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DOES ADVERTISING MATTER? ESTIMATING THE IMPACT OF CIGARETTE ADVERTISING ON SMOKING AMONG YOUTH IN DEVELOPING COUNTRIES

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The goal of this paper is to evaluate the impact of cigarette advertising on smoking among youth in developing countries. Using micro-level data from 19 developing countries, we examine the structural relationship between smoking behavior and advertising exposure and the reduced-form relationship between smoking and advertising bans. Instrumental variables are used to address the endogeneity of advertising exposure. Country-specific unobserved heterogeneity is further reduced by controlling for measures of antismoking sentiment and cigarette prices. After accounting for the endogeneity of advertising, we find that the positive correlation between smoking and advertising exposure in our sample can be largely explained by the disproportionately higher propensity of smokers to observe advertising rather than a direct causal effect of advertising on smoking. (*JEL* I12, I18)

I. INTRODUCTION

The worldwide pattern of tobacco consumption has been shifting away from developed countries toward less developed nations (WHO 2011). Smoking in developing countries can begin very early in life, and it is estimated that, worldwide, a quarter of the teenagers who smoke have tried their first cigarette before the age of 10 (Shafey et al. 2006). Because smoking habits are established primarily in youth, policies such as advertising restrictions that have the potential to alter youth smoking behavior attract special interest. Advertising restrictions are an established part of the policy toolkit for tobacco control in developed countries, and are becoming increasingly so in developing countries as well (WHO 2011). However, the vast majority of the current economic evidence on the impact of cigarette advertising on smoking is based on data from the United States and other advanced economies. It is unclear whether empirical findings from this literature can be applied to developing countries whose populations may have different patterns of responsiveness to tobacco control policies.

The existing evidence on the impact of advertising on smoking in the United States and other developed countries yields conflicting results. A literature review in Blecher (2008) lists 17 studies which find a positive and significant impact of advertising on smoking and 18 studies which find the opposite. Similarly, Saffer and Chaloupka (2000) identify nine studies with no advertising effect and nine studies with a positive advertising effect. A meta-analysis of 49 studies on cigarette advertising regulation in the United States and other developed countries in Nelson (2006) finds insignificant advertising regulation effects. Saffer and Chaloupka (2000) distinguish between different intensity levels of advertising regulation in 22 Organization for Economic Cooperation and Development (OECD) countries and find that weak advertising bans are ineffective while highly

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ABBREVIATIONS

CDC: Centers for Disease Control and Prevention
EIU: Economist Intelligence Unit
GLM: Generalized Linear Model
GYTS: Global Youth Tobacco Survey
LIML: Limited-Information Maximum Likelihood
MI: Multiple Imputation
NATIONS: National Tobacco Information Online System
OECD: Organization for Economic Cooperation and Development
PATIOS: Pan American Tobacco Information Online System
PPP: Purchasing Power Parities
WHO: World Health Organization

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comprehensive bans can impact aggregate consumption. Blecher (2008) evaluates aggregate data from 30 developed and developing countries and finds similar evidence that the impact of bans is largest when they are most comprehensive; however, both studies may be limited by nonstationarity of cigarette consumption data. Using U.S. data, Iwasaki, Tremblay, and Tremblay (2006) conclude that even if advertising restrictions do not decrease market demand, they are still effective in decreasing the equilibrium cigarette consumption in the United States due to supply side effects from reduced price competition. In contrast, Nelson (2003a) evaluates data from 20 OECD countries and concludes that the causal link between advertising bans and cigarette consumption flows not from bans to consumption but, rather, from consumption to bans—i.e., the change in political climate that was concurrent with reduced consumption led to the introduction of stricter bans.

While the aforementioned studies support a variety of opinions, virtually all are based on macro-level data, i.e., the dependent variable is aggregate cigarette consumption at the state or country level. However, the direction of the causality between bans and consumption is harder to identify when consumption is an aggregate measure than when it is measured on an individual basis. For instance, identification of a causal advertising effect may be complicated if higher overall consumption in certain locations prevents advertising bans from being passed, or if tobacco producers respond to higher consumption in certain areas by boosting advertising spending. The reverse causality problem can be addressed by modeling individual smoking behavior rather than aggregate consumption since this permits the assumption that no single person's response to advertising can influence advertising policy. However, micro-level data that contain information on both individual consumption and advertising exposure are not readily available even in developed countries, and such studies are rare. Micro-level analyses are further challenged by the endogenous nature of individual advertising exposure (Heckman, Flyer, and Loughlin 2008): as cigarette advertising may be designed to target smokers, smokers may observe it more often than the general population. Due to the lack of suitable micro-level data and the difficulty of dealing with the endogeneity of advertising exposure, advertising exposure is rarely evaluated as a driver of individual smoking behavior. One exception is a study by Avery et al. (2007) which examines the impact of exposure to magazine advertising for smoking cessation products on quit attempts in the United States. Using the within-magazine variability of advertising intensity to address the endogeneity of advertising exposure, the authors find that exposure to advertising for cessation products raises quitting attempts and may increase quitting as well.

Evidence from developing countries on the impact of advertising is limited, regardless of empirical setup. In a recent study, Kostova et al. (2011) find a positive association between local advertising prevalence and youth smoking in developing countries. However, the direction of causality in this association is difficult to determine because local advertising prevalence reflects the rate of smokers' exposure to advertising, introducing smoker bias into the results. To the best of our knowledge, only two studies (Blecher 2008; Nelson 2003b) evaluate the effect of advertising regulation on smoking in developing countries and they reach different conclusions. Nelson (2003b) uses individual data on smoking from youth from 42 developing countries and finds that advertising bans do not affect smoking prevalence. However, the micro-level model of smoking participation in Nelson (2003b) does not include prices, which economic theory suggests should be included. Blecher (2008) accounts for prices but the models are based on aggregate country consumption; in an empirical macro context, the study finds evidence that comprehensive advertising bans are effective. The present research combines the advantages of these prior studies while addressing their main limitations. Specifically, we employ individual-level data to investigate the causal impact of advertising on cigarette demand while also accounting for cigarette prices.

We examine advertising from three perspectives. First, we evaluate the structural relationship between smoking behavior and individual advertising exposure. Since this relationship is inherently endogenous, we use an instrumental variables approach where the excluded instrument for exposure is advertising bans. Second, we estimate the reduced-form model of cigarette demand where smoking is modeled directly as a function of advertising bans. The impact of bans in both the structural and the reduced-form specifications is identified with two-way country fixed effects and by controlling for country-specific antismoking sentiment. Third,

we estimate the impact of advertising exposure where exposure is aggregated at the survey site level and represents the overall site-specific level of advertising intensity rather than actual individual exposure. In this case, we address the endogeneity of the aggregate exposure variable by constructing it exclusively from the advertising exposure of nonsmokers. We evaluate the relationship between advertising and smoking from multiple angles and find fairly consistent results.

II. DATA

We obtain micro-level data on smoking behavior and individual characteristics from the Global Youth Tobacco Survey (GYTS). The GYTS is a survey developed by the World Health Organization (WHO) and the 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 since 1999. 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. The study is designed to be a random sample of schoolchildren only, and a major limitation is that it does not capture children who are not enrolled in school. In larger countries, the survey may be more representative of the local survey city or province than the nation, which is another data limitation. Yet another data limitation is that a large proportion of survey respondents (nearly 20%) have missing responses for at least one of the personal characteristics *Age*, *Male*, *Parental Smoking*, and *Pocket Money*. Such omissions are common in surveys, and complete-case analysis where only individuals with complete survey answers are used would lead to substantial loss of information. To address this issue, we use a multiple imputation (MI) technique which has an advantage over standard methods of imputation like variable means or single regression predictions because it takes into account the uncertainty of the imputed missing values (Rubin 1987) and has less risk of overestimating the statistical significance of the variables in the main models. MI in this analysis is based on five multiply imputed datasets, which has been shown to be the minimum number that sufficiently reflects the probability nature of the imputed values (Royston 2004).

Our final dataset contains data on 342,926 individuals from 19 countries corresponding to 117 local sites (i.e., cities/provinces). The number of countries used in this study is smaller than the number of countries originally included in the survey for two reasons. First, we only use countries which were surveyed in multiple years and provide repeated cross-sections, allowing the use of country fixed effects. Second, since this is a study of cigarette demand, we exclude countries for which cigarette price data are not available. Sample means are shown in Table 1, and means by country and survey year are shown in Table 2.

As described in the following section, our empirical framework is the two-part model of cigarette demand, where the outcome variables are smoking participation and conditional cigarette demand. 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 Russia (30% in 2002, down to 22% in 2004) and Chile (29% in 2000, down to 19% in 2003). Conditional cigarette demand is based on the average number of days that smoking occurred in the past month multiplied by the average number of cigarettes smoked daily by each smoker, both calculated as the midpoints of self-reported ranges. It is highest in Russia where the average monthly consumption among young smokers is up to eight packs. In the overall 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 in 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. The pocket money variable serves as a proxy for personal and family income, since the survey does not contain data on actual income measures.

We use three measures of advertising: individual advertising exposure, advertising bans, and a country-specific aggregate advertising intensity measure. The first is a binary variable equal to 1 if the individual reports recent exposure to cigarette ads on billboards, newspapers,

TABLE 1
Sample Means and Variable Definitions

Variable Type	Variable Name	Description	Mean
Person-level ($N = 342,926$)	Current smoker	1 if smoked at least one cigarette in past month, 0 otherwise	0.093
	Conditional cigarette demand	Number of cigarettes smoked per month (smokers only, $N = 31,948$)	69.6
	Age	Age in years	14.0
	Male	1 if male, 0 otherwise	0.50
	Pocket money	1 if receives pocket money or income, 0 otherwise	0.61
	Parental smoking	1 if at least one parent smokes, 0 otherwise	0.46
	Individual ad exposure	1 if recently exposed to cigarette advertising in print media and billboards, 0 otherwise	0.86
Site level	Aggregate rate of ad exposure among nonsmokers	% nonsmokers who report no recent exposure to cigarette advertising in print media and billboards	0.90
	Antismoking sentiment	% nonsmokers who support public smoking bans	0.80
Country level	Cigarette price	Real price of local brand cigarettes, PPP-adjusted, in constant 2000 USD	2.44
	GDP per capita	Log GDP per capita in constant 2000 USD	4,114
	Ad ban	Tobacco advertising is banned in at least five out of seven major media	0.28

or magazines. This variable is endogenous to smoking if persons who are more likely to smoke are also more likely to observe advertising. This issue is discussed in greater detail in the Methods section.

The second advertising measure, ad bans, is an indicator variable equal to 1 if a country has implemented comprehensive tobacco advertising regulation. Following Saffer and Chaloupka (2000), we determine the stringency of advertising regulation by considering seven types of media: TV, radio, print, billboards, cinema, point-of-sale, and sponsorship. A comprehensive ban is one where tobacco advertising is banned in at least five of these media; prior research indicates that only the most comprehensive regulation may have an effect on smoking (Saffer and Chaloupka 2000; Blecher 2008).

In order to classify the ad ban level of each country, data on regulations in each individual country were captured from a number of sources. For European nations, the regional office of the World Health Organization provides an online Tobacco Control Database which includes detailed information on each member country. A similar situation exists for some members of the Pan American Health Organization which provides the Pan American Tobacco Information Online System (PATIOS). This was also supplemented by the Tobacco Control Country Profiles (Shafey, Dolwick, and Guindon 2003) since only the current status is indicated in PATIOS, not the historical status which was found in Shafey, Dolwick, and Guindon (2003). Countries that were not included in either of the aforementioned databases were surveyed using an online survey of eminent persons in each country. Furthermore, for countries which were not surveyed due to language barriers or other logistical problems a search of Tobacco Control Country Profiles (Shafey, Dolwick, and Guindon 2003), the CDC National Tobacco Information Online System (NATIONS), and source documents was employed. In order to maintain consistency between the various sources, the dataset was constructed manually by the authors using the sources only as an indication. A series was constructed for each country indicating the number of media in which advertising was banned in each particular year.

The third measure of advertising in this research is the site-specific intensity of advertising exposure, measured as the aggregate prevalence of advertising exposure among youth who do not smoke. It is based on individual GYTS responses and is calculated as the proportion of nonsmokers at each survey site who report having been recently exposed to cigarette ads on billboards, newspapers, or magazines. We base this measure on nonsmokers only since smokers have a disproportionately higher propensity to observe cigarette advertising than the general population, thus including the advertising experiences of smokers would introduce bias to

TABLE 2
Sample Means by Country-Year[a]

Year	Country	Sample Size	Current Smoker	Conditional Cigarette Demand	Age	Male	Parental Smoking	Pocket Money	Aggregate Rate of Ad Exposure Among Nonsmokers	Antismoking Sentiment	GDP per Capita	Ad Ban
2002	Brazil	9, 909	0.12	106.7	15.0	0.44	0.41	0.62	0.89	0.88	3, 738	1
2004	Brazil	4, 861	0.09	82.9	14.6	0.45	0.38	0.54	0.88	0.85	3, 892	1
2005	Brazil	3, 428	0.08	65.0	14.5	0.45	0.32	0.63	0.94	0.90	3, 951	1
2006	Brazil	12, 384	0.09	79.5	14.6	0.46	0.34	0.55	0.92	0.88	4, 044	1
2000	Chile	5, 549	0.29	46.1	13.6	0.48	0.67	0.82	0.94	0.83	4, 917	0
2003	Chile	7, 432	0.19	44.2	13.4	0.52	0.61	0.70	0.91	0.83	5, 215	0
1999	China	10, 760	0.03	42.2	14.3	0.49	0.66	0.71	0.74	0.62	882	0
2001	China	3, 938	0.07	69.3	13.3	0.52	0.54	0.78	0.90	0.62	13, 509	0
2005	China	14, 952	0.05	117.7	14.2	0.50	0.66	0.77	0.66	0.61	1, 451	1
1999	Costa Rica	4, 120	0.15	54.7	13.7	0.54	0.33	0.64	0.98	0.89	4, 080	0
2002	Costa Rica	2, 854	0.13	58.2	14.1	0.49	0.29	0.69	0.95	0.85	4, 048	0
2001	Egypt	3, 427	0.04	99.3	13.6	0.81	0.46	0.64	0.85	0.87	1, 525	0
2005	Egypt	3, 719	0.03	37.1	13.5	0.54	0.57	0.64	0.73	0.85	1, 643	0
2000	India	27, 761	0.09	64.5	14.0	0.56	0.54	0.58	0.96	0.59	453	0
2001	India	3, 754	0.02	36.4	14.1	0.56	0.40	0.48	0.92	0.71	469	0
2002	India	8, 999	0.01	30.2	14.3	0.62	0.42	0.36	0.94	0.63	479	0
2003	India	8, 672	0.02	62.6	13.8	0.57	0.39	0.37	0.95	0.69	512	0
2004	India	17, 189	0.03	59.2	14.1	0.57	0.36	0.43	0.94	0.78	546	1
2006	India	10, 832	0.06	42.8	14.0	0.57	0.46	0.40	0.80	0.73	637	1
2000	Indonesia	1, 856	0.14	31.3	13.4	0.49	0.64	0.93	0.98	0.91	800	0
2004	Indonesia	5, 391	0.16	41.0	13.6	0.48	0.47	0.91	0.96	0.86	904	0
2005	Indonesia	1, 992	0.10	32.7	13.4	0.47	0.61	0.97	0.98	0.91	943	0
2006	Indonesia	4, 108	0.07	24.3	13.7	0.45	0.65	0.92	0.98	0.90	983	0
1999	Jordan	3, 297	0.09	60.5	13.5	0.45	0.53	0.67	0.78	0.77	1, 735	1
2003	Jordan	5, 015	0.14	101.8	14.5	0.48	0.52	0.72	0.85	0.76	1, 901	1
2001	Kuwait	5, 597	0.13	156.9	14.1	0.47	0.37	0.77	0.95	0.84	16, 700	1
2005	Kuwait	3, 515	0.13	139.7	14.5	0.44	0.42	0.75	0.93	0.85	21, 846	1
2000	Mexico	1, 658	0.13	46.6	13.7	0.48	0.49	0.81	0.97	0.81	5, 935	0
2005	Mexico	19, 691	0.13	39.7	13.4	0.47	0.40	0.64	0.94	0.87	6, 163	0
2006	Mexico	12, 943	0.11	42.1	13.6	0.47	0.39	0.61	0.94	0.87	6, 389	0
2001	Morocco	2, 665	0.03	103.4	14.2	0.57	0.26	0.47	0.70	0.77	1, 383	1
2006	Morocco	2, 842	0.04	90.5	14.3	0.48	0.28	0.34	0.76	0.81	1, 667	1

TABLE 2
Continued

Year	Country	Sample Size	Current Smoker	Conditional Cigarette Demand	Age	Male	Parental Smoking	Pocket Money	Aggregate Rate of Ad Exposure Among Nonsmokers	Antismoking Sentiment	GDP per Capita	Ad Ban
2003	Pakistan	3, 491	0.01	88.4	14.3	0.55	0.30	0.57	0.89	0.94	550	0
2004	Pakistan	3, 965	0.01	78.9	14.5	0.68	0.34	0.75	0.82	0.94	576	0
2000	Peru	4, 472	0.11	21.5	14.2	0.46	0.43	0.63	0.93	0.90	2, 077	0
2002	Peru	2, 236	0.09	21.8	13.9	0.48	0.43	0.58	0.93	0.87	2, 131	0
2003	Peru	6, 733	0.14	26.5	14.3	0.50	0.39	0.65	0.92	0.89	2, 190	0
2000	Philippines	9, 696	0.13	56.0	15.1	0.38	0.58	0.45	0.94	0.38	996	0
2004	Philippines	6, 353	0.10	63.8	14.7	0.39	0.57	0.79	0.94	0.89	1, 087	0
2002	Russia	1, 333	0.30	156.7	14.0	0.49	0.59	0.83	0.85	0.87	1, 968	0
2004	Russia	12, 268	0.22	118.3	13.4	0.48	0.63	0.78	0.86	0.91	2, 286	0
1999	South Africa	4, 923	0.19	113.2	15.0	0.48	0.49	0.42	0.86	0.52	2, 972	0
2002	South Africa	7, 677	0.17	85.1	15.5	0.45	0.42	0.44	0.83	0.58	3, 128	1
1999	Sri Lanka	2, 519	0.02	35.0	14.0	0.49	0.53	0.66	0.92	0.91	828	0
2003	Sri Lanka	1, 619	0.01	32.6	14.1	0.50	0.41	0.69	0.91	0.91	920	0
2002	UAE	3, 690	0.05	57.7	13.5	0.48	0.28	0.53	0.87	0.70	21, 704	0
2005	UAE	14, 771	0.06	71.8	13.8	0.49	0.31	0.58	0.82	0.53	25, 376	0
1999	Venezuela	9, 043	0.04	35.8	13.0	0.45	0.38	0.53	0.88	0.86	4, 734	0
2001	Venezuela	4, 540	0.05	39.7	13.0	0.41	0.38	0.60	0.91	0.88	4, 891	0
2003	Venezuela	8, 487	0.04	33.3	13.1	0.46	0.36	0.58	0.86	0.87	3, 967	0

[a]Variable definitions provided in Table 1.

the relationship between smoking and aggregate advertising exposure.

Cigarette prices are obtained from the Economist Intelligence Unit (EIU) World Cost of Living Survey. The EIU survey collects retail price data for a wide range of consumer products on a biannual 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 improves the comparability of prices across countries. We use local brand cigarette prices because these are generally cheaper and more likely to be considered when smoking decisions are made.

Variables that describe the environment of each individual include the locally prevailing level of antismoking sentiment (*Sentiment*) and domestic income (*GDP*). GDP accounts for the variability of income constraints across countries and over time. Antismoking sentiment has been recognized in the U.S. literature as an important predictor of smoking whose omission from a model of smoking may be detrimental (Decicca et al. 2008). Omitting antismoking sentiment may produce bias if it causes the error term to be correlated both with smoking and with advertising regulation. For instance, high antismoking sentiment may result in both lower cigarette consumption and stricter advertising policy; failing to account for this may lead to overestimation of the policy effect. In this paper the measure of *Sentiment* is the percentage of nonsmokers in each survey site who favor bans on smoking in public places. The variability in the proportion of smoke-friendly nonsmokers across sites proxies for the variability of cultural attitudes toward smoking in the population at large—a higher proportion of nonsmokers who do not mind being smoked around may be a reflection of the overall acceptability of smoking. We base this measure on nonsmokers only (as opposed to all survey participants including smokers) to avoid bias introduced by smokers who are disproportionately more accepting of public smoking than the general population. If smokers' attitudes were included, *Sentiment* would be more vulnerable to endogeneity with respect to cigarette demand because, for smokers, smoking affects sentiment as well as sentiment affecting smoking. Excluding the smokers when antismoking sentiment is calculated helps ensure that the relationship between site level *Sentiment* and cigarette demand is one-directional.

III. METHODS

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 model estimates the probability of smoking participation, $\Pr(Y_{ijt} > 0)$ where Y_{ijt} is the number of cigarettes smoked by individual i in country j at time t. The second part estimates the amount of cigarettes smoked by smokers, i.e., conditional cigarette demand $Y_{ijt}|Y_{ijt} > 0$.

$$(1) \qquad \Pr(Y_{ijt} > 0) = f(\text{Ad}, \text{Price}, \boldsymbol{X}_1, \boldsymbol{X}_2)$$

$$(2) \qquad Y_{ijt}|Y_{ijt} > 0 = f(\text{Ad}, \text{Price}, \boldsymbol{X}_1, \boldsymbol{X}_2)$$

Smoking participation $\Pr(Y_{ijt} > 0)$ and conditional cigarette demand $Y_{ijt}|Y_{ijt} > 0$ are functions of advertising (Ad), cigarette price (Price), a vector of individual characteristics ($\boldsymbol{X}_1$), and a vector of observed environmental characteristics ($\boldsymbol{X}_2$) where $\boldsymbol{X}_1$ includes age, gender, parental smoking, and pocket money, and $\boldsymbol{X}_2$ includes a measure of antismoking sentiment and national income. Unobserved country heterogeneity in both parts of the model is addressed with two-way country fixed effects, represented by country and year dummy variables. To avoid inflating the statistical significance of the advertising impact that may arise from autocorrelation, we perform a clustering adjustment of the standard errors by country (Bertrand, Duflo, and Mullainathan 2004).

We estimate the model from Equations (1) and (2) three times depending on the measure of Ad, as follows.

A. The Structural Model

In the structural model, Ad in Equations (1) and (2) is the individual advertising exposure of person i in country j at time t, Ad_{ijt}.

Ad_{ijt} is endogenous to smoking because people who smoke are also more likely to be exposed to cigarette advertising. Cigarette advertising is designed to target individuals with higher potential for cigarette consumption; smokers may read the type of magazines or go to the type of social events where tobacco is advertised and are therefore likely to report disproportionately higher advertising exposure. We use instrumental variables to deal with the endogeneity of individual ad exposure. The identifying instrument is an indicator variable of the presence of a comprehensive ad ban in each individual's country of residence. This instrument must be correlated with the instrumented variable, and must be uncorrelated with the error term from the cigarette demand equation. The first condition is satisfied since the first-stage equations show statistically significant correlation between ad exposure and ad bans.[1] Although we cannot explicitly test for the second condition because such a test would require a second exogenous instrumental variable, we assume that it is satisfied on the grounds that advertising bans are exogenous to individual smoking behavior when smoking behavior is net of unobserved country-specific heterogeneity. Since unobserved country heterogeneity is accounted for with two-way fixed effects and by controlling for antismoking sentiment, we assume that advertising bans are conditionally uncorrelated with smoking behavior and are a suitable instrument. Both parts of this model are estimated with two-stage limited-information maximum likelihood (LIML).

B. The Reduced-Form Model

If a structural link exists between individual advertising exposure and smoking, and if advertising bans affect smoking through preventing exposure to advertising, then we can estimate a reduced-form model of smoking where smoking is a direct function of advertising bans. In this model, Ad in Equations (1) and (2) denotes the presence of comprehensive advertising ban in country j at time t. The reduced-form model has several advantages in this context (Markowitz 2008). First, it produces a direct estimate of the effect of advertising bans, which has relevance for policy makers. Second, it can be used to identify causality in the structural relationship between advertising exposure and smoking when we suspect that unobserved factors remain in the error term. Since we can assume that an exogenous or well-identified advertising ban can affect individual smoking only through limiting an individual's exposure to advertising, then finding a significant effect of bans on smoking could be taken as evidence that reduced exposure leads to reduced smoking.

A main econometric concern in the reduced-form model is that advertising bans can be endogenous if there are unobserved country characteristics that may determine both the change in smoking patterns and the change in advertising regulation. For instance, if governments experience rising smoking rates, they may also increase the level of advertising regulation. In addition, unobserved country characteristics such as antismoking sentiment could determine both smoking and regulation, and would result in bias if they remain in the error term. To address bias from unobserved country heterogeneity, we rely on a combination of country fixed effects and a control for antismoking sentiment, where the sentiment variable can stand in as a proxy for other country-specific unobservable factors that change over time. The first part of the reduced-form model is estimated with logit and the second part is estimated using a generalized linear model (GLM) with a negative binomial distribution and a log link.[2]

C. An Alternative Approach to the Structural Model

Besides using instrumental variables, another way to address the endogeneity of individual ad exposure is to model smoking as a function of the aggregate site-specific rate of advertising exposure instead of individual exposure, provided that the aggregation of the exposure variable takes place over nonsmokers only. In such a case, Ad in Equations (1) and (2) is the rate of advertising exposure among nonsmokers in survey site j at time t. Excluding the smokers from the construction of the aggregate ad exposure variable is key for removing

1. The first-stage regressions are available from the authors.

2. In general notation, the GLM model used here can be expressed as $g(E(y)) = x\beta$, where the link function $g(\cdot) = ln(\cdot)$ and $y \sim$ Negative Binomial. The log-link GLM is used in order to produce more consistent and less biased elasticity estimates than a direct regression on $\ln(y)$ in the presence of heteroskedasticity (Manning and Mullahy 2001; Mullahy 1998; Tauras 2005, 2006). For instance, Tauras (2005) estimates that the bias from using ordinary least squares 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.

endogeneity from the variable. Since smokers are disproportionately more likely to observe advertising, countries with higher proportions of smokers will exhibit both higher rates of ad exposure and higher rates of smoking, inflating the relationship between exposure and smoking, and preventing a causal interpretation. However, such bias is lessened when the aggregate exposure rate is based on nonsmokers only.

The main advantage of estimating the impact of the advertising exposure rate over estimating the impact of ad bans is that the ad exposure rate is a continuous variable and therefore has greater variability within countries over time than the binary ad ban variable. As in all models, this model employs two-way country fixed effects to control for unobserved country heterogeneity, and controls for antismoking sentiment. The first part is estimated with logit and the second part is estimated using a GLM with a negative binomial distribution and a log link.

IV. RESULTS

Results from the smoking participation models are shown in Table 3 and results from the conditional demand models are shown in Table 4. In both tables, Specification 1 describes the relationship between individual ad exposure and smoking before it is corrected for endogeneity, while Specification 2 uses the same variable of interest and corrects for endogeneity through instrumental variables. The variable of interest in Specification 3 is the aggregate rate of ad exposure among nonsmokers. The variable of interest in Specification 4 is advertising bans.

A statistically significant correlation with the expected positive sign is found between smoking participation and individual ad exposure in Specification 1, Table 3. Since Specification 1 does not address the endogeneity of ad exposure, we cannot interpret these results causally. However, Specification 1 is useful as a baseline comparison to Specification 2 where causality is more explicitly pursued. We find that the positive correlation from Specification 1 does not translate into a causal effect once instrumental variables are employed in Specification 2. In comparison to Specification 1, the coefficient on ad exposure in Specification 2 loses its statistical significance and even reverses signs. This may

TABLE 3
Models of Smoking Participation (Marginal Effects)

	Without IV (1)	**With IV (2)**	**(3)**	**(4)**
Individual ad exposure	0.015**	−0.201		
	(0.006)	(0.218)		
Aggregate rate of ad exposure among nonsmokers			0.028	
			(0.128)	
Ad ban				0.001
				(0.020)
Price	−0.024*	−0.006	−0.024*	−0.023*
	(0.012)	(0.010)	(0.013)	(0.013)
Antismoking sentiment	−0.146***	−0.111***	−0.146***	−0.144***
	(0.047)	(0.033)	(0.049)	(0.049)
Age	0.022***	0.021***	0.022***	0.022***
	(0.002)	(0.004)	(0.002)	(0.002)
Male	0.051***	0.053***	0.052***	0.052***
	(0.007)	(0.010)	(0.007)	(0.007)
Parental smoking	0.047***	0.050***	0.047***	0.047***
	(0.004)	(0.006)	(0.004)	(0.004)
Pocket money	0.076***	0.082***	0.077***	0.077***
	(0.009)	(0.012)	(0.009)	(0.009)
ln GDP per capita	0.021***	0.045*	0.020	0.023***
	(0.008)	(0.024)	(0.016)	(0.008)
N	340,905	340,905	342,926	342,926

Standard errors in parentheses. Standard errors clustered at the survey site. All models include year dummies and country dummies.

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

TABLE 4
Models of Conditional Cigarette Demand (Marginal Effects)

	Without IV (1)	With IV (2)	(3)	(4)
Individual ad exposure	−6.359	41.452		
	(5.154)	(113.707)		
Aggregate rate of ad exposure among nonsmokers			53.645	
			(68.440)	
Ad ban				8.857
				(18.094)
Price	−37.944***	−29.843***	−38.930***	−37.230***
	(12.548)	(9.078)	(13.406)	(12.640)
Antismoking sentiment	−26.617	−23.071*	−28.142	−23.263
	(33.723)	(12.787)	(32.296)	(35.873)
Age	8.280***	7.857***	8.096***	8.074***
	(1.312)	(1.471)	(1.292)	(1.241)
Male	15.803***	13.220***	15.562***	15.458***
	(3.263)	(3.850)	(3.265)	(3.238)
Parental smoking	8.705***	7.506***	8.697***	8.779***
	(2.175)	(2.900)	(2.141)	(2.163)
Pocket money	14.087***	13.847***	13.482***	13.677***
	(4.205)	(4.875)	(4.194)	(4.219)
ln GDP per capita	2.042	5.550	−4.369	1.628
	(8.106)	(7.691)	(12.393)	(7.134)
N	31,481	31,481	31,948	31,948

Standard errors in parentheses. Standard errors clustered at the survey site. All models include year dummies and country dummies.
* $p < .1$, ** $p < .05$, *** $p < .01$.

indicate that the positive relationship between smoking participation and advertising exposure initially observed in Specification 1 is largely driven by the disproportionately higher propensity of smokers to observe advertising. The relationship between smoking participation and the aggregate advertising exposure rate among nonsmokers in Specification 3 has the expected positive sign but is not statistically significant. Similarly, we are unable to establish that a significant relationship exists between advertising bans and youth smoking participation in Specification 4.

As seen in Table 4, we find that none of our advertising measures statistically affects conditional cigarette demand among smokers, and half the time they do not have the expected sign. We are therefore unable to conclude that preventing youth smokers in our sample from observing ads would cause them to smoke fewer cigarettes.

In both parts of the model and in almost all specifications, cigarette prices are estimated to be a more statistically significant driver of smoking than advertising. Although antismoking sentiment plays a statistically significant role in determining smoking participation among youth, it does not impact how many cigarettes are smoked once the decision to smoke has been made. Prices, however, stand out as a statistically strong determinant of conditional cigarette demand among smokers. Individual demographic characteristics have strong explanatory power in the expected direction: cigarette demand increases with age, male gender, having a parent who smokes, and having pocket money.

V. CONCLUSION

This research evaluates the impact of cigarette advertising on smoking among youth in 19 developing countries. We evaluate the influence of advertising from multiple angles, estimating, alternatively, the effect of individual advertising exposure, the effect of the local aggregate rate of advertising exposure, and the effect of comprehensive advertising bans. Depending on the source of endogeneity, we control for the endogeneity of advertising through instrumental variables, two-way country fixed effects, and accounting for antismoking sentiment.

Antismoking sentiment impacts the decision to smoke or not but does not appear to determine how many cigarettes are smoked in the aftermath of that decision. We find that the increased likelihood of smokers to observe advertising is likely to explain the positive association between advertising exposure and cigarette demand, and that cigarette prices are substantially more likely to influence youth demand than advertising exposure or regulation. Although Blecher (2008) and Saffer and Chaloupka (2000) find in a macro-level empirical setup that strong advertising restrictions can reduce aggregate cigarette consumption in developing and developed countries, similar to Nelson (2003b) we are unable to establish this at the micro level for the youth in our sample, and are unable to confirm causality in the positive association between local advertising prevalence and youth smoking in Kostova et al. (2011). Our findings may not be representative of the overall advertising effect for several reasons. First, our sample is restricted to only the youngest of youth and does not encompass adult behavior. Second, this study is strictly a model of cigarette demand and as such it evaluates only the direct impact of advertising on market demand. It does not evaluate the indirect effect of advertising restrictions—the effect advertising restrictions wield on cigarette demand by changing the equilibrium price from the supply side.

While the indirect effect of advertising restrictions is beyond the scope of this analysis, it can and has been explored in a general equilibrium setting. Based on U.S. data, Iwasaki, Tremblay, and Tremblay (2006) show in a general equilibrium framework that the indirect effects of advertising regulation dominate the direct market effects, and that advertising bans end up reducing equilibrium consumption by decreasing price competition among tobacco suppliers rather than by lowering market demand among consumers. While extrapolating this evidence to developing countries must be done with caution, it shows that even as market demand equations such as the ones in this paper fail to present evidence of a strong advertising ban impact on market demand, the bans could still impact equilibrium consumption as decreased price competition in the cigarette market sustains a higher price level (Farr, Tremblay, and Tremblay 2001; Gallet 2003; Iwasaki, Tremblay, and Tremblay 2006).

We find that cigarette prices have a stronger direct effect than advertising on reducing youth demand for cigarettes. This finding has nontrivial policy implications, particularly in situations when tobacco policy makers have to make a choice between raising cigarette taxes and restricting cigarette advertising. Although advertising bans reduce the marketing freedom of cigarette producers, it has been shown that advertising bans may also benefit cigarette producers by restricting opportunities for competition, increasing market power, and discouraging price wars (Farr, Tremblay, and Tremblay 2001; Gallet 2003; Iwasaki, Tremblay, and Tremblay 2006). Thus, higher prices that are achieved indirectly through advertising restrictions are likely to be more profitable to tobacco companies than higher prices achieved directly through taxation. The evidence, therefore, suggests that taxation should be the primary tool of tobacco control policy with advertising restrictions playing a supplementary role, and that advertising restrictions may be best applied concurrently with increased tobacco taxation to avoid redistribution of welfare from consumers to tobacco producers.

REFERENCES

Avery, R., D. Kenkel, D. Lillard, and A. Mathios. "Private Profits and Public Health: Does Advertising Smoking Cessation Products Encourage Smokers to Quit?" *Journal of Political Economy*, 115(3), 2007, 447–81.

Bertrand, M., E. Duflo, and S. Mullainathan. "How Much Should We Trust Difference-in-Differences Estimates?" *Quarterly Journal of Economics*, 119(1), 2004, 249–75.

Blecher, E. "The Impact of Tobacco Advertising Bans on Consumption in Developing Countries." *Journal of Health Economics*, 27(4), 2008, 930–42.

Decicca, P., D. Kenkel, A. Mathios, Y. Shin, and J. Lim. "Youth Smoking, Cigarette Prices, and Anti-Smoking Sentiment." *Health Economics*, 17(6), 2008, 733–49.

Farr, S. J., C. Tremblay, and V. Tremblay. "The Welfare Effect of Advertising Restrictions in the U.S. Cigarette Industry." *Review of Industrial Organization*, 18(2), 2001, 147–60.

Gallet, C. "Advertising and Restrictions in the Cigarette Industry: Evidence of State-by-State Variation." *Contemporary Economic Policy*, 21(3), 2003, 338–48.

Heckman, J., F. Flyer, and C. Loughlin. "An Assessment of Causal Inference in Smoking Initiation Research and a Framework for Future Research." *Economic Inquiry*, 46(1), 2008, 37–44.

Iwasaki, N., C. Tremblay, and V. Tremblay. "Advertising Restrictions and Cigarette Smoking: Evidence from Myopic and Rational Addiction Models." *Contemporary Economic Policy*, 24(3), 2006, 370–81.

Kostova, D., H. Ross, E. Blecher, and S. Markowitz. "Is Youth Smoking Responsive to Cigarette Prices? Evidence from Low- and Middle-Income Countries." *Tobacco Control*, 20(6), 2011, 419–24.

Manning, W., and J. Mullahy. "Estimating Log Models; to Transform or Not to Transform." *Journal of Health Economics*, 20(4), 2001, 461–94.

Markowitz, S. "The Effectiveness of Cigarette Regulations in Reducing Cases of Sudden Infant Death Syndrome." *Journal of Health Economics*, 27(1), 2008, 106–133.

Mullahy, J. "Much Ado about Two; Reconsidering Retransformation and the Two-Part Model in Health Econometrics." *Journal of Health Economics*, 17(3), 1998, 247–81.

Nelson, J. "Cigarette Demand, Structural Change, and Advertising Bans: International Evidence, 1970-1995." *Contributions to Economics Analysis and Policy*, 2(1), 2003a, 1–27.

———. "Youth Smoking Prevalence in Developing Countries: Effect of Advertising Bans." *Applied Economics Letters*, 10(13), 2003b, 805–11.

———. "Cigarette Advertising Regulation: A Meta-analysis." *International Review of Law and Economics*, 26(2), 2006, 195–226.

Royston, P. "Multiple Imputation of Missing Values." *The Stata Journal*, 4(3), 2004, 227–41.

Rubin, D. B. *Multiple Imputation for Nonresponse in Surveys.* New York: J. Wiley & Sons, 1987.

Saffer, H., and Chaloupka, F. J., "The Effect of Tobacco Advertising Bans on Tobacco Consumption." *Journal of Health Economics*, 19(6), 2000, 1117–37.

Shafey, O., S. Dolwick, G. E. Guindon. *Tobacco Control Country Profiles.* 2nd ed. Atlanta: American Cancer Society, 2003.

Shafey, O., M. P. Eriksen, H. Ross, and J. Mackay. *The Tobacco Atlas*. Atlanta, GA: American Cancer Society, 2006.

Tauras, J. "An Empirical Analysis of Adult Cigarette Demand." *Eastern Economic Journal*, 31(3), 2005, 361–75.

———. "Smoke-Free Air Laws, Cigarette Prices, and Adult Cigarette Demand." *Economic Inquiry*, 44(2), 2006, 333–42.

World Health Organization. "WHO Report on the Global Tobacco Epidemic." 2011.