding illustrates the importance of compliance with anti-tobacco policies and highlights the discrepancy in outcomes between actual and desired policy that could arise from inadequate compliance. Indeed, studies from the US and elsewhere have been inconclusive as far as the impact of youth access policies and their enforcement on youth tobacco use, and highlight the difficulty of enforcing youth access policies (Lantz et al. 2000).

*Anti-Tobacco Media* is found to reduce smoking participation. Based on the estimate from Model 4, if anti-tobacco campaigns had perfect outreach and the proportion of youth witnessing them increased to 100% from the current mean of 83%, smoking prevalence may decline by about 1.5 percentage points.

#### 4.2 Conditional cigarette demand

Results from the second part of the two-part model which estimates conditional cigarette demand are presented in Table 3b. As in the models of smoking participation, *Price* remains a significant predictor of conditional cigarette demand throughout all specifications. The price elasticity of conditional demand is centered around -1.2, indicating that a 10% increase in *Price* corresponds to a 12% decrease in the intensity of cigarette consumption.

We find no evidence that *Anti-Smoking Sentiment*, *Cigarette Advertising*, or *Youth Access Restrictions* can influence cigarette demand among current smokers as the coefficients on these variables are statistically no different from zero. This leads us to believe that once the decision to smoke is made, not many factors besides cigarette prices can help explain how many cigarettes are smoked. One exception is *Anti-Tobacco Media*, which is shown to be a significant albeit not too large determinant of smoking intensity. *Anti-Tobacco Media* has a sample mean of 0.83, meaning that anti-tobacco messages reach 83% of the current smokers. We estimate that if instead all smokers had been exposed to anti-tobacco media, the conditional demand for cigarettes would be lower by 22% or by about half a cigarette daily per smoker at the mean.

#### *Ordered logit estimates*

To see how prices may affect different types of smokers, we use an ordered logit model of conditional cigarette demand with four smoker categories: very light smokers (1 – 15 cigarettes per month), light to medium smokers (15 to 100 cigarettes per month), medium smokers (100 to 300 cigarettes per month) and heavy smokers (over 300 cigarettes per month). Table 3c lists the price responsiveness of the probability of being in each smoker category. The results are similar across all four specifications. In Model 4, the estimates imply that increasing price by 10% decreases the probability of being a heavy smoker by 8.7%, decreases the probability of being a medium smoker by about 6.9%, decreases the probability of being a light to medium smoker by 3.4%, and increases the probability of being a very light smoker by 4%. These estimates show that higher prices progressively reduce the intensity of smoking for all but the lightest

smokers and increase the likelihood of smokers switching down to a lighter smoker status.

The results from the two-part model with local-brand cigarette prices can be summarized as follows. Price is a major determinant of both smoking participation and conditional cigarette demand and in addition seems to be the only major predictor of conditional demand. Smoking participation is responsive to more factors besides cigarette price and can be influenced by anti-smoking sentiment, youth access restrictions, anti-tobacco media, and cigarette advertising. In addition to raising cigarette taxes and intensifying advertising and access restrictions, policies against youth tobacco use could also include efforts to change the prevailing sentiment on smoking in a more negative direction.

*Using foreign-brand instead of local-brand cigarette prices to check for simultaneity bias*

In this research, local-brand cigarette prices are preferred over foreign brands because local brands are usually cheaper and therefore more likely to contribute to the consumption decision of the average individual. However, we also provide estimates using foreign-brand prices in order to address concerns about a potential simultaneity bias in the *Price* estimates. The presumption is that foreign-brand prices are more exogenous to cigarette demand because they are either set exogenously by a foreign brand owner, or contain a larger supply-side component like transportation costs and import duties. In such case, if simultaneity were a problem, using the more exogenous foreign-brand instead of local-brand prices should provide a smaller and/or statistically weaker *Price* estimate by reducing the simultaneity bias. Results from specifications using foreign-brand prices are listed in Table 4a for participation and 4b for conditional demand. Comparing these results to Tables 3a and 3b, we can see that neither the magnitude of the price elasticities nor their statistical significance is reduced. We take this as evidence that the risk of simultaneity bias in the original local-brand price estimate is minor. The results on all other coefficients are similar in sign and statistical significance to those in Table 3.

## 5. Conclusion

The contribution of this research is to provide insight into the factors that shape cigarette consumption among youth in developing countries. Besides estimating the price elasticity of demand, we are also the first to offer a thorough examination of multiple environmental aspects that may affect smoking, including cigarette advertising, anti-tobacco media campaigns, and the observed effectiveness of youth access restrictions. Although other papers have looked at the effect of advertising bans, we are able to extend our analysis beyond the nominal presence of smoking-related policies and are able to control for the observed effectiveness of such policies.

This research has multiple policy implications. It confirms the importance of cigarette prices in determining youth cigarette use. In our preferred specification, we estimate that the price elasticity of smoking participation is -0.6 while the price elasticity of conditional demand is -1.2, yielding a total price elasticity of demand of -1.8. This estimate is higher than elasticities produced from U.S. data on youth. (Comparable U.S. estimates range from -1.44 (Lewit et al. 1981), -1.31 (Chaloupka and Grossman 1996), -1.11 (Chaloupka and Wechsler 1997), -0.83 (Tauras et al. 2005), -0.7 (Ross and Chaloupka 2003, 2004) to zero (DeCicca et al. 2008)). It is perhaps not surprising that the price responsiveness of smoking among youth in developing countries is higher than existing U.S. estimates, for two reasons. First, income constraints are tighter for individuals from developing countries, resulting in higher price responsiveness. Second, the average age in our sample is fairly low at 14 years old. The domestic literature usually focuses on slightly older individuals while also recognizing that the responsiveness of smoking is higher for younger age groups.

In addition to confirming the existence of a price effect on youth smoking, we find that anti-smoking sentiment, cigarette advertising, and youth access restrictions influence the decision to participate in smoking but not the intensity of cigarette consumption among current smokers. We also show that anti-tobacco media campaigns may be effective in reducing both participation and intensity.

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**Table 1a. Descriptive statistics and variable definitions**

Variable type	Variable name	Variable description	Full sample (N=349,130)				Smokers only (N=33,187)				
			mean	sd	min	max	mean	sd	min	max	
Individual-level	Current Smoker	1 if smoked at least one cigarette in past month, 0 otherwise	0.10	0.29	0	1	1	0	1	1	
	Cigarette Demand	Number of cigarettes smoked in past month	6.9	46.6	0	630	71.9	135.0	1.5	630	
	Age	Age in years	14.0	1.4	8.6	19	14.5	1.5	9.7	19	
	Male	1 if male, 0 otherwise	0.50	0.50	0	1	0.63	0.48	0	1	
	Pocket Money	1 if receives pocket money/income, 0 otherwise	0.62	0.49	0	1	0.85	0.36	0	1	
	Parental Smoking	Parental Smoking	1 if at least one parent smokes, 0 otherwise	0.46	0.50	0	1	0.63	0.48	0	1
			* 1 if supports public smoking bans, 0 otherwise	0.76	0.43	0	1	0.56	0.50	0	1
			* 1 if recently exposed to cigarette advertising in print media, 0 otherwise	0.86	0.35	0	1	0.90	0.30	0	1
			* 1 if recently exposed to anti-smoking media messages, 0 otherwise	0.81	0.39	0	1	0.81	0.39	0	1
			* 1 if tried to buy cigarettes but was turned away due to age	0.05	0.22	0	1	0.23	0.42	0	1
Site-level	Anti-Smoking Sentiment	% nonsmokers who support public smoking bans	0.83	0.11	0.40	0.96					
	Cigarette Advertising	% survey participants who report recent exposure to cigarette advertising in print media	0.88	0.09	0.44	0.99					
	Anti-Tobacco Media	% survey participants who report recent exposure to anti-smoking media messages	0.83	0.07	0.61	1.00					
	Youth Access Restrictions	% survey participants who report being unable to buy cigarettes due to age	0.37	0.18	0.05	0.87					
	Country-level	Price (local brand)	Real price of local-brand cigarettes, PPP-adjusted, constant 2000 USD	2.40	0.84	1.12	4.68				
Price (foreign brand)		Real price of foreign-brand cigarettes, PPP-adjusted, constant 2000 USD	3.39	1.64	1.45	8.94					
		* Nominal price of local-brand cigarettes	1.03	0.34	0.54	1.53					
		* Nominal price of Marlboro cigarettes	1.43	0.58	0.67	2.92					

\* These variables are not used in any of the models but are displayed here for better sample description

**Table 1b. Distribution of conditional cigarette demand**

	Number of cigarettes per month
Mean	71.9
Min	1.5
10th percentile	1.5
25th percentile	3.8
Median	14.0
75th percentile	85.8
90th percentile	240.0
Max	630.0
N	33187

**Table 2. Sample means by country and region**

Region	Country	Years	Smoking Prevalence	Cond. Cig. Demand	Pocket Money	Parental Smoking	Anti-Smoking Sentiment	Cig. Advertising	Anti-Tobacco Media	Youth Access Restrictions	Cig. Price, local brand	Cig. Price, foreign brand
Africa	South Africa	1999, 2002	0.17	96.86	0.44	0.45	0.55	0.86	0.79	0.34	2.87	2.87
	Mid East	2001, 2005	0.03	72.70	0.65	0.52	0.89	0.83	0.79	0.35	2.78	2.78
Mid East	Egypt	2001, 2005	0.03	72.70	0.65	0.52	0.89	0.83	0.79	0.35	2.78	2.78
	Jordan	1999, 2003	0.12	90.03	0.71	0.52	0.80	0.75	0.81	0.33	1.41	3.45
Mid East	Kuwait	2001, 2005	0.13	150.18	0.75	0.39	0.86	0.94	0.68	0.26	2.06	2.06
	Morocco	2001, 2006	0.04	96.08	0.40	0.27	0.79	0.66	0.68	0.42	2.73	5.26
Mid East	Pakistan	2003, 2004	0.01	82.66	0.67	0.32	0.96	0.81	0.78	0.58	2.28	3.79
	UAE	2002, 2005	0.05	69.33	0.57	0.30	0.73	0.86	0.74	0.37	2.54	3.38
Mid East avg			0.07	102.30	0.63	0.38	0.87	0.81	0.76	0.43	2.30	3.46
Europe	Poland	1999, 2003	0.20	130.46	0.83	0.63	0.88	0.96	0.92	0.30	2.31	3.18
	Russia	2002, 2004	0.23	123.26	0.79	0.63	0.91	0.81	0.87	0.47	2.02	3.93
Europe avg			0.22	125.32	0.80	0.63	0.89	0.88	0.90	0.37	2.16	3.56
Americas	Brazil	2002, 2004, 2005, 2006	0.10	89.41	0.58	0.37	0.89	0.87	0.89	0.18	1.44	1.68
	Chile	2000, 2003	0.24	45.24	0.75	0.63	0.88	0.91	0.80	0.17	2.85	3.35
Americas	Costa Rica	1999, 2002	0.15	56.02	0.84	0.31	0.91	0.95	0.74	0.38	1.12	1.45
	Mexico	2000, 2005, 2006	0.12	40.91	0.64	0.40	0.89	0.91	0.85	0.49	1.99	2.65
Americas	Peru	2000, 2002, 2003	0.12	24.45	0.63	0.41	0.91	0.88	0.90	0.28	2.26	3.43
	Venezuela	1999, 2001, 2003	0.04	35.97	0.57	0.37	0.88	0.86	0.81	0.31	2.60	2.92
Americas avg			0.11	51.33	0.63	0.41	0.89	0.89	0.85	0.32	2.04	2.58
Southeast Asia	India	2000, 2001, 2002, 2003, 2004, 2006	0.05	59.41	0.47	0.45	0.76	0.92	0.79	0.49	2.98	4.63
	Indonesia	2000, 2004, 2005, 2006	0.12	35.44	0.93	0.57	0.91	0.96	0.91	0.37	2.15	2.15
SE Asia avg	Sri Lanka	1999, 2003	0.01	34.08	0.84	0.48	0.92	0.89	0.90	0.63	4.68	8.94
	China	1999, 2001, 2005	0.06	52.69	0.55	0.47	0.78	0.92	0.81	0.47	3.27	5.24
Western Pacific	China	1999, 2001, 2005	0.05	88.84	0.76	0.64	0.61	0.65	0.79	0.17	3.68	4.14
	Philippines	2000, 2004	0.12	58.48	0.58	0.58	0.40	0.91	0.84	0.50	1.26	1.70
W Pacific avg			0.07	71.34	0.70	0.62	0.59	0.68	0.79	0.21	2.47	2.92

**Table 3a. Logit model of smoking participation**  
Coefficients represent marginal effects on the probability of smoking participation

	Without <i>Sentiment</i>		With <i>Sentiment</i>	
	(1)	(2)	(3)	(4)
Log Price ( <i>local brand</i> )	-0.058*** (0.021)	-0.033** (0.015)	-0.064*** (0.020)	-0.037** (0.014)
Anti-Tobacco Media		-0.103** (0.046)		-0.090* (0.047)
Cigarette Advertising		0.111** (0.048)		0.130*** (0.045)
Youth Access Restrictions		-0.089*** (0.027)		-0.104*** (0.028)
Anti-Smoking Sentiment			-0.064* (0.033)	-0.094*** (0.026)
Age	-0.051*** (0.017)	-0.048*** (0.017)	-0.051*** (0.017)	-0.047*** (0.016)
Age <sup>2</sup>	0.002*** (0.001)	0.002*** (0.001)	0.002*** (0.001)	0.002*** (0.001)
Male	0.039*** (0.005)	0.038*** (0.005)	0.038*** (0.005)	0.038*** (0.005)
Parental Smoking	0.037*** (0.003)	0.035*** (0.003)	0.037*** (0.003)	0.035*** (0.003)
Pocket Money	0.062*** (0.004)	0.059*** (0.004)	0.063*** (0.004)	0.060*** (0.004)
Obs	349,130	345,847	349,130	345,847
Price elasticity	-0.957***	-0.557**	-1.066***	-0.631**
Advertising elasticity		1.638**		1.916***

All specifications include year and country dummies

Standard errors clustered by survey site

Standard errors in parentheses

\* p<.1, \*\* p<.05, \*\*\* p<.01

**Table 3b. Generalized linear model of conditional cigarette demand**  
Coefficients represent marginal effects on log cigarettes per month.

	Without <i>Sentiment</i>		With <i>Sentiment</i>	
	(1)	(2)	(3)	(4)
Log Price ( <i>local brand</i> )	-1.126*** (0.276)	-1.205*** (0.322)	-1.134*** (0.275)	-1.198*** (0.327)
Anti-Tobacco Media		-1.288** (0.527)		-1.274** (0.537)
Cigarette Advertising		1.068 (0.696)		1.112 (0.723)
Youth Access Restrictions		0.150 (0.327)		0.138 (0.334)
Anti-Smoking Sentiment			-0.192 (0.469)	-0.130 (0.310)
Age	-0.954*** (0.265)	-0.962*** (0.265)	-0.955*** (0.265)	-0.962*** (0.265)
Age <sup>2</sup>	0.036*** (0.009)	0.037*** (0.009)	0.037*** (0.009)	0.037*** (0.009)
Male	0.212*** (0.036)	0.218*** (0.037)	0.212*** (0.036)	0.218*** (0.037)
Parental Smoking	0.132*** (0.022)	0.133*** (0.023)	0.132*** (0.022)	0.133*** (0.023)
Pocket Money	0.200*** (0.070)	0.200*** (0.071)	0.201*** (0.070)	0.200*** (0.071)
Obs	33,187	32,532	33,187	32,532
Price elasticity	-1.126***	-1.205***	-1.134***	-1.198***
Advertising elasticity		0.938		0.976

All specifications include year and country dummies

Standard errors clustered by survey site

Standard errors in parentheses

\* p<.1, \*\* p<.05, \*\*\* p<.01

**Table 3c. Ordered logit estimates of the price elasticity of the probability of being in a smoker category**

Cigarettes per month	Without <i>Sentiment</i>		With <i>Sentiment</i>	
	(1)	(2)	(3)	(4)
1 to 15	0.528***	0.396***	0.523***	0.396***
15 to 100	-0.437***	-0.339***	-0.432***	-0.339***
100 to 300	-0.900***	-0.688***	-0.892***	-0.687***
>300	-1.144***	-0.869***	-1.133***	-0.868***

All specifications include year and country dummies

Standard errors clustered by survey site

Standard errors in parentheses

\* p<.1, \*\* p<.05, \*\*\* p<.01

**Table 4a. Logit model of smoking participation**

Coefficients represent marginal effects on the probability of smoking participation

	Without <i>Sentiment</i>		With <i>Sentiment</i>	
	(1)	(2)	(3)	(4)
Log Price ( <i>foreign brand</i> )	-0.084*** (0.024)	-0.051** (0.021)	-0.091*** (0.023)	-0.054*** (0.019)
Anti-Tobacco Media		-0.105** (0.048)		-0.091* (0.051)
Cigarette Advertising		0.097** (0.049)		0.115** (0.046)
Youth Access Restrictions		-0.093*** (0.027)		-0.108*** (0.028)
Anti-Smoking Sentiment			-0.063* (0.033)	-0.091*** (0.027)
Age	-0.048*** (0.018)	-0.046** (0.018)	-0.048*** (0.018)	-0.045** (0.018)
Age <sup>2</sup>	0.002*** (0.001)	0.002*** (0.001)	0.002*** (0.001)	0.002*** (0.001)
Male	0.038*** (0.005)	0.038*** (0.005)	0.038*** (0.005)	0.038*** (0.005)
Parental Smoking	0.037*** (0.003)	0.035*** (0.003)	0.037*** (0.003)	0.035*** (0.003)
Pocket Money	0.058*** (0.004)	0.055*** (0.004)	0.059*** (0.004)	0.056*** (0.004)
Obs	326,597	323,314	326,597	323,314
Price elasticity	-1.418***	-0.904**	-1.540***	-0.950***
Advertising elasticity		1.456*		1.749**

All specifications include year and country dummies

Standard errors clustered by survey site

Standard errors in parentheses

\* p&lt;.1, \*\* p&lt;.05, \*\*\* p&lt;.01

**Table 4b. Generalized linear model of conditional cigarette demand**  
Coefficients represent marginal effects on log cigarettes per month.

	Without <i>Sentiment</i>		With <i>Sentiment</i>	
	(1)	(2)	(3)	(4)
Log Price ( <i>foreign brand</i> )	-1.218*** (0.316)	-1.239*** (0.384)	-1.224*** (0.311)	-1.227*** (0.384)
Anti-Tobacco Media		-1.337** (0.536)		-1.320** (0.542)
Cigarette Advertising		1.365* (0.802)		1.417* (0.820)
Youth Access Restrictions		0.104 (0.330)		0.087 (0.335)
Anti-Smoking Sentiment			-0.176 (0.521)	-0.161 (0.303)
Age	-0.908*** (0.273)	-0.915*** (0.269)	-0.908*** (0.273)	-0.915*** (0.270)
Age <sup>2</sup>	0.035*** (0.009)	0.035*** (0.009)	0.035*** (0.009)	0.035*** (0.009)
Male	0.216*** (0.037)	0.223*** (0.038)	0.217*** (0.037)	0.223*** (0.038)
Parental Smoking	0.134*** (0.022)	0.135*** (0.023)	0.134*** (0.022)	0.135*** (0.023)
Pocket Money	0.200*** (0.072)	0.198*** (0.073)	0.201*** (0.072)	0.198*** (0.074)
Obs	30,534	29,879	30,534	29,879
Price elasticity	-1.218***	-1.239***	-1.224***	-1.227***
Advertising elasticity		1.196*		1.242*

All specifications include year and country dummies

Standard errors clustered by survey site

Standard errors in parentheses

\* p<.1, \*\* p<.05, \*\*\* p<.01