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Investigating the Effects of Excise Taxes, Public Usage Restrictions, and Antismoking Ads Across Cigarette Brands

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Abstract

The prevalence of strong brands such as Coca-Cola, McDonald's, Budweiser, and Marlboro in "vice" categories has important implications for regulators and consumers. While researchers in multiple disciplines have studied the effectiveness of antitobacco countermarketing strategies, little attention has been given to how brand strength may moderate the efficacy of tactics such as excise taxes, usage restrictions, and educational advertising campaigns. In this research, the authors use a multiple discrete-continuous model to study the impact of antismoking techniques on smokers' choices of brands and quantities. The results suggest that although cigarette excise taxes decrease smoking rates, these taxes also result in a shift in market share toward stronger brands. Market leaders may be less affected by tax policies because their market power allows strong brands such as Marlboro to absorb rather than pass through increased taxes. In contrast, smoke-free restrictions cause a shift away from stronger brands. In terms of antismoking advertising, the authors find minimal effects on brand choice and consumption. The findings highlight the importance of considering brand asymmetries when designing a policy portfolio on cigarette tax hikes, smoke-free restrictions, and antismoking advertising campaigns.

Keywords

advertising, antismoking, cigarette excise taxes, cigarette marketing, smoke-free restrictions, public policy

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While the goal of marketing is usually to boost purchase rates and strengthen relationships between consumers and brands, countermarketing is an increasingly common strategy for reducing the consumption of "vice" goods such as cigarettes. Countermarketing activities may include excise taxes that increase consumer costs, usage constraints that restrict public consumption, and advertising that highlights product dangers. Cigarette countermarketing has seemingly been effective, as U.S. smoking rates have dropped from 44% in 1950 to 14% in 2011 (Centers for Disease Control and Prevention [CDC] 2017). In addition, countermarketing is now increasingly applied in other categories that may create health risks, such as soft drinks and fast food (Khan, Misra, and Singh 2016).

A notable feature of many "vice" categories is that they are dominated by very strong or high-equity brands. For example, the Interbrand Top 100 brands list has often included Coca-Cola, McDonald's, Budweiser, and Marlboro. However, economic and public health research on countermarketing effectiveness has largely ignored the role of brands. This is an oversight in that the perceived importance of branding and marketing is demonstrated by advocacy groups' and regulators' efforts to limit brand advertising. Although almost all previous branding research has focused on the value of strong brands in forming and maintaining brand–consumer relationships, it is reasonable to speculate that strong brands might also affect the efforts of advocacy groups and regulators to disrupt these relationships and reduce consumption.

The marketing literature discusses a variety of benefits that accrue to strong brands. Strong brands may have advantages in terms of increased customer loyalty, diminished price sensitivity, wider distribution, heightened consumer awareness, and other benefits (Aaker 1996; Agarwal and Rao 1996). For example, brands may provide symbolic benefits that increase the

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value of public consumption, and there may be strong psychological bonds between a brand and its customers (Fournier 1998). Furthermore, stronger brands might enjoy greater channel power that results in wider distribution and customer awareness. A prominent example of an effort to reduce brand power is the Australian government's attempt to limit the influence of branding through mandating plain packaging without any iconography for tobacco products starting in December of 2012 (Bonfrer et al. 2020; Wakefield et al. 2015).

An important aspect of the literature on branding is that brand strength may be manifested through different mechanisms. Critically, the different dimensions of brand strength may protect brands against or make brands more vulnerable to specific countermarketing tactics. For instance, if brands provide benefits by conveying status or glamor, the most effective regulations may be different than if brand strength involves deeper psychological bonds that influence loyalty or price sensitivity. This insight highlights the importance of including brand-level effects for alternative countermarketing activities in an empirical specification.

Our research investigates how the interplay between branding and countermarketing activities influences consumers' consumption of cigarettes. The tobacco industry provides an important and useful context for our research for several reasons. First, tobacco consumption causes significant economic costs and adverse health consequences. Cigarette smoking has been estimated to cause 480,000 premature deaths each year in the United States, and it imposes health care costs and productivity losses of about $300 billion each year (CDC 2014). Second, this industry has been the target of a significant amount of countermarketing activities that affect consumer decision making. For instance, taxes increase consumer prices, smoking bans make public consumption less convenient, and educational advertising campaigns highlight adverse health consequences. In addition, as countermarketing tactics are largely determined at the state level in the United States, there is a significant variation in policies across states. This variation facilitates identification of the effectiveness of different countermarketing techniques. Third, advocacy groups and regulators are currently using experience from the tobacco category to guide efforts in other categories. For example, there is significant interest in using countermarketing techniques to reduce obesity (Khan, Misra, and Singh 2016; Ma, Ailawadi, and Grewal 2013; Seiler, Tuchman, and Yao 2021; Talukdar and Lindsey 2013). Fourth, differences in brand equity in the cigarette category afford an opportunity to study the interplay between countermarketing techniques and brand power.

Vice categories such as cigarettes are also of interest because they highlight the existence and incentives of diverse stakeholders within a category. These diverse perspectives are relevant to consider because groups with different goals may adjust strategies in response to different regulatory approaches. For instance, the literature on countermarketing (Chaloupka and Warner 2000) has primarily focused on the effectiveness of regulations in reducing smoking. This perspective is concerned with identifying successful tactics for regulators by tallying smoker quit rates. While these analyses are important, they are incomplete. In addition to quit rates, governments may be interested in the impact of policies on tax revenues, and consumers may suffer economic consequences.

Beyond regulators and consumers, brand manufacturers are often overlooked as relevant participants in the category. This omission affects our knowledge on two aspects of this issue. First, firms wish to select the most effective strategies for their environment. Second, firms and brands vary in terms of their characteristics, distribution strength, and awareness. These factors may lead to different regulatory tactics with asymmetric effects across the category. For example, some brands may have pricing or distributional power that allows them greater flexibility in managing the tax pass-through to consumers. Policies that limit the public consumption of cigarettes may also be relevant because cigarettes have long been considered a prototypical example of a badge product, one used to project social status (Balmford, Borland, and Yong 2016). Thus, prohibitions on public consumption may vary in effectiveness on the basis of brand strength. How different dimensions of brand strength influence the effectiveness of countermarketing techniques remains an open research topic.

To investigate the relationship between branding and countermarketing, we assemble a data set that includes a consumer panel of cigarette purchases for a six-year period from 2005 to 2010, retail scanner data from 2006 to 2010, and a comprehensive data set on state-level cigarette taxes, state-level smoke-free restrictions, and national antismoking advertising campaigns. We conduct our analysis using a multiple discrete-continuous choice model of smokers' monthly brand and quantity decisions. Our empirical specification is designed to evaluate if and how cigarette excise taxes, smoke-free restrictions, and antismoking advertising campaigns influence cigarette purchase decisions asymmetrically across a variety of brands and composites of brands based on price tier. Our research also includes an analysis of tax pass-through, highlighting the role of brand positioning and channel characteristics. The pass-through analysis is used in a series of counterfactual simulations that assess the full effects of alternative countermarketing techniques across different stakeholders.

Our results show that the effects of antismoking interventions vary significantly across brands. For example, the demand model reveals that Marlboro is relatively less affected by tax increases but relatively more affected by usage restrictions. The resistance to taxes is driven by Marlboro's ability to pass through less of the tax increases than most other brands. This effect may be due to market share based on economies of scale or distribution strength that leads retailers to limit price increases of their highest-volume brand. In the case of usage restrictions, results show that high-equity brands incur more negative effects, and our speculation is that public prohibitions make it more difficult for consumers to garner symbolic or image-based benefits through consumption of high-equity

brands. In regard to antismoking advertising, we find that these communications have relatively little effect overall but do have a slightly above-average impact on Marlboro. In terms of category evolution, our results offer an explanation for why Marlboro's relative market share has increased dramatically over time. During our observation window, cigarette excise taxes almost doubled. This aggressive tax policy has shifted demand toward the category leader.

We conduct a series of policy experiments to assess the differential effects of alternative countermarketing policies across stakeholders including regulators, consumers, and brands. We find that a 100% tax increase yields a 30% increase in quit rate, but it imposes significant costs to consumers and only increases tax receipts by about 28%. In contrast, an aggressive smoke-free policy increases quit rates by 9% and reduces tax revenues by 6%. With usage restrictions, consumers may experience inconvenience and reduced symbolic benefits but do not incur economic costs. In general, we find that stronger brands tend to be more resilient to tax increases and more susceptible to usage restrictions. Collectively, our simulations show that the choice of countermarketing tactics greatly impacts relative quit rates, consumer costs, government revenues, and brands' market shares.

Conceptual Foundations

To frame our research, we consider selected literature on countermarketing from the fields of economics, public health, and marketing. Economics and public health have significant traditions of studying countermarketing effectiveness, and these disciplines typically rely on surveys rather than actual customer behavior; therefore, marketing issues are usually neglected. The marketing literature focused on tobacco countermarketing has used a variety of experimental and empirical methods to examine consumer response to countermarketing. In addition to research on tobacco control, we also review literature related to the possible interactions between countermarketing and branding. In our review, we put explicit focus on branding topics that may lead to asymmetric effects of countermarketing tactics for stronger versus weaker brands.

Antismoking Interventions

The economics literature on smoking has relied on large-scale surveys and reduced-form models to investigate the role of individual countermarketing tactics on consumption (Chaloupka 1991; Coppejans et al. 2007; e.g., Becker, Grossman, and Murphy 1994). Of the various countermarketing instruments, excise taxes and pricing have received the most attention in the economics literature. Cigarette excise taxes are implemented at the pack level and are included in retail prices (Chetty, Looney, and Kroft 2009). These taxes typically include a federal and state component. In general, researchers have found that excise taxes have a significant impact on smoking rates. The price elasticity of cigarette demand is generally found to be about −.4 (see Chaloupka and Warner 2000).

Antismoking advocates have been increasingly successful in implementing "smoke-free" restrictions such as prohibitions against smoking in bars, restaurants, and public places. These interventions reduce convenience and increase time costs by forcing smokers outdoors. Smoke-free restrictions have increased in prevalence over time. In the year 2000, approximately 50% of the U.S. population was potentially affected by clean-air smoking policies. By 2008 this percentage had grown to over 70%. Research on smoke-free air policies has yielded mixed results. Evans, Farrelly, and Montgomery (1999) find that voluntary workplace restrictions lead to minor reductions in smoking. Bitler, Carpenter, and Zavodny (2010) and Adda and Cornaglia (2010) find that smoke-free laws have no impact on smoking behavior. However, these studies all rely on self-reports collected via surveys.

There is a significant literature on the impact of marketing communications on cigarette purchases. For example, Pollay et al. (1996) find that cigarette brand advertising elasticity is .28. Several marketing studies provide lab-based experimental evidence on the effectiveness of antismoking ad messages (Andrews et al. 2004; Pechmann and Shih 1999; Pechmann et al. 2003). For example, Pechmann and Shih (1999) use experimental methods to study how smoking scenes in movies elicit different emotional reactions depending on whether an antismoking message was shown before the film. Other research attempts to quantify the relationship between levels of antismoking advertising and quitting behaviors. Wakefield et al. (2008) show that an increase of 390 monthly gross rating points leads to a .3% decline in smoking prevalence in Australia. Farrelly et al. (2012) claim that an increase of 5,000 gross rating points annually increases the odds of quit attempts by 21% in New York City.

There is also a growing marketing literature that evaluates consumer-level purchasing data. In terms of pricing and taxes, Chen, Sun, and Singh (2009) examine the effect of Marlboro's permanent 1993 price cut on brand choice; Gordon and Sun (2015) investigate the elasticity of demand for temporary versus permanent price adjustments. Gordon and Sun find that short-term price elasticity is smaller than the long-term elasticity. While these marketing studies illustrate the roles of pricing and promotion on brand-tier choice and incidence, they consider only limited elements of countermarketing. Wang, Lewis, and Singh (2016) investigate the relative effectiveness of cigarette excise taxes, antismoking advertising, and smoke-free restrictions on category sales. They examine the consequences of the countermarketing mix on product substitution among products with varying nicotine levels but do not consider branding effects. In general, this literature pays little attention to the issues of branding and consumer loyalty. In a notable exception, Bonfrer et al. (2020) use secondary data to measure the causal effect of the Australian antibranding legislation at both the cigarette category level and the brand-strength tier level. They find that the elimination of branding

elements results in greater price sensitivity to increases for premium and mainstream brands.

Some research investigates the impact of countermarketing on other categories. Goli and Chintagunta (2018) measure the cross-category spillover effects of selling tobacco products on the revenue generated by nontobacco categories. In addition to tobacco, there is growing interest in using countermarketing techniques to reduce obesity (Khan, Misra, and Singh 2016; Ma, Ailawadi, and Grewal 2013; Seiler, Tuchman, and Yao 2021; Talukdar and Lindsey 2013).

Branding and Asymmetric Response

The literature on smoking cessation has largely ignored the impact of branding on efforts to reduce cigarette consumption. This is an oversight given that marketing researchers have found that brand–consumer relationships have significant effects on consumer decision making (Ailawadi, Lehmann, and Scott 2003; Fournier 1998; Keller and Lehmann 2006). The Australian plain tobacco packaging policy has yielded significant results related to the importance of packaging and branding. For example, Dunlop et al. (2014) find that the elimination of branding elements reduces the perceived attractiveness of cigarette packages and affects brand choice. They find that eliminating branding reduces consumer perceptions that the look of their cigarette package "says something good about them" or "is fashionable." In addition, Wakefield et al. (2015) find that the health-oriented warnings mandated by the Australian policy result in an increase in smokers concealing or hiding packages.

A negative link between removing visual branding elements and consumption intentions is intuitive. Cigarettes have often been referred to as badge products, as cigarette consumption frequently involves displays of branded packages in public settings such as bars and nightclubs. There are multiple streams of the marketing literature relevant to the value a badge brand may give a consumer. Holt (2002) discusses how brands can act as vehicles for expressing psychological and social traits. Keller (1993) suggests that brands provide a means for consumers to express their self-concepts. For instance, consumers might choose Marlboro to associate the rugged brand image with themselves (Aaker 1997).

Brands can also serve as a focal point for communities of consumers (McAlexander, Schouten, and Koenig 2002; Muñiz and O'Guinn 2001). Brand communities are groups largely based on admiration and preference for a focal brand. For these communities to exist, consumption and brand preferences must be publicly expressed so that members can identify each other. A notable example of a consumption community built around a cigarette brand was Marlboro Lights in the U.K. market. The economics literature also includes work that emphasizes the social-signaling benefits of conspicuous consumption (Bagwell and Bernheim 1996).

The role of brands as instruments for expressing self-identity or as a focal point for a consumption community is potentially relevant to the effectiveness of smoke-free air policies. These policies are primarily designed to limit cigarette consumption in public venues. By limiting public consumption, these policies may limit the value that brands provide to consumers. However, there remains an outstanding question as to whether the impact of such policies will vary across types of brands if some brands provide greater symbolic benefits.

Brand strength may also operate through other mechanisms that affect how tax increases are passed through to consumers by the retailer. Specifically, tax increases may have differential effects across brand price tiers due to differences in price sensitivity and distribution channel power (Aaker 1996). First, higher-equity brands may be more able to pass through greater percentages of tax increases simply because consumers are less price-sensitive for these brands. In fact, given that taxes will tend to shrink the entire category, it is possible that stronger brands may even choose to implement price increases to make up for lost volume. Second, if stronger brands charge higher prices than other brands, then imposing constant per pack taxes will result in lower percentage price increases. Third, awareness and broad distribution may offer benefits in terms of larger market shares and economies of scale—advantages that can accrue to higher-equity brands if retailers wish to maintain prices on especially important brands within a category.

The addictive nature of cigarettes carries its own implications for the design of a consumer demand model. Because nicotine is an addictive substance, much of the repeat buying of cigarettes is driven by physical addiction. However, it is also possible that some type of attitudinal loyalty exists in the category. The key point is that in a category such as cigarettes that includes powerful brands, purchase feedback effects such as brand loyalty, satiation rates, and addiction effects need to be included in any empirical specification.

Summary and Model-Specification Implications

The review of the existing literature on antismoking effectiveness highlights several salient empirical issues and research gaps. Researchers have investigated the effects of taxes, usage restrictions, and negative advertising. However, these variables have seldom been evaluated simultaneously, and there is still debate about the effectiveness of interventions such as smoke-free restrictions. Therefore, it is critical that any empirical specification include the complete set of countermarketing tactics.

The discussion of branding and consumer issues highlights key considerations for an empirical specification. In terms of branding, the cigarette category includes many brands that vary in terms of price, market share, brand personality, and distribution power. As discussed previously, there are theoretical reasons to believe that different types of brands may be differentially affected by alternative policy interventions. There are also important aspects of brand loyalty that need to be incorporated in an empirical specification. For example, brand loyalty and other purchase feedback effects may be

relevant for modeling brand choice. Even basic elements of consumer choice such as whether consumers purchase single or multiple brands need to be considered.

Data

Our research objectives necessitate the use of multiple data sets. To understand consumer-level decisions about brand choices and quantity consumed over time, we use panel data of individual smoker purchases. Given the large number of brands in the category, we supplement the individual-level data with market-level data to identify the price environment faced by consumers. To study the effects of countermarketing, we assemble information on taxes, antismoking ads, and smoke-free restrictions from governmental agencies and nongovernmental organizations.

Smoker Panel Data and Retail Scanner Data

The individual smoker panel for our study is from the Nielsen Consumer Panel for the six-year period between January 2005 and December 2010.[1] The Consumer Panel provides each household with an optical scanner for scanning the barcodes of all consumer packaged goods they purchase, regardless of the outlet. The data, therefore, include purchases from supermarkets, convenience stores, drug stores, gas stations, and other outlets. This broad coverage is important because, unlike the product categories often studied in the literature (i.e., those primarily sold in supermarkets), smaller retail outlets account for a significant proportion of cigarette sales.

We select a sample of smokers for our study by applying the following ordered criteria: (1) keep only single smokers that stayed in the Nielsen Consumer Panel for all six years, (2) keep smokers that made at least 20 cigarette purchases, and (3) keep smokers that had cigarette purchases in 2005, the beginning of our observation window. The three selection criteria result in a panel of 422 single smokers that were potentially in the process of quitting smoking or did quit smoking over the six-year period. We use 2005 as an initialization period and the years 2006–2010 for estimation.

Table 1 shows that approximately 22% of smokers quit smoking, where quitting is defined as individuals with no purchases during the final 12 months of the observation window. The median cigarette purchase interval is about once per month. On average consumers purchase 23 packs and spend an average of $75 on cigarettes per month. To ensure representativeness, we cross-validate our sample's demographics and cigarette consumption patterns against the 2009–2010 CDC National Adult Tobacco Survey. We show in Web Appendix W1 that the 422 single smokers in our estimation sample had similar demographic distributions[2] and consumption levels as those in the CDC National Survey.

Table 1. Smoker Cigarette-Purchase Summary.

	Mean (SD)	Median
Quit rate	22.27%	—
Purchase interval (in months)	1.69 (1.41)	1.20
Monthly cigarette spending (cond. on purchase)	75.74 (55.99)	63.64
Monthly cigarette packs (cond. on purchase)	22.68 (16.17)	20.05

Notes: Quitting is defined as no cigarette purchase during the final 12 months of the observation window.

A primary benefit of the Consumer Panel is that we can observe consumers' brand and quantity choices. However, the 422 smoker panelists purchased more than 170 cigarette brands. We use the following approach to facilitate the analysis: First, we select the top four cigarette brands (in terms of purchase volume) within our purchase panel: Marlboro, Basic, Winston, and Virginia Slims. Next, we aggregate the remaining brands into three categories—premium, mainstream, and economy—on the basis of average national retail price (see Web Appendix W2).

To implement the brand categorization scheme, we obtain information on cigarette prices and quantities sold at the Universal Product Code/store/week level between January 2006 and December 2010 from the Nielsen Retail Scanner Data. We construct brand-level data at the monthly level for each store by aggregating the Universal Product Code–level data at a set of 3,874 retail stores across 46 states. These stores are selected because they have complete price and sales information for the four brands and three price-tier categories. Table 2 presents the average prices of the four individual brands and the three categories of brands. The average price differentials between premium and mainstream brands, and between the mainstream and economy brands, are $.70. Marlboro, Basic, and Winston are priced similarly to the mainstream brand category, while Virginia Slims is priced similarly to the premium category.

Table 2 also includes data on brand choice and consumption. In Table 2 and the other exhibits in this section, all results related to price are from the 3,874-store Retail Scanner Data, and all results related to brand choice and consumption are calculated using the 422 smokers in the Consumer Panel. In terms of choice, the mainstream category has the highest monthly choice probability at 20%, followed by Marlboro at 15%, economy brands at 13%, and premium brands at 12%. Basic, Virginia Slims, and Winston have choice probabilities of less than 6%. Conditional on brand choice, smokers typically purchase in the range of 20 to 30 packs per month. There is some variation in the average brand purchase quantity. Winston and the economy brands are purchased in slightly larger quantities. The multiplication of brand choice

[1] We chose the observation window 2005–2010 to include the significant federal tax hike in April 2009. It is also a period when electric cigarettes were yet to be a significant part of the nicotine delivery market.

[2] The only difference is that our estimation sample has a larger proportion of senior panelists older than 65 years.

Table 2. Cigarette Brand Prices and Purchases.

	Per Pack Price ($)	Monthly Brand Choice Prob.	Monthly Purchased Packs Conditional on Brand Choice	Unconditional Brand Share
Marlboro	4.251 (1.156)	15.23%	21.180 (18.377)	19.49%
Basic	4.194 (1.283)	5.71%	20.601 (15.878)	7.11%
Virginia Slims	4.797 (1.307)	4.65%	20.828 (16.103)	5.85%
Winston	4.295 (1.221)	3.47%	27.301 (20.012)	5.72%
Premium tier	4.867 (1.183)	11.70%	20.260 (19.397)	14.33%
Mainstream tier	4.103 (1.134)	19.89%	21.644 (19.361)	26.02%
Economy tier	3.563 (1.131)	13.14%	27.055 (23.051)	21.48%

Notes: Standard deviations are in parentheses. "Monthly brand choice probability" refers to the probability a brand will be chosen in the estimation sample, and "monthly packs" refers to the number of packs conditional on purchase. The multiplication of brand choice probabilities and conditional brand purchase quantity provides the unconditional brand shares among the seven brands.

probabilities and conditional brand purchase quantity provides the unconditional brand shares among the seven brands.

The figure in Web Appendix W3 gives additional insight by illustrating the distribution of consumption levels and brand shares for different monthly consumption levels. It shows that conditional on buying any cigarettes, 28% of smokers buy more than 30 packs per month, 22% buy between 20 and 30 packs, 28% buy between 10 and 20 packs, and 22% purchase fewer than 10 packs. Conditional on monthly purchase quantities, the relative brand shares across the seven brand categories vary. Notably, Marlboro captures a substantial share at all levels of consumption. This implies that Marlboro is the dominant brand among both casual and regular smokers.

Web Appendix W4 presents data related to brand loyalty and switching. If we define the category in terms of the seven brands and brand categories, Web Appendix W4a shows that over the five years of the data window, 30% of smokers stick with one brand, 28% have purchased only two brands, and about 41% have purchased more than two brands.

Web Appendix W4b explores whether multiple brand purchases occur within a month or over time. In 89% of months, smokers purchase only one out of seven cigarette brands. In the other 11% of months, they purchase two or more cigarette brands. Therefore, although the majority of brand switching happens over time, multibrand purchasing within a month is still meaningful. Web Appendix W4c shows that 60% of smokers engage in multiple brand purchases within a month at some point over the observation window. This pattern suggests a need for our demand model to accommodate multiple brand purchase and quantity decisions within a decision period.

Antismoking Measures

Our investigation's critical interventions are countermarketing tactics such as cigarette excise taxes, smoke-free restrictions, and antismoking advertising. Figure 1 shows the evolution of cigarette purchases for the sample of 422 single smokers and the three countermarketing programs' levels over time. Specifically, Figure 1, Panel A, shows that cigarette consumption declines over time for the sample. The average monthly purchase quantity drops from 20 packs in 2006 to 10 packs in 2010.

Cigarette excise taxes are from the "Tax Burden on Tobacco" report (Orzechowski and Walker 2018), which collects detailed information on federal, state, and local tax rates and effective dates. Figure 1, Panel B, and Table 3 show the evolution of the taxes faced by panelists. The jump in taxes during 2009 is from an increase in the federal tax from $.39 to $1.01 per pack in April 2009. The other changes in taxes are due to changes in state and local taxes.

To measure smoke-free restrictions, we collected smoke-free air policy information for eight common venues defined as restaurants, bars, hospitals, private workplaces, government workplaces, grocery stores, hotels, and motels from the CDC's state tracking studies. In each venue, smoke-free restrictions are assigned one of two values: 0 for no restriction and 1 for a complete restriction. We sum the number of smoke-free restrictions in the eight venues to describe a state's smoke-free restriction level. Figure 1, Panel C, shows the evolution of smoke-free restrictions. Smoke-free restrictions dramatically increased between 2006 and 2008.

We also obtained the U.S. monthly spending on antismoking campaigns from Kantar Media. Figure 1, Panel D, shows nationwide monthly spending on antismoking advertising. This figure highlights a significant antismoking advertising campaign that accompanied the federal tax hike in 2009. Overall, expenditures on antismoking ads averaged $535,932 per month over the observation period.

We use zip codes to match the taxes and smoke-free restrictions to each smoker. For simplicity, we assume that a smoker purchases only from stores located in the same state where they live and that match the federal, state, and local cigarette excise taxes, respectively. Smoke-free restrictions are matched to each smoker on the basis of the state where they live. The 422 single smokers in our estimation sample cover 46 states. There is substantial variation in the two tactics across states and over time. At the start of our observation window, the tax per package varied from a low of $.46 in South Carolina to a high of $3.30 in New York. At the end of 2010, tax per package varied from $1.18 in Missouri to $6.86 in New York. In terms of smoke-free restrictions, there were relatively few restrictions at the start of the data window. However, by the end of 2010, 19 of the 46 states had complete smoking bans in all eight venues.

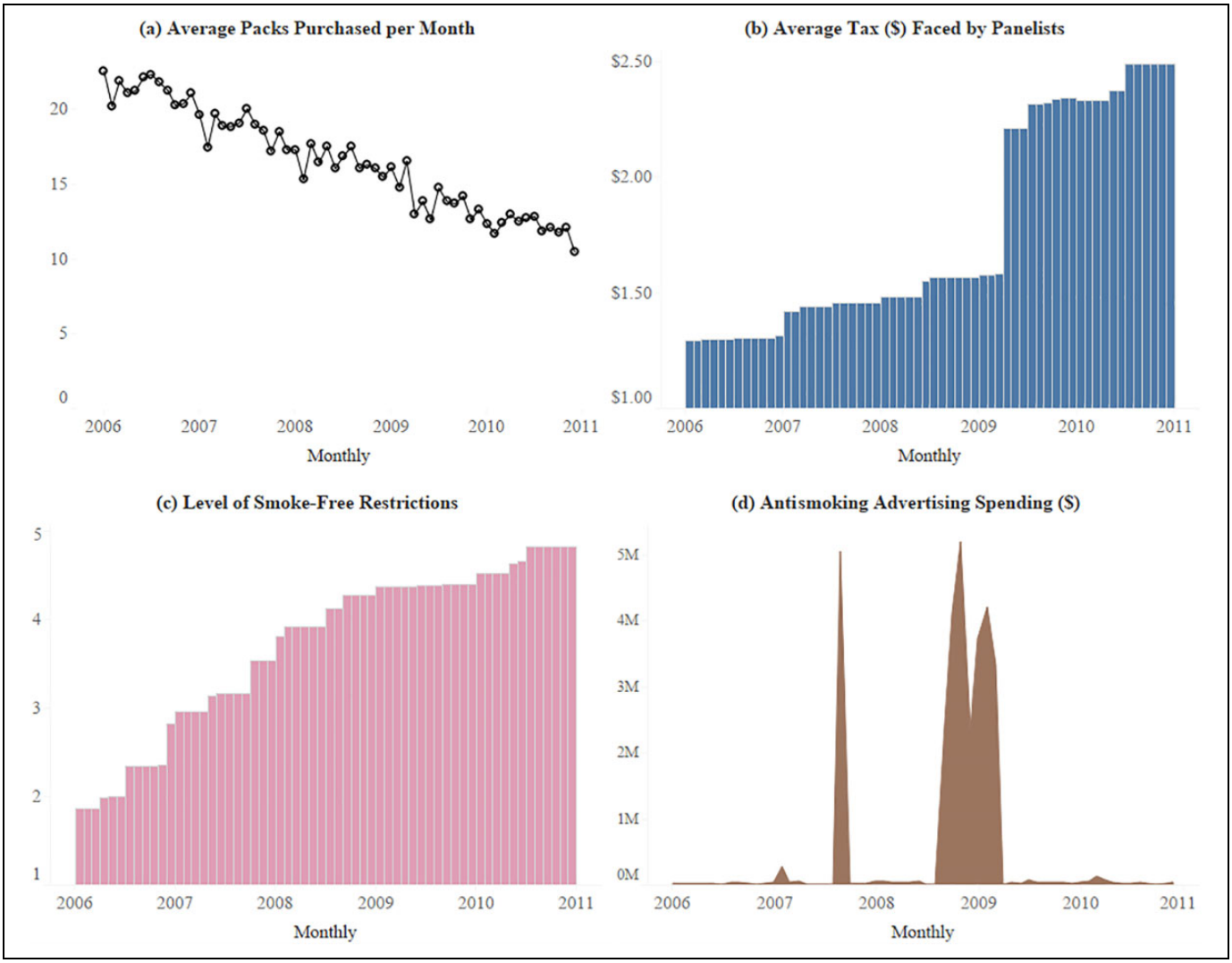

Figure 1. Purchased quantities and antismoking techniques over time.
Notes: Panel A illustrates the unconditional number of packs per month. In Panel C, smoke-free restrictions are enforced in part or all of the eight locations including restaurants, bars, hospitals, private workplaces, government workplaces, grocery stores, hotels, and motels.

Model-free evidence related to the relationship between countermarketing and branding is also possible. For example, based on the Nielsen retailer scanner data, the figure in Web Appendix W5 shows that every state increased its per pack tax rates over the five-year observation window and that the market share of Marlboro also increased in almost all states over the five years. For example, in South Carolina, Marlboro's market share increased by 51% as the state per pack tax rates increased by $4.47. Web Appendix W5 also plots the distribution of Marlboro's market shares by year and shows increases over time in response to greater taxes. These analyses suggest asymmetric effects of antismoking techniques across brands, with the market leader consistently gaining share as taxes increase.[3]

Model

We use a multiple discrete-continuous choice model (Bhat 2008, 2018; Shriver and Bollinger 2017; Thomassen et al. 2017) to model smokers' monthly cigarette purchase-quantity decisions within the seven brand categories. The model provides a parsimonious structural approach for investigating the purchase of multiple combinations of brand choices and quantities. The analysis quantifies the effect of the three antismoking techniques on brand choices and purchase quantities while allowing for the possibility of asymmetric effects across brands.

[3] In Web Appendix W6 we further examine situations where smokers encountered changes in taxation rates and smoking restrictions due to migration across states. The migration sample is different from the estimation panel as we do not require a six-year panel. Instead, we only require the smokers to be in the Nielsen consumer panel one year before and after the move. The migration sample shows that when taxes increase, there is a shift toward high-price-tier brands, while an increase in smoke-free restrictions results in a decrease in the consumption of Marlboro.

Table 3. Antismoking Techniques Summary.

Variable	Mean	SD	Min	Max	N
Tax per pack ($)	1.762	.902	.460	6.860	25,320
Federal tax per pack ($)	.607	.296	.390	1.010	25,320
State tax per pack ($)	1.118	.728	.070	4.350	25,320
County tax per pack ($)	.032	.225	0	2.000	25,320
City tax per pack ($)	.004	.053	0	.68	25,320
Smoke-free restriction level	3.702	3.573	0	8	25,320
Antismoking ads ($)	535,932	1,331,248	0	5,191,064	25,320

Notes: Smoke-free restrictions are enforced in part or all of the eight locations (restaurants, bars, hospitals, private workplaces, government workplaces, grocery stores, hotels, and motels).

As there are J brands in the choice set, a smoker i can potentially choose any quantity x_{ijt} of brand j in period t. We drop the subscripts i and t and specify the monthly cigarette purchase utility to a smoker as the sum of the utilities obtained from purchasing x_j packs of each cigarette brand as

$$U(x) = \phi_1 \ln x_1 + \sum_{j=2}^{8} \gamma_j \phi_j \left\{ \ln\left(\frac{x_j}{\gamma_j} + 1\right)\right\}, \quad (1)$$

where $U(x)$ is a quasiconcave, increasing, and continuously differentiable function with respect to the purchase quantity vector x ($x_j \geq 0$ for all j). The first good x_1 is the outside good that is always consumed. Term ϕ_j is the baseline marginal utility that represents the utility of choosing brand j at the point of zero purchase:

$$\frac{\partial U(x)}{\partial x_j} = \phi_j \left(\frac{x_j}{\gamma_j} + 1\right)^{-1}. \quad (2)$$

The marginal rate of substitution between any brand k and l at the point of zero purchase of both goods is ϕ_k/ϕ_l. We parameterize smoker i's baseline utility of purchasing brand j in period t as

$$\phi_{ijt} = \exp\begin{bmatrix} \beta_{0i} + \text{Brand}_j\beta_{1ij} + \beta_{2ij} \times \text{Brand}_j \times \text{SF}_{it} + \beta_{3ij} \\ \times \text{Brand}_j \times \ln(1 + \text{AntiAdS}_t) \\ +\beta_{4i}\text{BrandLoyal}_{ijt} + \sum_t \text{Year}_t\beta_{5,t} + \varepsilon_{ijt} \end{bmatrix}, \quad (3)$$

where the Brand_j terms are brand dummies, and β_{1ij} is smoker i's intrinsic preference for brand j. The term SF_{it} represents the level of smoke-free restrictions faced by smoker i in period t. We allow the impact of smoke-free restrictions to vary across brands (β_{2ij}). The term AntiAdS_t denotes the antismoking national advertising stock that a smoker is exposed to in period t. We let the antismoking advertising stock evolve as $\text{AntiAdS}_t = \text{AntiAd}_t + \rho_1\text{AntiAdS}_{t-1}$.[4] The effect of antismoking advertising also potentially varies across brands (β_{3ij}). The term BrandLoyal_{ijt} is a dummy variable indicating purchase or not of brand j in the last period. The coefficient of BrandLoyal_{ijt} represents brand choice state-dependence. We also include year fixed effects in the baseline utility to account for any trend in smoking. The term ε_{ijt} is an extreme value distributed error term that is i.i.d. with a scale parameter of σ. The baseline utility for the outside good ϕ_{i0t} is normalized to 1.

Term γ in Equation 2 is a satiation (or translation) parameter.[5] A larger γ value indicates a stronger preference (or lower satiation) for cigarette brand j. All else equal, smokers would purchase more of brand j if γ is larger. Including a satiation parameter specific to brand j allows for the model to yield corner solutions where only brand j is chosen. We parameterize the satiation term as $\gamma_{ijt} = \delta_{1ij} + \delta_{2i}\ln(1 + \text{Adct}_{it})$. The satiation parameter is brand-specific and is also a function of past cigarette consumption and addiction. We formulate a cigarette addiction stock as $\text{Adct}_{it} = \sum_j x_{ijt-1} + \rho_2\text{Adct}_{it-1}$, where the addiction decay ρ_2 is evaluated with a grid search of the .1 intervals from 0 to 1. This formulation is consistent with Becker and Murphy's (1988) theoretical model of addiction behaviors, where past consumption of addictive goods such as cigarettes increases the desire for present consumption. In our specification, we include the past consumption stock in the satiation parameter. A positive value for δ_{2i} indicates that past consumption of cigarette brand j increases the marginal utility of consuming an additional package of brand j.

In each period, a smoker chooses an optimal set of cigarette purchase quantities x over the J brands, which solves the following Lagrangian condition. We drop subscripts i and t in the following equation:

$$L = \phi_1 \ln x_1 + \sum_{j=2}^{8} \gamma_j \phi_j \left\{ \ln\left(\frac{x_j}{\gamma_j} + 1\right)\right\} - \lambda\left(\sum_{j=1}^{8} x_j P_j - E\right), \quad (4)$$

where λ is the Lagrangian multiplier associated with the budget constraint E, and P_j is the tax-inclusive cigarette price per pack

[4] The carryover parameters are determined by comparing log-likelihood from .1 to 1 at a .1 interval. We use the 2000–2005 period as the initialization period to create the antiadvertising stock.

[5] Note that Bhat (2008, 2018) refers to this parameter as the "translation parameter," whereas we refer to it as the "satiation parameter."

of brand j. The Khun–Tucker first-order conditions for optimal purchase quantities x_j^* can be derived as follows:

$$\varepsilon_j = V_1 - V_j + \varepsilon_1 \text{ if } x_j^* > 0 \quad (5)$$

$$\varepsilon_j < V_1 - V_j + \varepsilon_1 \text{ if } x_j^* = 0. \quad (6)$$

Thus, the indirect utility V_j is written as

$$V_j = Z_j'\beta - \ln\left(\frac{x_j^*}{\gamma_j} + 1\right) - \ln P_j \text{ and } V_1 = -\ln x_1^*, \quad (7)$$

where $Z_j'\beta$ indicates the deterministic component in the baseline marginal utility in Equation 3. Note that ε_j is an extreme value distribution error term that is independently distributed across brands with a scale parameter of σ. Thus, the scale parameter σ is the negative inverse of the price coefficient of $\ln P_j$.

All the parameters in the baseline marginal utility and satiation terms $\theta_i = (\beta_i, \delta_i)'$ are random coefficients that follow a multivariate normal distribution $\theta_i = \theta + \eta_i$ where $\eta \sim N(0, \Omega)$. Conditional on θ_i, the probability that a smoker i purchases a nonzero quantity of cigarette packs of M of the J brands and zero cigarette packs of the remaining J-M brands in period t is

$$L_i(\theta_i, x_{it1}^*, x_{it2}^*, \ldots, x_{itM}^*, 0, \ldots, 0) = \int |J| \times \prod_{l=2}^{M} g\left(\frac{V_1 - V_l + \varepsilon_1}{\sigma}\right) \times \prod_{s=M+1}^{J} G\left(\frac{V_1 - V_s + \varepsilon_1}{\sigma}\right) d\varepsilon_1. \quad (8)$$

The probability combines the integrals capturing a combination of extreme value density functions g(.) for the nonzero purchased brands and extreme value cumulative distribution functions G(.) for the zero purchased brands. We follow Bhat (2008) and show in Web Appendix W7 that conditional on θ_i the multiple discrete-continuous probability in Equation 8 has the closed form in Equation 9:

$$L_i(\theta_i, x_{it1}^*, \ldots, x_{itM}^*, 0, \ldots, 0) = \frac{1}{P_{it1}} \frac{1}{\sigma^{M-1}} \left[\prod_{l=1}^{M} \frac{1}{x_{itl}^* + \gamma_{itl}}\right] \left[\sum_{l=1}^{M} P_{itl}(x_{itl}^* + \gamma_{itl})\right] \left[\frac{\prod_{l=1}^{M} e^{V_{itl}/\sigma}}{(\sum_{j=1}^{J} e^{V_{itj}/\sigma})^M}\right] (M-1)!, \quad (9)$$

where $\gamma_{it1} = 0$ for the first outside option. Letting $x_{it}^* = \{x_{it1}^*, x_{it2}^*, \ldots, x_{itM}^*, 0, \ldots 0\}$, the unconditional probability that a smoker makes the observed sequence of choices over T periods is the integral over all values of random coefficients θ:

$$L(x_i^*) = \int_{\theta} \prod_{t=1}^{T} L_i(\theta, x_{it}^*) dF(\theta), \quad (10)$$

where F is the multivariate cumulative normal distribution. The simulated maximum likelihood approach is used for estimation. We use a scrambled version of the Halton sequence to draw realizations of θ. Additional estimation details are in Web Appendix W8. We also show in Web Appendix W9 that the closed-form solution of this multiple-discreteness continuous model collapses to the multinomial choice model in the case when M = 1 (i.e., only one brand is chosen).

The model parameters are identified through variation in different aspects of the environment and consumer decision-making. The satiation parameters are identified from the observable differences in purchase quantities when only a single brand is purchased. Bhat (2008) shows that the role of the satiation parameters is to allow for corner solutions where some optimal quantity of a single brand is purchased. Observations involving the purchases of two brands provide variation that allows for the identification of the parameters in the baseline utility via the marginal rate of substitution between pairs of brands.

Year fixed effects control for any trends or cultural shifts outside the model that influence smoking rates. Controlling for external trends helps facilitate the identification of the effects of the countermarketing techniques. The relationship between cigarette purchase probabilities and temporal/cross-sectional variation in cigarette excise taxes identifies the price coefficient. The relationship between across-brand variation in choice probabilities and temporal/across-state variation in smoke-free restrictions identifies the brand-specific smoke-free parameters. The relationship between across-brand variation in choice probabilities and temporal variation in antismoking ads identifies the brand-specific antismoking coefficients.

Results

Web Appendix 10 reports model comparisons for estimating the likelihood function using a baseline model and several extensions. We start with a baseline model that contains only brand intercepts, year dummies, cigarette prices, and satiation parameters. We then add each additional term discussed previously and examine the relative impact on model performance. The full model has the best performance in log-likelihood (−121,327), Akaike information criterion (242,792), and Bayesian information criterion (243,354). The remainder of this section focuses on the full model.

We report the estimation results in Table 4. The first set of parameters is the mean estimates of intrinsic brand preferences in the marginal utility. These parameters range from −6.765 for mainstream brand categories and −6.780 for Marlboro to −7.200 for Winston. The ratio of marginal utilities at the point of zero purchase is the marginal rate of substitution between any two brands. For example, the marginal rate of substitution between Marlboro and economy brands is $1.401 = [\exp(-6.780)]/[\exp(-7.117)]$. Controlling for other factors, higher marginal utility implies that a smoker can increase overall utility by consuming Marlboro rather than an economy brand at the point of zero purchases of both brands. In addition,

Table 4. Estimation Results of Cigarette Brand Choice and Quantity Decisions.

Variable	Estimate (SE)	SD (SE)
Intercept in the Baseline Utility ϕ_k		
Marlboro	−**6.780** (.066)	**1.337** (.079)
Basic	−**7.108** (.076)	**1.139** (.091)
Winston	−**7.200** (.082)	**.830** (.107)
Virginia Slims	−**6.861** (.074)	**.714** (.097)
High-price tier	−**6.769** (.069)	**1.310** (.083)
Mainstream tier	−**6.765** (.064)	**1.565** (.076)
Low-price tier	−**7.117** (.068)	**1.506** (.078)
Brand Loyalty in the Baseline Utility ϕ_k		
Brand loyalty	**4.704** (.053)	**1.769** (.052)
Smoke-free restrictions in the baseline utility ϕ_k		
Smoke-free on Marlboro	−**.034** (.007)	**.056** (.009)
Smoke-free on Basic	−.007 (.010)	.018 (.013)
Smoke-free on Winston	−**.030** (.011)	**.030** (.015)
Smoke-free on Virginia Slims	−**.026** (.009)	.001 (.013)
Smoke-free on high-price tier	−.002 (.007)	.006 (.009)
Smoke-free on mainstream tier	−**.022** (.005)	**.020** (.008)
Smoke-free on low-price tier	−**.020** (.007)	.001 (.009)
Antismoking Ads in the Baseline Utility ϕ_k		
Antismoking ads on Marlboro	−**.136** (.037)	.071 (.052)
Antismoking ads on Basic	−.078 (.049)	.002 (.063)
Antismoking ads on Winston	−**.163** (.064)	.058 (.085)
Antismoking ads on Virginia Slims	−.031 (.053)	.048 (.072)
Antismoking ads on high-price tier	−.027 (.039)	.034 (.053)
Antismoking ads on mainstream tier	−**.085** (.032)	.038 (.045)
Antismoking ads on low-price tier	−**.080** (.037)	.047 (.049)
Year Dummies in the Baseline Utility ϕ_k	Yes	Yes
Satiation Parameters γ_k (reparam as exp(.))[a]		
Intercept Marlboro	**.081** (.077)	**.639** (.082)
Intercept Basic	**.158** (.093)	**.720** (.104)
Intercept Winston	**.360** (.108)	**1.262** (.134)
Intercept Virginia Slims	**.237** (.100)	**1.234** (.124)
Intercept high-price tier	−.012 (.081)	**.768** (.088)
Intercept mainstream tier	.060 (.075)	**.625** (.080)
Intercept low-price tier	**.288** (.081)	**.702** (.087)
Category-specific addiction stock	**.465** (.014)	**.059** (.017)
Price Coefficient		
Sigma (inverse of the coef. of − ln Price)	**.844** (.007)	

[a]Satiation parameters suggest the satiation preference, with a larger number referring to a stronger preference (lower satiation). The carryover parameter is found to be .3 for advertising stock and .8 for addiction stock.

Notes: We model the brand choice and purchase quantity decisions of seven brands and one outside good for 422 individuals over five years at monthly level. Estimates in bold are significant at the 5% level. The baseline utility is the marginal utility at the point of zero purchase. The carryover parameters are determined by grid search from .1 to 1 at .1 interval. Results with continuous time trend are provided in Web Appendix W11.

there is little individual heterogeneity in the intrinsic preferences of the seven brands. For example, the standard deviation in the intrinsic brand preference for Marlboro is 1.337 compared to the mean Marlboro (−6.780).

The brand-loyalty term has a significant positive coefficient (4.704). The model comparison illustrates that brand loyalty has a greater impact on model fit than other variables. In our context, brand loyalty is operationalized as a brand purchase dummy in the last period. The positive coefficient implies that brand choice in the previous period increases the marginal utility of purchase in the current period.

The next block of Table 4 reports estimates for the smoke-free restriction coefficients across brands. Smoke-free restrictions have significant negative effects on five of the seven brands. Interestingly, we find that smoke-free restrictions have the greatest influence on Marlboro purchases (−.034) relative to lower-priced brands such as Basic (−.007) or the economy brand category (−.020). As smoke-free restrictions become stricter and more prevalent, preference for Marlboro is significantly reduced compared with other brands. The smoke-free findings are especially interesting from public health and marketing perspectives. The literature on intrinsic versus image-related motivations provides a possible explanation for our finding that strong brands such as Marlboro are more susceptible to usage restrictions. Intrinsic motivations are derived from internally focused concerns such as economic costs or

health fears (Ryan and Deci 2000). Image-related motivations, in contrast, describe the motivation to reduce smoking because of how one is perceived by others (Fehr and Falk 2002; Moore et al. 2006; Toubia and Stephen 2013). Because they impact public consumption, smoke-free restrictions reduce this type of image motivation. The stronger brand–consumer relationship between Marlboro and smokers may make customers less responsive to intrinsically motivated countermarketing tactics such as tax hikes (price increase) but more responsive to smoking bans that impact image-related consumption.

The antismoking advertising results suggest that these education campaigns have relatively little effect on reducing cigarette consumption. The antismoking advertising coefficients are significant for four of the seven brands. We acknowledge that the observation window from 2006 to 2010 is not a period with intensive antismoking campaigns relative to previous time periods, such as 1998 to 2003. It is possible that earlier educational campaigns had already successfully educated the public about potential health hazards.[6]

Table 4 also includes satiation parameter estimates. Higher values of the satiation parameter mean that less satiation occurs when consumers purchase the brand. With less satiation, a smoker will purchase greater quantities. Because the model includes individual heterogeneity, the mean satiation parameter estimates need to be considered together with the estimated random coefficients of the satiation parameters. For example, Marlboro has a below-average mean satiation parameter estimate ($1.084 = e^{.081}$). It also has a relatively large standard-deviation estimate ($1.895 = e^{.639}$) as compared with the mean estimate ($1.748 = 1.895/1.084$). This pattern suggests that there is a great deal of individual heterogeneity in the satiation effect of Marlboro. This finding is consistent with the purchase quantity distributions in Web Appendix W3, where we observe sizable populations who consume small purchase quantities (i.e., 1–10 packs per month) and large purchase quantities (more than 30 packs). This implies that Marlboro has a large segment based on preference but also attracts a segment of more casual users. The cigarette addiction stock has a significant positive effect on the satiation parameters. It suggests that past cigarette consumption increases the marginal utility of consuming cigarettes (Becker and Murphy 1988).

Finally, we consider the estimated coefficient of lnPrice, $-1.184 = -1/.844$. While cigarette excise taxes are applied equally at the per pack level, the same tax hike may differentially impact brands because brand manufacturers and their retailers may vary in terms of their ability and willingness to pass through tax increases to consumers. We use weekly store pricing data for each brand at the 3,874 retailer stores in the Nielsen Retail Scanner data to analyze pass-through practices. We calculate pass-through by regressing the cigarette prices per pack of brand j in week t at store s on combined federal, state, and local taxes per pack as in Equation 11.

$$\text{Price}_{jst} = \alpha_1 + \text{Tax}_{st}\alpha_2 + \text{Brand}_j \times \text{Tax}_{st}\alpha_{3j} + \alpha_j + \alpha_s + \alpha_t + \delta_{jst}. \quad (11)$$

To determine brand-level pass-through, we interact the tax rate with the four individual brands and three brand categories. For estimation, we use Marlboro as the baseline. Brand, store, year, and weekly fixed effects are included. The coefficient α_{3j}, associated with cigarette taxes per pack, measures the pass-through rate for brand j compared with the baseline Marlboro. A coefficient of 1.0 indicates full pass-through, whereby a \$1 increase in cigarette taxes per pack will increase cigarette per-pack prices by \$1. Table 5, Panel A, presents the pass-through regression results. The tax pass-through coefficient of Marlboro is .916. This is the lowest pass-through compared with the other cigarette brands. The coefficients of the interaction of tax and the other six brands indicate that the pass-through rates vary from approximately 94% to 110% across the seven brands. In descending order, the ranking of pass-through rates is Marlboro (91.6%), the economy brand category (94%), the mainstream brand category (95.4%), the premium brand category (96%), Winston (102%), Virginia Slims (108%), and Basic (109%). These pass-through estimates are broadly consistent with the range of the pass-through rates from 80% to 118% reported in the literature on cigarette excise taxes (Harding, Leibtag, and Lovenheim 2012).

The low pass-through of Marlboro versus the high pass-through of the higher-equity brands is an interesting finding. The economics literature includes multiple studies that consider tax pass-through rates. In general, the literature has found that pass-through is lower for products with lower demand elasticity (Fullerton 2002). Lower demand elasticity is likely to be related to the brand equity construct. Although our finding of a lower-than-average pass-through for Marlboro is consistent with economic theory, the results for other brands do not seem to vary on the basis of brand equity. There may be a number of reasons for this, including the manufacturer's desire to capture optimal levels of revenue premium (Ailawadi, Lehmann, and Neslin 2003), the retailer's desire to maximize category contribution across its whole brand portfolio, and strategic considerations by both players.

Excise tax pass-through rates are likely determined by a combination of brand and retailer strategy. On the one hand, as tax hikes reduce overall category consumption, higher-equity brands may exploit the lower price sensitivity of consumers for their products (Aaker 1996) and raise prices. This approach would trade off increased margins with lost volume. On the other hand, for a dominant brand such as Marlboro, retailers may wish to minimize pass-through for the category leader to maintain overall volume. In this case, retailers may engage in promotions or reduce their own margins. These types of institutional considerations cannot be observed but are consistent with the observed industry trends.

Tax hikes also cause discrete jumps in prices that may create a sticker-shock effect. Sticker shocks occur when the relative price increase also influences consumer reaction (Bell and

[6] There is limited variation in advertising expenditures during our observation window. As such, our ability to precisely identify the effect of antismoking advertising is limited.

Table 5. Linear Regression Results of Pass-Through Rates.

	A: DV = Price ($)			B: DV = Log (Price)		
Variable	Estimate	Robust SE	*p*-Value	Estimate	Robust SE	*p*-Value
Intercept	2.133	.005	<.001	1.137	.001	<.001
Basic	−.331	.004	<.001	−.056	.001	<.001
Virginia Slims	.291	.005	<.001	.121	.001	<.001
Winston	−.262	.006	<.001	−.052	.001	<.001
High price	.479	.005	<.001	.144	.001	<.001
Mainstream	−.114	.004	<.001	−.024	.001	<.001
Low price	−.638	.005	<.001	−.205	.001	<.001
Tax	.916	.005	<.001	/		
Tax × Basic	.172	.003	<.001	/		
Tax × Virginia Slims	.167	.004	<.001	/		
Tax × Winston	.106	.003	<.001	/		
Tax × High price	.046	.004	<.001	/		
Tax × Mainstream	.038	.002	<.001	/		
Tax × Low price	.024	.003	<.001	/		
Log tax	—			.312	.001	<.001
Log tax × Basic	—			.092	.001	<.001
Log tax × Winston	—			.066	.001	<.001
Log tax × Virginia Slims	—			.020	.001	<.001
Log tax × High price	—			−.030	.001	<.001
Log tax × Mainstream	—			.027	.001	<.001
Log tax × Low price	—			.099	.001	<.001
Store fixed effects	Yes			Yes		
Year fixed effects	Yes			Yes		
Week fixed effects	Yes			Yes		
Adjusted R-square	.9503			.9445		
N observations	7,050,680			7,050,680		

Notes: DV = dependent variable. The analyses are conducted at the brand-store-week level with seven brands in 3,874 stores over five years ($7 \times 3,874 \times 52 \times 5 = 7{,}050{,}680$ observations). Marlboro is the omitted baseline brand. Standard errors are clustered at store-brand level. Panel A investigates dollar pass-through rates. The coefficient of cigarette taxes represents the dollar change in cigarette prices per one dollar change in cigarette excise taxes. Marlboro has the lowest pass-through rate compared with all other cigarette brands (92% vs. 94%–110%). Panel B investigates the pricing change percentage. The coefficient of logarithm tax represents the percentage change in cigarette prices per 1% increase in cigarette excise taxes. Premium brand categories and Marlboro have the lowest percentage increase in prices (28% and 31%) compared with other brands (33% to 41%).

Lattin 2000). Table 5, Panel B, reports the results of a log-log specification of the pass-through analyses, revealing the percentage price increase caused by increased taxes for each brand. The results suggest that a 100% tax increase translates into a 31% price increase for Marlboro. Most of the other brands, with the exception of the premium category, have significantly higher percentage increases in price. A 100% tax increase leads to a 41% price increase for Basic, 40% for the economy category, 38% for Winston, 34% for the mainstream category, 33% for Virginia Slims, 31% for Marlboro, and 28% for the premium category. The higher relative price increase provides a possible explanation for why economy cigarette brands show the greatest loss of volume over time. In contrast, the relatively low markup for Marlboro might explain why Marlboro has higher volumes following the tax increase.

Policy Evaluation

The preceding model results suggest that the effects of countermarketing tactics vary across brands. In this section, we conduct a set of simulations that evaluate the effects of alternative countermarketing tactics on a variety of usage and revenue metrics. These counterfactuals highlight the consequences of countermarketing activities on various category stakeholders and for different types of brands. The policy experiments involve five years of simulated monthly cigarette consumption decisions for 422 consumers with identical initial states as the estimation sample. We follow the simulation procedures proposed by Pinjari and Bhat (2011, Equations 15 and 16). Details are provided in Web Appendix W12.

Table 6 reports the results of six countermarketing scenarios, including a 100% increase in tax rates, a shift toward maximum smoke-free restrictions in all states, and a doubling of antismoking advertising. We also evaluate more incremental scenarios including a 37.6% increase in taxes, a single additional smoke-free restriction, and a policy that employs the combination of a 37.6% tax increase and an additional smoke-free restriction. We assume that brands maintain the same level of pass-through estimated in the preceding section for the tax increase scenarios. For each of the six scenarios, we calculate changes in category volume, spending on cigarettes, quit rates, packs purchased per day for active smokers, and

Table 6. Counterfactual of the Three Antismoking Techniques.

	100% Tax Increase	Max Smoke-Free Restriction	Double Antismoking Ads	37.6% Tax Increase	One-Level Smoke-Free Increase	37.6% Tax + One-Level Smoke-Free Increase
Smokers						
Consumption vol.	−35.95%	−7.51%	−1.14%	−16.36%	−1.21%	−17.45%
Spending ($)	−13.78%	−6.58%	−1.52%	−5.39%	−1.07%	−6.48%
Packs a day[a]	−32.06%	−5.49%	−.81%	−14.74%	−.91%	−15.54%
Quit rate[b] ppt.	10.65	3.25	1.86	3.95	.48	4.49
Quit rate[b] chg.	29.92%	9.17%	5.21%	11.08%	1.35%	12.61%
Government						
Tax revenue ($)	27.89%	−6.19%	−1.46%	15.05%	−1.01%	13.80%
Brand Sales						
Marlboro	−33.08%	−14.03%	−2.76%	−14.67%	−2.20%	−16.68%
Basic	−43.28%	n.s.	n.s.	−20.10%	n.s.	−20.19%
Winston	−41.88%	−16.34%	−4.69%	−19.70%	−2.63%	−21.97%
Virginia Slims	−37.11%	−11.23%	n.s.	−16.89%	−1.92%	−18.64%
High-price	−27.70%	n.s.	n.s.	−12.06%	n.s.	−11.89%
Mainstream	−33.52%	−7.34%	−1.44%	−15.03%	−1.12%	−16.05%
Low-price	−42.68%	−8.53%	n.s.	−20.01%	−1.47%	−21.31%

[a]Packs a day before quitting calculates the average daily cigarette consumption in months when there are cigarette purchases.
[b]Quit rate is defined as the percentage of smokers who quit within five years, and quitting is defined as no cigarette purchase during the final 12 months of the observation window.
Notes: n.s. = nonsignificant at the 95% confidence interval. The table compares counterfactual results of seven policy simulations. The 37.6% tax increase corresponds to $.94 federal cigarette tax hike proposed in October 2014 by the Obama Administration. A table with confidence intervals on all the evaluation metrics can be found in Web Appendix W13.

government tax revenues. We also calculate the sales impact on cigarette brands and brand price-tier categories.

The first scenario involves a 100% increase in taxes from the start of the observation window in 2006. This large increase in taxes results in a decrease in consumption volume of 36%, a decrease in spending of 14%, and a quit-rate increase of 30%. The consumption volume elasticity of −.36 is very close to the price elasticity of −.4 reported in previous meta-analyses (Chaloupka 1991). The simulation also suggests that a 100% tax increase results in a decrease in packs per day of nonquitting smokers of 32%. Despite the dramatic increase in tax rates, the reduced consumption results in just a 28% increase in tax revenues. In terms of the effects on brands, we find that Basic, Winston, and the lower-price-tier brands suffer greater losses in volume sales than do the high-price and mainstream tiers and Marlboro. These brand-level effects are driven by the pass-through policies described in the "Results" section.

The second scenario involves a shift toward complete smoke-free restrictions in all markets. In this case, category volume decreases by 7.5%, the quit rate increase is 9.1%, and packs per day for nonquitters drop by 5.5%. This reduction in usage combined with no increase in tax rates results in a loss of 6.2% in tax revenues. The effects on individual brands vary considerably. Marlboro, Winston, and Virginia Slims suffer losses of 14.0%, 16.3%, and 11.2%, respectively. Mainstream and low-price brands suffer approximately 8% losses in volume. In contrast, there is little impact on Basic and high-price-tier brands. Doubling antismoking advertising causes a 1% drop in category volume and a 5.2% increase in quit rate. The brand-level effects vary from negligible effects on Virginia Slims to a 5% decrease for Winston.

According to the CDC (2014, 2017) and the "Tax Burden on Tobacco" report (Orzechowski and Walker 2018), federal and state gross tax revenues have increased by approximately 20% from $273 to $330 million as combined federal and state taxes rates almost doubled from $1.34 in 2006 to $2.68 in 2016. Our policy simulation suggests that the tax revenues would increase by 28% for a 100% tax increase and decrease by 6% due to a complete smoke-free restriction. Combining the tax and smoke-free effects suggests a 22% change in revenues from a 100% tax increase and a complete nonsmoking policy. A comparison of this result with the CDC estimates suggests that our simulations are consistent with their findings.

Overall, the simulations reveal important elements of the category structure for consumers, regulators, and brands. For consumers, the tax increase results in a large decrease in usage and a substantial amount of quitting. However, nonquitting consumers are forced to pay considerably higher prices, which may have social welfare implications given the higher prevalence of smoking in low socioeconomic groups (CDC 2014). Maximum smoke-free restrictions have a substantial but smaller impact on consumption and quitting. In contrast to the tax increase, the maximum smoke-free restrictions result in a loss of tax revenues. These two policies have very different effects across governmental and consumer stakeholders. Increased taxes and smoke-free restrictions both decrease consumption and increase quitting rates. However, taxes impose significant financial burdens on consumers while providing revenues to the government, whereas smoke-free restrictions lead to a loss in tax revenue but do not impose economic costs on consumers. In terms of brands, we find that

Table 7. Counterfactual of the Three Antismoking Techniques by Heavy Versus Light Smokers.

	100% Tax Increase	Max. Smoke-Free Restriction	Double Antismoking Ads	37.6% Tax Increase	One-Level Smoke-Free Increase	37.6% Tax + One-Level Smoke-Free Increase
Heavy Smokers						
Consumption vol.	−34.73%	−6.59%	−1.27%	−15.73%	−1.08%	−16.72%
Spending ($)	−12.01%	−5.73%	−1.24%	−4.62%	−.95%	−5.60%
Packs a day	−33.58%	−6.36%	−1.00%	−15.42%	−1.06%	−16.38%
Quit rate ppt	8.74	1.77	1.27	2.37	.19	2.72
Light Smokers						
Consumption vol.	−39.62%	−10.27%	−1.94%	−18.24%	−1.58%	−19.63%
Spending ($)	−18.97%	−9.09%	−1.97%	−7.67%	−1.40%	−9.05%
Packs a day	−31.06%	−5.62%	n.s.	−14.35%	n.s.	−15.10%
Quit rate ppt	12.23	4.47	2.35	5.25	.72	5.94

Notes: n.s. = nonsignificant at the 95% confidence interval. We group smokers into heavy and light smokers using the median split of cigarette purchase volume in the initialization period in 2005. The median consumption in 2005 is 220 packs a year. Table 7 reports only the mean counterfactual estimates for simplicity of interpretation. We provide a table with confidence intervals on all the evaluation metrics in Web Appendix W14.

stronger brands tend to gain share following tax hikes but lose share due to smoke-free policies. We do not find a readily identifiable pattern of the effects of antismoking advertising across brands.

Table 6 also includes results for simulations that involve smaller policy interventions. We examine a 37.6% tax increase, which corresponds to the $.94 federal cigarette tax hike proposed in October 2014 by the Obama Administration. A 37.6% tax increase results in a decrease in category consumption of approximately 16% and yields about a 11% increase in quit rate. Tax revenues increase by about 15%. This more moderate intervention yields 54% of the tax revenue from the draconian 100% tax increase. The quit rate for the 37.6% tax increase is about 37% of the rate of the 100% rate. The imposition of a single incremental smoke-free restriction reduces consumption by 1%, and the impact on tax revenues is 1%. As before, the critical policy decision is whether to place the burden on consumers through taxes or on the government through smoke-free restrictions. The pattern of brand effects is similar to the previous high-tax and high-restriction simulations. Again, taxes have relatively less effect on high-equity brands that tend to pass through less tax, whereas usage restrictions have a relatively greater effect on higher-market-share brands such as Marlboro, Virginia Slims, and Winston. The only relatively high-market-share brand that is not affected by restrictions is the budget brand Basic.

In Table 7, we compare the effects of the six countermarketing policies on heavy versus light smokers. For this comparison, we segment customers using a median split based on consumption volume in the initialization period. We find that across all policy simulations, antismoking activities have a larger impact on light compared with heavy smokers. Light smokers reduce volume of packs, decrease spending, and increase quit rates more than heavier smokers in response to countermarketing. This may reflect a higher level of addiction among heavier smokers.

Discussion

Marketing and branding are powerful tools that can have both positive and negative effects on consumers and society. Marketing can provide value by connecting consumers to products that maximize individual utility, but marketing can also result in excessive or dangerous consumption. In the current research, we explore an underresearched but important aspect of marketing: the use of marketing tools to reduce the long-term consumption of dangerous branded products with negative health outcomes. There is an existing literature that has focused on techniques or "nudges" to change short-term behaviors (Thaler and Sunstein 2008). However, studies of short-term nudges often neglect important dynamic factors that may lessen one-time interventions' long-term impact.

Our research studies the effectiveness of marketing tools for disrupting consumption in a category that includes long-term consumption and high-equity brands. These aspects are important because purchase feedback effects, addiction, and brand loyalty may all have significant long-term consequences. Our research can be thought of as an application of attempting to reduce customer–brand bonding as we study interventions designed to disrupt and end consumer relationships with brands such as Marlboro. Disrupting brand relationships is an important area for researchers as there are numerous categories dominated by well-known and well-loved brands where excessive consumption may be injurious. For example, many consumers have life-long relationships with brands in fast food, soda, or snack foods (Moorman, Ferraro, and Huber 2012; Sekar, Rajagopal, and Gilbride 2010). Beyond these health-oriented categories, antirelationship marketing might be employed to reduce consumption potentially viewed as having negative social consequences such as climate harming travel or gambling.

As demarketing or countermarketing designed to disrupt brand–consumer relationships becomes more prevalent, it is

important to consider how different types of countermarketing affects various category stakeholders. In the remainder of the article, we discuss our research's implications for policy makers, consumers, and manufacturers. As part of this discussion, we also acknowledge several limitations to our research and future research directions.

Policy Implications

Policy makers may be guided by a substantial academic literature. Our research further informs policy makers through a comparison of the relative effectiveness of pricing interventions (taxes), public usage restrictions (smoke-free policies), and antismoking communications. In general, we find that the pricing mechanism is the most powerful regulatory technique. The pricing mechanism also provides benefits to the regulatory state through incremental tax revenues, though at a cost to category users.

However, a gap in the countermarketing literature is a lack of research that focuses on how brand strength may impact countermarketing efficacy. This omission is a significant gap, given the importance of branding to consumers and its potential to attenuate social marketing initiatives. Because brands may serve a variety of purposes, such as guaranteeing quality or providing status, it is critical that policy makers consider branding issues. In this category, we find that the market leader is relatively less affected by increased taxes and more affected by policies that limit public consumption.

Our results could be interpreted as evidence that placing constraints on visual branding elements might be useful for reducing the consumption of unhealthy foods or beverages. These effects are likely to be especially pronounced for market leaders. The key implications for regulators and advocacy groups are that different instruments vary in terms of effectiveness and that the effects are heterogeneous across brand tiers. These heterogeneous effects and different levels of efficacy should be considered when designing or campaigning for regulatory interventions.

Consumer Welfare

The effects of countermarketing on consumer welfare are complex. Different countermarketing tools change consumer behavior through different mechanisms. For example, taxes impose direct costs on consumption. Taxes, therefore, reduce consumer utility of consumption and increase costs. For example, we project that a 100% tax increase decreases consumption by 36% while lowering expenditures by only 14%. However, consumer utility is also indirectly affected by a reduction in health risks. From the consumer's perspective, tax-based countermarketing may be viewed as extremely negative. The consumer directly observes high costs and diminished consumption, whereas health benefits are more abstract or future-oriented.

In contrast, usage restrictions reduce consumption but do not impose additional costs. We find that a complete smoke-free policy results in a 7.5% drop in consumption and a 6.6% drop in spending. Smoke-free restrictions have a more moderate effect on usage and quitting but reduce tax collections. In the case of usage restrictions, the costs are mainly related to reduced convenience and the ability of consumers to use brands for social signaling. Again, the positive consequences for health are not directly observed by consumers.

Educational advertising to counter smoking appears to have little impact on consumers but also does not impose any direct costs on them. It is possible that antismoking advertising imposes a cost on smokers by stigmatizing the consumption of cigarettes. We should note that our observation window follows decades of educational messaging. Our results may indicate a diminishing return to antismoking advertising during the mature phase of countermarketing programs and may not be relevant to negative advertising in other vice categories. Furthermore, our findings related to the effects of antismoking advertising should also consider the realities of funding. While antismoking advertising does not directly impose costs on smokers, these campaigns are often funded by cigarette tax revenues.

The different countermarketing policies may also result in different changes to the category structure. If countermarketing operates differentially across segments, then countermarketing costs and benefits may not be equally shared across consumer groups. For example, taxes seem to favor stronger brands, whereas smoke-free restrictions have a greater negative impact on these brands. The implication is that the impact on consumer welfare is segment specific. If consumer segments vary in terms of socioeconomic factors, then the costs and benefits of alternative countermarketing approaches will vary across demographic groups.

Brand Management Implications

Our research also has implications for manufacturers and brand managers. In particular, our results suggest that brand strength may differentially lessen or increase the impact of different countermarketing activities. As categories are subjected to countermarketing, brand managers may devise strategies or lobbying efforts based on their category position.

We find that brand strength moderates the impact of increased category taxes through several mechanisms. First, if stronger brands are able to charge price premiums (Aaker 1996; Agarwal and Rao 1996), then per-pack tax increases result in a lower percentage-price increase. Second, stronger brands with larger market shares or distribution advantages may be better able to absorb some tax increases. For example, we find that Marlboro has the highest market share, the largest number of stockkeeping units, and some of the lowest tax pass-through rates. However, we also find evidence that strong cigarette brands are more susceptible to smoke-free policies. This finding is intuitive because smoke-free policies reduce consumers' ability to gain status from the consumption of strong brands.

While lessons learned from tobacco control efforts are also likely to be used when designing countermarketing tactics in

categories such as fast food or soda, our findings suggest that efforts to tax soda or fast food might result in increased market shares for high-equity brands. However, this is speculation, and additional research is needed. It should also be noted that these categories are viewed differently from tobacco by most consumers. While tobacco is almost universally viewed as dangerous, opinions about fast food and soda are more diverse. In particular, many consumers believe that these categories are only harmful when they are consumed excessively.

Categories now targeted by antiobesity groups include powerful brands such as McDonald's and Coca-Cola. In response, Coca-Cola has launched antiobesity ads and argued that it is unfair to blame any single brand. Public relations responses are just one option for brands facing countermarketing. Our research suggests that different tactics are appropriate for different types of brands. Relationships between consumers and relatively weak brands may be disrupted using taxes, while for strong brands, the appropriate tactic seems to be usage restrictions that limit public consumption. Our results suggest that brand building is the correct response to taxes, whereas usage restrictions would call for other responses, such as lobbying.

While our results highlight the role of countermarketing in the cigarette category, we do note that this category has evolved in a unique manner. Specifically, product innovation in the form of e-cigarettes has had a significant impact on the category (Tuchman 2019; Chen and Rao 2020). We selected our data-collection window partly to minimize the impact of the diffusion of electronic cigarettes on traditional cigarettes. Interestingly, public health organizations have begun to use countermarketing tactics to limit electronic cigarettes and other vaping devices (Fox 2018).

Limitations and Future Research

In terms of limitations, our unit of analysis is highly aggregated, as we focus on monthly quantity choices. It may be useful to analyze more granular weekly purchasing quantities to understand the role of stockpiling. Another caveat is that antismoking policies might also affect the propensity for consumers to scan products if countermarketing makes tobacco products less socially acceptable. Specifically, these policies might lead to more or fewer single-pack purchases that would be consumed before returning home. Another limitation of our analysis is that we focus only on the behavior of existing smokers. Countermarketing may also be used to prevent the adoption of vice products by nonusers. For example, the use of tactics that eliminate the symbolic benefits associated with brands might also reduce the entry of new smokers into the category. If antibranding efforts are enacted, then young nonsmokers may be less likely to develop the "positive associations" with brands such as Marlboro.

In addition, our selection and categorization of brands were based on pricing. It is possible that brands may exhibit asymmetric responses to countermarketing activities based on other branding elements. For example, researchers could conceivably examine how visual elements of branding such as color, font size, or the use of iconography influence consumer response to countermarketing. The success of the Australian government's ban on branding elements suggests that this type of research might yield valuable insights (Bonfrer et al. 2020).

There are also additional opportunities for more dynamically oriented research. For instance, a dynamic structural model that considers both brand choice and purchase quantity decisions would allow researchers to examine how smokers trade off long-term financial costs and health concerns. We also acknowledge that without a dynamic structural model, our policy simulations are subject to the Lucas (1976) critique.

This discussion of using a dynamic structural model of consumer choice also raises the issue of long-term dynamics of a category with significant countermarketing activity. As we have noted, consumers may act in a dynamically optimal manner and trade off health, money, and smoking utility. It is also possible that other category stakeholders may adopt strategic or forward-looking approaches. For instance, our results suggest that tax policies may lead to greater market power for the most dominant brands. This prediction is consistent with the observed growth in market share for Marlboro. If this is the case, then policy makers and brands may also wish to adopt dynamic forward looking strategies.

Policy makers may benefit from using a dynamic strategy that begins with tax hikes as the most effective tool for decreasing demand. At some point, it may then be useful to switch to policies that disrupt public consumption, such as smoke-free restrictions or plain packaging. Researchers should investigate the question of the optimal sequence of educational initiatives, taxes, and branding restrictions.

Brands may also wish to develop dynamic strategies when their categories are targeted by critics. In the case of tobacco, the industry faced a massive antimarketing campaign that resulted in a cultural shift against smoking. When a category is targeted, and public sentiment toward a category becomes negative, firms may benefit from knowing how to respond to different stages of a countermarketing lifecycle.

Finally, it should be noted that public health advocates and other regulatory agencies are not infallible. The use of countermarketing techniques to disrupt an industry is usually portrayed as a positive social influence. However, the rights and wrongs of social movements are often more complex. Countermarketing encompasses both activities that aim to persuade (e.g., educational advertising) and activities that aim to limit a brand's communications (e.g., advertising prohibitions, plain packaging mandates). Limitations on communications are a challenging issue, as prohibitions on branding are constraints on speech. There are those who would question the extent to which the state in general and regulators in particular should arbitrate what is good for individuals. Our goal in the current research was to measure the effectiveness of a variety of countermarketing tools. However, as countermarketing becomes more prevalent, legal and marketing research should also consider the boundary between marketing and protected speech.

Authors' Note

Researcher(s) own analyses calculated (or derived) based in part on data from Nielsen Consumer LLC and marketing databases provided through the NielsenIQ Datasets at the Kilts Center for Marketing Data

Center at The University of Chicago Booth School of Business. The conclusions drawn from the NielsenIQ data are those of the researcher(s) and do not reflect the views of NielsenIQ. NielsenIQ is not responsible for, had no role in, and was not involved in analyzing and preparing the results reported herein.

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