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Abstract

In response to the growing childhood obesity rate, the Children's Food and Beverage Advertising Initiative (CFBAI) was launched in November 2006. Our study presents the first empirical analysis of the impact of CFBAI on consumers' food choices. We combine monthly data on advertising exposure, measured by gross rating points and by age group between 2006 and 2008, and household candy purchases. We find that CFBAI has not produced significant changes in consumers' exposure to television advertising because its guidelines are vague. Nor has it had the intended effect on consumers' dietary choices. However, an observed reduction in advertising exposure could reduce households' purchase propensity by approximately 30-40% for specific candy products. This suggests that strengthening the link between reducing advertising on child-directed programs and reducing children's actual advertising exposure should be a priority in ensuring the future success of CFBAI.

1 Introduction

Over the past three decades, the childhood obesity rate has escalated in many countries and nearly tripled in the United States. Growing public concerns about childhood obesity have driven researchers and policymakers to search for ways to reduce this rate. Among those efforts has been close scrutiny of the role of child-directed food-and-beverage advertising, because children who spend a significant amount of time watching television can easily be exposed to advertisements promoting low-nutrient and high-calorie foods and beverages. In response to the debate on the impact of mass media advertising on children's health, the Council of Better Business Bureaus (BBB) launched the Children's Food and Beverage Advertising Initiative (CFBAI) in November 2006. The initiative is a voluntary program in which many of the nation's largest food and beverage companies have participated. The CFBAI requires its participants to devote at least 50% (100% effective January 1, 2010 according to CFBAI's enhanced core principles) of their advertising directed primarily to children under 12 on TV, radio, print, and the Internet to better-for-you products, and/or to messages that encourage good nutrition or healthy lifestyles. This is designed "to shift the mix of advertising messaging directed to children under 12 to encourage healthier dietary choices and healthy lifestyles." (Kolish and Peeler, 2008)

However, the effectiveness of CFBAI has been contested ever since its start. Some activist groups, such as Campaign for a Commercial-Free Childhood, insist that formal regulatory oversight should be in place, because CFBAI participants could easily sidestep self-regulatory guidelines (Lukovitz, 2008). There is also a debate about whether food-and-beverage advertising to children might be responsible for childhood obesity and, if so, to what extent restrictions on such advertising can affect dietary choice.

Between 2006 and 2008, three major candy manufacturers completely implemented their CFBAI pledges. Although their compliance was thoroughly examined by the BBB, there are few studies of the impact of this self-regulation on dietary choice. Matching data on candy purchases and advertising exposure during CFBAI's implementation period, our study is

the first empirical analysis of the impacts of CFBAI more than three years after its launch.[1] Specifically, we combine longitudinal data on household monthly candy purchases between 2006 and 2008 with data on monthly advertising exposure (measured by gross rating points) of different age groups at the designated-market-area (DMA)-level in the same period. Next we examine the effect of CFBAI implementation (a "treatment") on a household's purchasing decisions about a product manufactured by the CFBAI participants. We use two measures for the household's purchasing decision: the product-specific *volume* purchased and the product-specific *relative* purchase frequency, which is the frequency of a household's purchasing the product relative to the household's total monthly grocery shopping trips.

Using a difference-in-differences (DID) approach, we do not find that CFBAI implementation has produced the intended effect on household purchasing decisions. We consider the periods before and after the CFBAI implementation (the treatment) and compare households in the treatment group who only purchase the product manufactured by the CFBAI participants with households in the control group who only purchase the product manufactured by the non-CFBAI participants. We find no statistically significant difference between the two groups' product-specific volumes purchased or their product-specific relative purchase frequencies in the post-treatment period as opposed to the pre-treatment period.

Next, we seek to explain the lack of CFBAI's intended effect by examining the impact of CFBAI implementation on product-specific advertising exposure at the DMA level. We find that CFBAI implementation did not effectuate the intended reductions in children's exposure to advertising on most candy products, despite the fact that the compliance of CFBAI participants was thoroughly examined by the BBB. This may be because the CFBAI participants only committed not to advertise on child-directed programs, defined as programs for which children under 12 exceed a certain percentage of the total target audience. Hence,

[1] The CFBAI is intended to encourage a healthy diet and is targeted at children under 12. Ideally, we would examine the CFBAI effect on children's consumption explicitly, but we are unable to do so because we do not have data on children's consumption exclusively. Due to lack of data, we are also unable to examine whether the CFBAI implementation has had any effect on persuading consumers to choose "better-for-you" products that can be advertised to children.

there can be two consequences of this regulatory guideline. First, for those participants who did not advertise most of their products on such child-directed programs prior to the CFBAI implementation, their practices for most products hardly changed. Second, any decrease in advertising on a child-directed program can well be offset by an increase in children's exposure to advertising on non-child-directed programs (especially for popular programs such as "American Idol").

It is not surprising that the voluntary advertising ban does not bring about the desired changes in a household's product-specific purchasing decisions, so we go on to investigate whether this lack of effect can be explained by a lack of change in exposure to the product advertising targeted by the voluntary ban. We study the impact of an observed reduction in advertising exposure, not due to the CFBAI, on a household's dietary choices. We further show that the reduced advertising exposure is likely to be a result of firms' reduced advertising expenditures, not a response to falling demand. Our analysis also serves as a falsification check on the "CFBAI effect." Its results could be indicative of what would happen with a mandatory advertising ban.

For our study, we consider two products—bubble gum and lollipops—both of which are marketed primarily to children under 12. In our sample period, the major manufacturers of lollipops did not participate in the CFBAI. And, for households purchasing lollipops (but not bubble gum), the advertising exposure of children under 12 and the audience among other age groups remained virtually unchanged. In contrast, prior to the beginning of 2010 when Mars officially extended its CFBAI pledge to its bubble gum products, there already had been a significant reduction in consumers' exposure to advertising of these products. Furthermore, that reduction occurred roughly around Mars' original CFBAI implementation date. So, we use this reduction in advertising exposure to Mars bubble gum as a "fake treatment" to see if any "CFBAI effect" can be falsified. Because the reduction in advertising *exposure* stemmed from a decrease in advertising *expenditure* and advertising units on television, both of which were decided upon by Mars, the fake treatment arguably cannot be self-selected

by households. We examine the effect of this fake treatment on a household's monthly relative frequency of purchasing Mars bubble gum, using the DID approach to deal with time-invariant omitted variables such as consumer taste. The treatment group consists of households who only purchased the bubble gum and who experienced a reduction in their exposure to the product's advertising. The control group consists of households who only purchased lollipops produced by non-CFBAI participants and experienced no change in their exposure to the product's advertising. Before Mars' original CFBAI implementation, we find, the product-specific monthly relative purchasing frequencies are similar between the treatment and the control group. However, after the CFBAI implementation, those households in the treatment group exhibit a decrease in their monthly relative purchasing frequency compared with the households in the control group. We interpret that decrease as an advertising-exposure effect, which is a decrease in the monthly relative frequency of a household's purchasing a product when the household is exposed to less advertising of the product.

Our findings suggest that the success of CFBAI—a self-regulation on advertising practices—hinges on its effectiveness in reducing consumers' exposure to advertising of unhealthy products. On average, we find that a household purchases a product less frequently when it is exposed to less advertising of the product. We also find that when CFBAI did not effectuate real changes in advertising exposure for some of the high-calorie and high-sugar candy modules such as chocolate, it failed to generate changes in consumers' dietary choices.

Our study also contributes to the literatures on the effectiveness of self-regulations and the impacts of advertising restrictions on consumer choices. The former literature has focused on voluntary environmental regulations (Gamper-Rabindran, 2006); the latter examines advertising bans on alcohol or tobacco (Blecher, 2008; Cox, 1984; Saffer and Dave, 2002). Evaluating self-regulation is challenging, because participation decisions are very likely to be endogenous. In contrast, in the United States advertising restrictions on alcohol and cigarettes are mandatory, which allows participation to be exogenously determined, to a

certain extent. However, a mandatory advertising ban at the country level *can* be endogenous in cross-country comparisons of aggregate consumption. Many existing studies relying on state- or country-level data offer conflicting views whether advertising, and the degree of exposure to it, have any effect on consumption. Half of them find little or no effect of advertising or its bans on consumption (Baltagi and Levin, 1986; Hamilton, 1972; Saffer and Chaloupka, 2000; Schmalensee, 1972; Schneider, Klein, and Murphy 1981; Stewart, 1993). The rest conclude that more advertising leads to more consumption, or that an advertising ban can reduce consumption (Laugesen and Meads, 1991; Saffer and Dave, 2002; Seldon and Doroodian, 1989). With advertising decisions made at an aggregate level (such as states or countries), the endogeneity problem may account for those inconsistent findings.

However, our study uses household-level purchase data, combined with data on advertising exposure (not advertising expenditure). Thus, the endogeneity problem that often arises in studies using more aggregated data on consumption (at the state or country level) can be partially mitigated, because households neither make the CFBAI participation decision nor the firms' advertising decisions (although they can control their exposure to advertising available to them). Nonetheless, firms may base their CFBAI participation decisions or advertising decisions on household characteristics that can be observable to a researcher. To deal with this type of endogeneity problem due to omitted variables, we use a DID approach to remove the time-invariant unobserved heterogeneities that affect household purchase decisions, in the presence and the absence of the CFBAI or the reduction in advertising exposure.

Baylis and Dhar's (2009) study based on the Canadian food expenditure survey is closest to our empirical setting. They investigate the impact of a ban on advertising to children in Quebec in 1980 on household fast-food purchase propensity and expenditures. But, their household-level biweekly purchase data are limited to the post-regulation period only, from 1984 to 1992. The treatment is defined by a household's meeting all three criteria: 1) speaking French; 2) having children; and 3) living in Quebec. Households that do not meet any of the three criteria constitute the control group. Under this setup and because of their

data limitation, a major confounder—the difference in household consumption between the treatment and the control group in the pre-regulation period—is assumed to be represented by the difference in consumption between English-speaking and French-speaking households in the post-regulation period. However, if a French-speaking household in Quebec has access to media outside the province, then the researchers will mistakenly attribute the household's reduced fast-food expenditure to the ban in Quebec itself.

In contrast, our study has household purchase data both before and after the regulation or the reduction in advertising exposure. This enables us to separate a change in household consumption due solely to the CFBAI (or due to the reduction in advertising exposure) from those changes induced by any time-invariant unobservables in the absence of the CFBAI (or the reduction in advertising exposure).

The rest of this paper is organized as follows. Section 2 surveys the policy debate on the impact of child-directed food-and-beverage advertising on TV on children's dietary choices and thus situates our contribution. Section 3 provides the background of CFBAI. Section 4 explains our empirical setting for analyzing the CFBAI effects on consumer food choices, including data, research design, identification assumptions, and econometric specification. Section 5 discusses the results, including a falsification check on the impact of a fake CFBAI implementation on household purchasing decisions. Section 6 concludes.

2 The Policy Debate

To highlight the policy relevance of our findings, we give a brief review in this section of the ongoing debate over the impact of child-directed TV advertising on dietary choice and child obesity. According to a 2008 report by the Federal Trade Commission, the food and beverage industry spent $1.6 billion dollars on advertising directed to children in 2006.[2] Advocates of advertising bans point out that children are vulnerable to commercial exploitation, be-

[2]For more details, see http://www.commercialalert.org/news/archive/2008/07/ftc-kids-target-of-16-billion-in-food-ads.

cause they do not have the same level of cognitive development as adults to allow them to distinguish advertising from programming, or to view advertising in light of its bias. The House Report for the Children's Television Act (enacted in 1990), the first federal legislation directly addressing children's programming, shares this view (House Report, 1989). An influential report by the Institute of Medicine (2006), based on a review of more than 120 relevant studies, concludes that there is strong evidence that TV advertising, at least in the short term, influences purchase preferences of children between the age of 2 and 11. However, the report finds no compelling evidence that TV advertising causes child obesity. Some studies use hours spent watching television as a measure for advertising exposure to examine their impact on body weight. However, variations in time spent watching TV can be decided by the individual. Failing to deal with this endogeneity will confound a sedentary TV-watching lifestyle with an induced food purchase due to the TV advertisement for food.

In a recent study, Chou, Rashad, and Grossman (2008) conclude that watching fast-food TV advertisements has a causal effect on the body weight status of children and adolescents. They use data from the National Longitudinal Survey of Youth and advertising data on exposure to fast-food TV commercials at the DMA level. They find that more fast-food advertising on television increases the likelihood of children's and adolescents' becoming overweight. Their estimates imply that a ban on fast-food TV advertisements "would reduce the number of overweight children ages 3-11 in a fixed population by 18 percent and would reduce the number of overweight adolescents ages 12-18 by 14 percent." Chou, Rashad, and Grossman (2008) manage to separate the effect on weight gain of watching TV food commercials from the effects of other activities associated with watching TV by using advertising exposure, measured by the number of fast-food commercials seen in a DMA. However, their empirical evidence does not show a link between TV advertising exposure and dietary choice.

Our study explores a mechanism that underlies their findings, a "first-stage" effect: the direct impact of reducing exposure to food advertising on TV on household food purchases. This effect might be the result of restricting information on food and beverage products, or

of suppressing the salience of the images of these products. We cannot distinguish between these two sources, given the scope of our data.

Bollinger, Leslie, and Sorensen (2010) investigate the impact of a mandatory calorie posting law, which requires disclosing calorie information or making calorie information more salient to consumers, on consumer purchases. They find that the law has reduced calories per transaction mainly through a reduction in food, but not beverage, purchases.

The debate on the role of advertising to children in terms of childhood obesity continues. Industry representatives opposing advertising restrictions emphasize that during the past three decades, in which the childhood obesity rate has nearly tripled, children's exposure to food advertising on television actually remained unchanged or even declined, according to a 2007 Federal Trade Commission (FTC) report (Holt, Ippolito, Desrochers, and Kelley, 2007). Many industry representatives contend that limiting advertising to children is "no magic wand that we can wave to solve the problem." (Jaffe, 2007)

Despite the lack of definitive scientific evidence on a causal effect on child obesity of fast-food advertising to children, the regulators and the industry nonetheless have worked together to establish the CFBAI. Its guidelines and implementations have been criticized for being vague and slack. For instance, Coca-Cola committed not to advertise on child-directed programs if more than half of the targeted audience were children under age 12. However, there is a loophole in defining a "child-directed" program based on the percentage of children among the target audience of the program. For example, a large number of children under age 12 may watch, and thus can be exposed to Coca-Cola's advertisement, on programs such as "American Idol," even though less than half of its targeted audience are children under 12 (Consumers International, 2009; Lukovitz, 2008). In addition, the CFBAI did not have a standardized definition of "better-for-you." Instead, it allowed its participants to use their own definition, which can be bewildering to consumers and self-serving for the industry (Consumers International, 2009).

Our study contributes to the policy debate in two ways. First, we find that the CFBAI

itself did *not* have significant effects on consumer purchases with respect to some high-calorie and high-sugar candy products, such as chocolate. Second, we provide empirical evidence that *is* consistent with a causal effect of a household's exposure to food advertising on the household's food choice. Specifically, we find that although the CFBAI failed to reduce a child's exposure to TV advertising, for products such as chocolate, for bubble gum products—for which consumers *did* experience an arguably exogenous reduction in their exposure to the product advertising (over a period coincidentally consistent with the CFBAI implementation period)—purchases of the product were less frequent. Thus, despite being a self-regulation, the CFBAI can be effective as long as regulators and the industry indeed reduce the amount of and thus exposure to advertising of unhealthy products.

Throughout our sample period, the CFBAI participants were only required to devote a minimum of 50% of their child-directed advertising to "better-for-you" products. Child-directed advertising is defined as advertising aired on programs in which children under 12 exceed a certain percentage of the total target audience. Thus, CFBAI participants still were able to advertise on programs watched by many children with a large absolute number but a small percentage of the total target audience not exceeding the CFBAI regulation threshold. Effective January 1, 2010, the CFBAI enhanced its core principles so that participants are now required to devote 100% of their child-directed advertising to "better-for-you" products. This seems to be a step towards a more effective reduction in advertising exposure. As our empirical findings suggest, more stringent guidelines by the CFBAI to change the landscape of advertising directed to children seems promising for real changes to occur in children's and consumers' dietary choices.

3 Background of the Children's Food and Beverage Advertising Initiative

The CFBAI requires its participants: 1) to reduce third-party licensed character use in child-directed advertising; 2) to incorporate healthier dietary choices, or to include healthy lifestyle messages in child-directed interactive games; 3) to stop paying for product placement of food and beverage products in child-directed editorial or program content; and 4) to stop advertising branded foods and beverages in elementary schools (Kolish and Peeler, 2008). The BBB oversees and monitors the compliance annually. Noncompliance results in termination of CFBAI membership.

By July 2007, the CFBAI included 11 leading food and beverage companies, which collectively accounted for at least two-thirds of the expenditures of child-directed television advertising on food and beverage in 2004. As of 2009, 16 companies had joined: Burger King, Campbell's, Coca-Cola, ConAgra Foods, Dannon, General Mills, Kellogg Company, Kraft Foods, McDonald's, Nestlé USA, PepsiCo, Post Foods, Unilever, and three top candy manufacturers, Mars, Hershey's, and Cadbury Adams. The CFBAI did not standardize the definition for "child-directed programs." Instead, each participant used its own definition and had individual pledge and implementation timelines. Among the three candy manufacturers, Mars committed not to purchase advertising dayparts (i.e., Monday-Friday, 3-6 p.m.), in which its estimated total child audience would exceed 25 percent. The company also eliminated certain time blocks that would likely include programs with a larger-than-expected under-12 audience. Hershey's pledged not to purchase advertising either in media with at least 30 percent of the annual audience being under 12, or on programs traditionally considered for children only. Cadbury Adams' pledge, which only covered Bubblicious Gum (the company's only product that had been advertised primarily to children), was to not buy television advertising during dayparts in which over 50 percent of the audience were under age 12 (Peeler, Kolish, and Enright, 2009).

In our sample period from February 2006 to December 2008, the three top candy manufacturers completed their CFBAI pledges not to engage in any child-directed advertising for their products. The implementation dates were January 1, 2007, March 31, 2007, and January 1, 2008 for Hershey's, Mars, and Cadbury Adams, respectively.[3] Based on these three companies' own annual compliance reports and the BBB's independent monitoring, the BBB concluded that all three companies had fulfilled their obligations (Kolish and Peeler, 2008; Peeler, Kolish, and Enright, 2009).[4]

4 Empirical Setting

The candy industry is ranked third largest in the food category in terms of total revenue in the United States in 2008, following carbonated beverages and milk. According to the FTC report (Holt, Ippolito, Desrochers and Kelley, 2007, p.87), (non-gum) candy and gum account for 2.3% of advertising exposure for children ages 2-11 in 2004. This is the third largest in the food category, following restaurants and fast food (5.3%) and highly sugared cereals (3.3%). Many studies have linked over-consumption of confectionery products to excessive weight gain, tooth decay, increased cholesterol levels, and diabetes.

For us, one advantage of focusing on the candy category is that implementation dates of some CFBAI participants in the candy industry fall within our sample period (from February 2006 to December 2008).[5] Thus, we can compare household purchasing behaviors both before

[3]Mars originally pledged to cease advertising of its "traditional candy and snack" when it joined the CFBAI in January 2007, but it amended its pledge in March 2008 to state that it would not advertise any products to children under 12. Cadbury Adams initially committed either to stop advertising its Bubblicious brand bubble gum to children under 12, or devote at least half of its advertising for a better-for-you version of the product, starting on March 31, 2008. In March 2008 Cadbury informed the BBB that it had stopped all advertising to children under 12 earlier in 2008 (Peeler, Kolish, and Enright, 2009).

[4]Two other major candy manufacturers, Nestlé USA and Kraft Foods also joined the CFBAI during our sample period with different implementation timings: Nestlé USA committed to limit 100% of its child-directed advertising to better-for-you products in measured media after January 1, 2009. Kraft Foods claimed that its pledged commitments had already been effective since November, 2006 (Peeler, Kolish, and Enright, 2009).

[5]According to the BBB report (Peeler, Kolish, and Enright, 2009), the following 12 companies completed their CFBAI pledges before or during 2008: Burger King, Cadbury Adams, Campbell's, Coca-Cola, ConAgra Foods, General Mills, Hershey's, Kraft Foods, Mars, McDonald's, PepsiCo, and Unilever. The following 3

and after CFBAI implementation. In other categories, such as soft drinks, breakfast cereals, and snacks, we lack observations either before or after CFBAI implementation, which hinders identification of the CFBAI's effect on household dietary choices.

4.1 Data

We use two proprietary datasets from Nielsen Homescan and Nielsen Media Research. The former tracks a panel of 13,985 households and all of their candy purchases from grocery stores, drug stores, vending machines, and on-line shopping sites from February 2006 to December 2008.[6] Our sample includes households living in 16 DMAs across the country.[7] For each purchase, we have information on product characteristics (such as brand, Universal Product Code, flavor, package, and size), marketing information (such as unit price, price paid, coupon use, and in-store displays and features), and the location and time of each transaction. We also have demographic information for each household, including income, household size, education, employment and occupation of household heads, and most importantly, age and presence of children. The Nielsen Media dataset records brand-level television advertising information for each of the 16 DMAs in a given period, taken at weekly intervals. It includes information on advertising expenditures and, in particular, weekly advertising exposure measures for each brand for five different age groups at the DMA level. Specifically, the data document Gross Rating Point (GRP) on cable, syndicated, network, and spot television for these age groups: audience ages 2-5, 6-11, 12-17, 18-24, and over 25. The GRP measures the percentage of an audience in a given population reached by a specific commercial over a specified period of time. It is the sum of all rating points over a specific time period, where the rating point of a show is the percentage of people (or households) tuned

companies undertook or completed their CFBAI pledges in 2009 (before October 2009): Dannon, Kellogg Company, and Nestlé USA. Post Foods joined CFBAI on October 1, 2009.

[6] Because impulse-buys constitute a significant component of candy purchases, it is important to collect consumer purchase information from almost all possible retail outlets.

[7] The 16 DMAs are: Atlanta, Boston, Baltimore, Chicago, Detroit, Hartford and New Haven, Houston, Kansas City, Los Angeles, Miami-Ft. Lauderdale, New York, Philadelphia, San Francisco-Oakland-San Jose, Seattle-Tacoma, Springfield-Holyoke, and Washington DC.

into a commercial relative to the total number of people (or households) with television sets in a DMA. That is, if a commercial has a rating of 7, then 7% of all households who have television sets in this DMA tune into this commercial. If a commercial is aired twice during a specified period, and has a rating of 7 and 10 respectively, then its GRP for that period is 17.

4.2 Research Design

Our study has two specific objectives. The first is to identify the effect of a voluntary advertising restriction (CFBAI) on a product on a household's relative purchase frequency or volume purchased of the product. Ultimately, we are interested in exploring the underlying mechanism that motivates the self-regulation. Hence, our other objective is to investigate whether, and how, advertising exposure affects consumer choices. Ideally, we would use the CFBAI-induced variations in household-level advertising exposure to measure how households' purchase behavior responds to advertising exposure. However, our advertising exposure data from Nielsen Media Research are measured only at the DMA level, not the household level. Accordingly, we aim to examine: 1) the effect of the CFBAI implementations on consumer choice, with household level purchase data; and 2) whether the CFBAI implementations actually have led to reductions in advertising exposure, with the DMA-level advertising data. If we find that the CFBAI's impact on advertising exposure is consistent with its impact on consumer food choices, then there will be indirect evidence supporting the role of advertising exposure in influencing consumer dietary choices.

In Figure 1 we show consumers' exposure to advertising on all products in the candy category during the sample period from February 2006 to December 2008. The over-time advertising exposure for products covered by the CFBAI pledges, manufactured by the three CFBAI participants, are presented in Panels A to C. Panel D illustrates the changes in advertising exposure over time for the products manufactured by non-CFBAI-participants. The vertical lines indicate the CFBAI participants' implementation dates. Advertising ex-

posure is measured by GRPs in the national market, aggregated across all four formats of television programming (cable, network, syndicated, and spot), and summed across all brands for audiences in five age groups: 2-5, 6-11, 12-17, 18-24, and over 25. For Hershey's (Panel A) and Mars (Panel B), we notice that the GRPs for children under 12 are lowest relative to the other age groups. In contrast, for Cadbury Adams (Panel C), the GRPs for children under 12 dominate the other age groups. This suggests that Cadbury Adams directs its advertising primarily to children under 12, and its advertising practice appears to have been fully restricted by its CFBAI pledge. However, as Panels A and B suggest, Hershey's and Mars do not direct advertising of all their products primarily to children. Therefore, the GRPs representing children's exposure to their products barely seem affected by their CFBAI pledges.

Figure 2 shows the changes in advertising exposure over time, by CFBAI participation status, for the following five modules: chocolate, non-chocolate, bubble gum, chewing gum, and lollipop.[8] We observe that the GRPs which represent advertising exposure of children under 12 dominate the GRPs of all other age groups only for: bubble gum produced by all firms; non-chocolate candy produced by all non-participants; and lollipops produced by all non-participants. In Figure 2, however, the GRPs shown for all age groups for all these products actually follow a very similar trend over time. This suggests that the changes in exposure to child-directed advertising attributable to the CFBAI implementation may not be limited to children. Such spillovers will occur when a family watches child-directed commercials together.

Using CFBAI-induced variations in advertising exposure, we focus on two products: bubble gum and chocolate.[9] For each, we examine the effect of the CFBAI implementation on household purchase decisions using a treatment-effect framework. The treatment is defined as a company's implementing its CFBAI pledge. Both before and after the CFBAI implementation, households that purchase only the product made by a CFBAI participant

[8] We will use product and module interchangeably.

[9] We do not examine chewing gum because of its small market share.

constitute the treatment group. For chocolate, the control group is households who only purchase chocolate made by non-CFBAI participants. However, because of a decline in advertising exposure coincident with the CFBAI participation, bubble gum made by non-CFBAI participants is not a suitable product for defining the control group. For the bubble gum product, we instead define the control group as households who only purchase lollipops made by non-CFBAI participants both before and after the CFBAI implementation. Both bubble gum and lollipops are primarily marketed to children. For households who bought either product during the sample period, we assume that what drives the choice between bubble gum and lollipops for the treatment versus the control group on average remains unchanged over time.

Panels A and B of Figure 3 show the changes over time in monthly aggregated GRP in the national market for the five age groups and by product for: the bubble gum made by Cadbury Adams and lollipops made by all non-participants, respectively.[10] The vertical lines represent the CFBAI implementation dates. It appears that Cadbury Adams completely ceased advertising its bubble gum in 2008, while the non-CFBAI participants maintained their existing lollipop advertising practices: their adverting exposure pattern barely changed.

Because the Nielsen Homescan data measure the bubble gum size by piece count and lollipop size by ounce, which makes direct volume comparisons difficult, we focus instead on a household's relative purchasing frequency, defined as the frequency of a household's purchasing the product relative to the household's total number of grocery shopping trips per month.[11] Figure 4 shows the average monthly relative purchasing frequency of the treatment group (purchasing Cadbury Adams' bubble gum) and the control group (purchasing non-participants' lollipops). Panel A shows the entire sample period: the vertical line indicates the date of Cadbury Adams' CFBAI implementation. Candy purchases tend to be cyclical

[10] No households purchased any bubble gum made by Hershey's in our sample period. Mars' CFBAI pledge did not extend to bubble gum until January 2010.

[11] In our data, we observe transactions made by each household who bought products from the following four categories: candy, carbonated soft drink, snacks, and breakfast cereal. We use the number of trips in a month during which a household bought any products from these four categories as a measure of the total number of grocery shopping trips per month.

and seasonal, so we compare two periods that include the same months before and after the implementation. Panels B and C show the relative purchase frequencies in a 9-month period from April to December 2007 (before Cadbury Adams' implementation) and 2008 (after its implementation). A comparison of these two panels reveals that the relative purchase frequency of the treatment group seems to decline in the post-implementation period relative to that of the control group. However, given the very low relative purchase frequencies, and the small size of the treatment group, one should be cautious in reading the graphical patterns, because noise can be overwhelming.

Next we focus on the chocolate product, for which CFBAI did not seem to reduce advertising exposure to the participants' products. Similar to previous definition, Both before and after the CFBAI implementation, households who purchased only chocolate made by a CFBAI participant constitute the treatment group, and households who purchased only chocolate made by non-CFBAI participants constitute the control group. Figure 5 illustrates GRPs by participants and non-participants for all five age groups for chocolate. In Figure 5, the GRPs for children under 12 are consistently lower than those for other age groups. This suggests that chocolate is not advertised primarily to children under 12. Figure 5 also reveals that Mars' and Hershey's CFBAI implementations did not reduce children's exposure to advertising on chocolate; there actually seemed to be an increase in advertising exposure of audiences above age 12 during the post-implementation periods.

Figure 6 shows the relative purchase frequencies of chocolate for both the treatment group and the control group over the entire sample period (in Panel A), 9 months before the CFBAI implementation (in Panel B), and 9 months after the CFBAI implementation (in Panel C).[12] There is little evidence of a reduced relative purchasing frequency because of the CFBAI. Comparing Figure 6 with Figure 5, we suspect the lack of CFBAI effects on

[12] We do not present the graphical analysis for the Hershey's chocolate sample, because we only have very short pre- and post-treatment periods, making graphical analysis uninformative. Hershey's had completed its CFBAI implementation by January 1, 2007. In order to avoid the convoluted effect due to Mars' completion of its CFBAI pledge on March 31, 2007, we can look only at a 2-month period including February and March in 2006 as the pre-treatment period, and February to March in 2007 as the post-treatment period.

the relative purchasing frequency may come from the absence of reductions in advertising exposure. Next we turn to a DID-based regression analysis to explore this conjecture.

Tables 1A and 1B report the summary statistics for the two samples for chocolate and bubble-gum-and-lollipop, respectively, and by company. Indeed, there is a stark difference in the proportions of households who bought the products of CFBAI participants for the bubble-gum-and-lollipop versus the chocolate samples. In particular, only 4.2% of households bought Cadbury Adam's bubble gum (shown in the third column of Table 1B), but nearly 60% of households bought Mars' or Hershey's chocolate (shown in Table 1A). This is because of the vastly different market shares of these two companies within the bubble gum and chocolate market. Another significant difference between the products is the share of households with children under age 12 in their markets. Specifically, 42% of the households in the bubble-gum-and-lollipop sample have children under 12 (shown in the third column of Table 1B), but fewer than 30% of the households who bought chocolate have children under 12 (shown in Table 1A). This distinction suggests that children under 12 represent a proportionally larger market for bubble gum and lollipops than for chocolate. Similarly, a higher fraction of the households is married and there are larger families in the bubble-gum-and-lollipop sample than in the chocolate samples. On the other hand, other demographic variables such as race, income, and education do not make much difference across the bubble-gum-and-lollipop sample and the chocolate samples.

4.3 Econometric Specification

For our DID-based analysis, we collapse the monthly time-series data into one pre-treatment and one post-treatment period. This approach closely follows Bertrand, Duflo, and Mullainathan (2004) to correct for artificially low standard errors in the presence of serially correlated outcomes. Specifically, for each household we compute the average monthly relative frequency for each of the two periods with the same months in different years, before and after the relevant CFBAI implementation, respectively. The econometric model based

on potential outcomes is specified as follows:

$$y_{jit} = \beta_0 + \beta_1 G_i + \beta_2 T_i + \beta_d j + \mathbf{x}'_{it}\beta_x + \alpha_i + u_{jit}.$$

The treatment state ($j = 1$) refers to the presence of a company's CFBAI implementation. The control state ($j = 0$) refers to the absence of a company's CFBAI implementation. In this model, y_{jit} denotes a household i's potential purchase decision, which is measured by monthly relative purchase frequency or monthly volume purchased, in period t ($t = 1$, 2 for pre- and post-treatment period, respectively) under the state j ($j = 0$, 1). In this model, we allow household i's unobserved heterogeneities u_{jit} to vary over time (t) and to differ by the state (j). Certain unobservables, such as household i's taste, are assumed to be time-invariant and denoted by α_i. The group indicator G_i denotes whether a household i belongs to the treatment group that only bought a product made by a CFBAI participant ($G_i = 1$) or a non-CFBAI participant ($G_i = 0$). The time indicator T_i denotes whether a household i is in the pre-treatment period ($T_i = 0$ if $t = 1$) or the post-treatment period ($T_i = 1$ if $t = 2$). Other covariates affecting a household i's purchasing decision are included in $\mathbf{x}_{it}$, which are assumed to be the same across the two states. The average impact of the CFBAI on a household's purchase decision is given by β_d.

If we assume that the unobservables in the treatment group and the control group on average share the same change over time in the absence of treatment—that is, a common trend— then the parameter β_d will identify the average effect of treatment on the treated ($G_i = 1$) in the second period ($T_i = 1$) (ATT). To identify the average treatment effect (ATE) unconditional on G and T, we need a stronger assumption that the common trend still holds, in both the absence and the presence of treatment. With our balanced panel structure, we can difference out the unobservables α_i fixed over time and obtain the a first-differenced

potential outcome model,

$$\begin{aligned}\Delta y_{0i} &= \beta_2 + \Delta \mathbf{x}_i' \beta_x + u_{0i2} - u_{0i1} \\ \Delta y_{1i} &= \beta_2 + \beta_d + \Delta \mathbf{x}_i' \beta_x + u_{1i2} - u_{0i1}.\end{aligned}$$

The observed change in a household i's purchase decision is:

$$\Delta y_i = \Delta y_{0i} + G_i(\Delta y_{1i} - \Delta y_{0i}),$$

where $\Delta w \equiv w_t - w_{t-1}$ $(t = 1, 2)$.[13] The observed change in the household i's purchase decision between the two periods Δy is a linear combination between the two potential changes in purchase decisions in the presence (Δy_1) and in the absence of the treatment (Δy_0). Conditional on the changes in the observables and treatment status, the expected changes in purchase decisions are:

$$\begin{aligned}\mathbb{E}(\Delta y|\Delta \mathbf{x}, G &= 1) = \beta_2 + \beta_d + \Delta \mathbf{x}' \beta_x + \mathbb{E}(u_{12} - u_{01}|\Delta \mathbf{x}, G = 1) \\ \mathbb{E}(\Delta y|\Delta \mathbf{x}, G &= 0) = \beta_2 + \Delta \mathbf{x}' \beta_x + \mathbb{E}(u_{02} - u_{01}|\Delta \mathbf{x}, G = 0).\end{aligned}$$

The DID will simply give:

$$\begin{aligned}\text{DID} &= \mathbb{E}(\Delta y|\Delta \mathbf{x}, G = 1) - \mathbb{E}(\Delta y|\Delta \mathbf{x}, G = 0) \\ &= \beta_d + \mathbb{E}(u_{12} - u_{01}|\Delta \mathbf{x}, G = 1) - \mathbb{E}(u_{02} - u_{01}|\Delta \mathbf{x}, G = 0),\end{aligned}$$

which does not identify a causal effect unless we make certain assumptions about the difference in the change over time in the unobservables in the treatment and the control group.

[13] Note that with no group membership switched between the two periods, we have $\Delta G_i = 0$. By definition, $\Delta T_i = 1$. The treatment occurred in the second period $(G_i T_i = 1)$ in the treatment group. To simplify notations, we omit the subscript i hereafter.

4.4 Identification Assumptions

If the unobservables on average likely share the same change over time between the treatment and control groups (the common trend) conditional on changes in the observables, then the following identification assumption holds:

$$\mathbb{E}(u_{02} - u_{01}|\Delta\mathbf{x}, G = 1) = \mathbb{E}(u_{02} - u_{01}|\Delta\mathbf{x}, G = 0).$$

Under this common-trend assumption, DID enables us to replace $\mathbb{E}(u_{02} - u_{01}|\Delta\mathbf{x}, G = 0)$ with $\mathbb{E}(u_{02} - u_{01}|\Delta\mathbf{x}, G = 1)$. Thus, we can difference out $\mathbb{E}(u_{01}|\Delta\mathbf{x}, G = 1)$ to identify ATT by DID.

$$\begin{aligned} \text{DID} &= \beta_d + \mathbb{E}(u_{12} - u_{02}|\Delta\mathbf{x}, G = 1) \\ &= \mathbb{E}(\Delta y_1 - \Delta y_0|\Delta\mathbf{x}, G = 1) = \mathbb{E}(y_1 - y_0|\mathbf{x}, GT = 1) \\ &= \text{ATT}(\mathbf{x}) \end{aligned}$$

Note that $\mathbb{E}(u_{12} - u_{02}|\Delta\mathbf{x}, G = 1)$ represents the treatment effect heterogeneity due to unobservables in the treatment group, which is the source of difference between ATE (β_d) and ATT.[14]

If the unobserved difference between the treatment and the control group is due only to time-invariant factors, then we will have $\mathbb{E}(u_{02} - u_{01}|\Delta\mathbf{x}, G = 1) = \mathbb{E}(u_{02} - u_{01}|\Delta\mathbf{x}, G = 0) = 0$. The common-trend assumption for DID to identify ATT will hold (trivially). The plausibility of the common-trend assumption depends critically on whether the time-varying unobservables in the treatment and control group have the same change between the two periods. Because this identification assumption is not directly testable, we conduct a mean comparison of purchase decisions as well as observed household characteristics in the pre-treatment period to suggest the difference between $\mathbb{E}(u_{01}|\mathbf{x}_1, G = 1)$ and $\mathbb{E}(u_{01}|\mathbf{x}_1, G = 0)$. If

[14] If there is no interaction, on average, between the unobservables and the treatment, we will have $\mathbb{E}(u_{12} - u_{02}|\Delta\mathbf{x}, G = 1) = 0$ and ATT will be identical to ATE.

the purchase behavior and the observed characteristics in the pre-treatment (in the absence of treatment) are very similar on average between the treatment and the control group, then it is more plausible for us to assume that the unobservables are also similar on average conditional on the observables:

$$\mathbb{E}(u_{01}|\mathbf{x}_1, G=1) - \mathbb{E}(u_{01}|\mathbf{x}_1, G=0) = \mathbb{E}(u_{02}|\mathbf{x}_2, G=1) - \mathbb{E}(u_{02}|\mathbf{x}_2, G=0).$$

This is the same as the common-trend assumption. This assumption requires that, in addition to time-invariant unobservables between the treatment and control group, any other systematic differences due to time-varying unobservables between these two groups in the absence of treatment remain the same in the two periods. In terms of the first-differenced model,

$$\Delta y = \beta_2 + \Delta\mathbf{x}'\beta_x + \beta_{\text{ATT}}G + (u_{02} - u_{01}) + [(u_{12} - u_{02}) - \mathbb{E}(u_{12} - u_{02}|\Delta\mathbf{x}, G=1)]G, \quad (1)$$

where $\beta_{\text{ATT}} = \beta_d + \mathbb{E}(u_{12} - u_{02}|\Delta\mathbf{x}, G=1)$.[15] Our key identification assumption is $Cov(G, u_{02} - u_{01}|\Delta\mathbf{x}) = 0$, which is equivalent to[16]

$$\mathbb{E}(u_{02} - u_{01}|\Delta\mathbf{x}, G=1) = \mathbb{E}(u_{02} - u_{01}|\Delta\mathbf{x}, G=0).$$

In Tables 2A, 2B, and 2C we present comparisons of relative purchase frequencies and household characteristics between the treatment group and the control group in the pre-treatment period for all the estimation samples. In the bubble-gum-and-lollipop samples, the purchase frequencies between the treatment and the control group are at most barely significantly different at 10% level. This similarity in purchase propensity between the treatment and the control group in the absence of treatment suggests a higher likelihood that the unobservables, on average, share similar changes between the pre- ($T=0$) and the post-

[15] Note that $Cov(G, [(u_{12} - u_{02}) - \mathbb{E}(u_{12} - u_{02}|\Delta\mathbf{x}, G=1)]G) = 0$.

[16] Note that $Cov(G, u_{02} - u_{01}|\Delta\mathbf{x}) = Var(G|\Delta\mathbf{x})[\mathbb{E}(u_{02} - u_{01}|\Delta\mathbf{x}, G=1) - \mathbb{E}(u_{02} - u_{01}|\Delta\mathbf{x}, G=0)]$.

treatment ($T = 1$) period. In these samples, the household characteristics of the two groups are not always similar on average. We control explicitly for those household characteristics in our regression model. For the chocolate samples, the relative purchase frequencies *are* statistically different, suggesting brand loyalty (for chocolate) towards a particular CFBAI participant. The dissimilarity between the relative purchase frequencies and some household characteristics between the treatment and the control groups does not necessarily invalidate the common-trend assumption, which requires that the difference between the two groups, although unobservable, on average remains the same over time. However, this common-trend assumption could be more stringent for the chocolate analysis than for the bubble-gum-and-lollipop analysis.

4.5 Regression Model

Based on equation (1), we specify our regression model as follows:

$$\Delta y_{ik} = \beta_2 + \beta_{\text{ATT}} G_i + \mathbf{h}_i' \beta_h + \mathbf{m}_k' \beta_m + \Delta \mathbf{m}_k' \beta_{\Delta m} + \gamma_k + \epsilon_{ik}, \tag{2}$$

where Δy_{ik} is the change in the purchase decision of household i living in DMA k. Next we estimate β_{ATT} based on three variations of equation (2). In the first case we include only G_i and an intercept term controlling for the time trend, β_2. In the second case we include the regressors in the previous case, plus a set of household demographics, $\mathbf{h}_i$ (such as income, household size, race, marital status, household head's employment and education in the pre-treatment period), as well as marketing conditions, $\mathbf{m}$ (such as average prices, sales, coupon availability, and in-store display of the products) measured at the level of DMA k in the pre-treatment period, and the associated changes, $\Delta\mathbf{m}$. The third case includes all of the control variables in the second case, plus a set of DMA dummy variables each for the effect (γ_k) of DMA-level time-invariant unobservables .

5 Empirical Results

We first conduct the econometric analysis just specified with two products: bubble gum and lollipops. The CFBAI implementations decrease advertising on bubble gum made by the participants but not advertising on lollipops made by the non-participants. Table 3 presents the DID results of the CFBAI effect on relative purchase frequencies of Cadbury Adams' Bubblicious brand bubble gum, and we use lollipop products made by non-participants as the control group. We report the results in three columns, each corresponding to one of the previously described specifications. In all specifications the standard errors are clustered at the DMA level. The Bubblicious brand of bubble gum has a very small market share. As a result, there are only a few households in our sample who purchased only the Bubblicious brand. We use a 9-month period from April to December 2007 as the pre-treatment period. This is prior to Cadbury Adams' completing its CFBAI implementation on January 1, 2008 and does not overlap Mars' completing its CFBAI implementation on March 31, 2007. We use the same 9 months—April to December—in 2008 as the post-treatment period. We select the same time period to match the treatment and the control group in order to control for any cyclical (or seasonal) purchase patterns. Because of the small market share of the Bubblicious brand, there are only 57 households in the treatment group, defined as those who purchased the Bubblicious brand but not non-participants' lollipop products. The treatment group is small (57 households) relative to the control group (1,301 households) and gives us limited power to detect any statistically significant effects. In Table 3, we only find that the CFBAI effect is statistically significant at the 10% level for the second specification. The only explanatory variable that is consistently significant in all specifications is the relative purchasing frequency in the pre-treatment period. Its negative relation to the change in the relative purchase frequency suggests a reversion to a long-term average of the relative purchase frequency. Failing to control for mean reversion could overstate the CFBAI effect, because both mean reversion and the CFBAI lead to a reduction in relative purchase frequency.

Next we repeat the analysis with chocolate. As shown in Figures 5 and 6, we do not find significant reductions in advertising exposure to Mars' chocolate 6 or 9 months before and after its CFBAI implementation, nor do we find any significant reductions in advertising exposure to Hershey's chocolate 2 months before and after its CFBAI implementation, relative to the non-CFBAI participants. If there is a causal link between advertising exposure and purchase decisions, then we do not expect to find a negative effect for CFBAI implementation on purchase decisions when there is little change in the advertising exposure. Tables 4 and 5 confirm this conjecture. In all columns of Tables 4 and 5, almost no treatment effect estimates are negative and statistically significant. Note that we obtain those statistically insignificant estimates with much larger sample size in Tables 4 and 5 than in Table 3. For the 6-month sample (in Table 4), there are 2,644 households in the treatment group and 1,575 households in the control group. For the 9-month sample (in Table 4), there are 1,970 households in the treatment group and 1,257 households in the control group.[17] For the 2-month sample (in Table 5), there are 2,618 households in the treatment group and 1,858 households in the control group. Again, relative purchase frequencies in the pre-treatment period are consistently negative and statistically significant in all samples and specifications, which suggests the existence of mean reversion in relative purchase frequency.

Because of a lack of comparable quantity units in the data, we could not gauge the impact of CFBAI implementations on quantities of bubble gum and lollipops that a household purchases. However, for chocolate, the size of the products are all recorded in ounces. Thus we can measure the CFBAI effect on volume purchased. We report these results in Tables 6 and 7. Across all columns, and like the relative purchase frequency results, we do not find the CFBAI effects to be negative and statistically significant. Such consistency suggests that the lack of reduction in advertising exposure despite CFBAI implementation could be linked to a lack of reduction in purchase propensity in the presence of CFBAI implementation.

[17]Because households that bought both product made by CFBAI participants and product made by non-CFBAI participants are not included in the estimation sample so that there will no households in both the treatment and the control group, the sample size of the 9-month period can be and is actually smaller than the sample size of the 6-month period in Table 4.

To sum up, we find little evidence supporting a significant effect of the CFBAI implementation in reducing relative purchase frequency (and volume purchased in some cases), which coincides with a lack of reduction in advertising exposure. We examine two products, bubble gum and chocolate. In the case of bubble gum, although Cadbury Adams' CFBAI implementation appears to have reduced consumers' exposure to its advertising, the limited number of households who purchased the product prior to the implementation hinders us from detecting a significant CFBAI effect. In the case of chocolate, the CFBAI implementation does not restrain the advertising exposure to chocolate, nor does it reduce the relative purchase frequency or the purchase volume of the CFBAI participants. These results lead to our next question: can consumers' food choices be affected through a change in their exposure to food advertising?

5.1 Falsification Check

We use the following falsification check to see whether an actual decrease in consumers' exposure to advertising on a product can falsify a "CFBAI effect" which, if present, should reduce consumers' relative purchase frequency of the product. Note that in the presence of an actual advertising exposure reduction such a falsified "CFBAI effect" suggests an effect of a *mandatory* restriction on advertising practice. To conduct this falsification check, we need to find a product that undergoes a significant reduction in advertising exposure during our sample period *not due to* CFBAI. Because our advertising exposure data are measured at the DMA level only, we are not able to directly examine the relationship between a household's purchase decision on a product and the household's exposure to advertising of the product. Instead, we still use the DID approach to isolate an excessive change in a household's relative purchase frequency in the treatment group, which experiences a reduction in advertising exposure *not due to* CFBAI relative to the control group in which there is little change in advertising exposure. We label the excessive change in the household's relative purchase frequency a "CFBAI effect."

For the falsification check, we select the bubble gum produced by Mars and its current subsidiary, the William Wrigley Jr. Company. The original pledge that Mars implemented on March 31, 2007 covered only its snack and confectionery products. Mars acquired the William Wrigley Jr. Company on April 28, 2008 and did not extend its CFBAI pledge to bubble gum until January 2010. Hence, the bubble gum brands of Mars (including a couple of Skittle brands) and the William Wrigley Jr. Company (including a number of Hubba Bubba brands) were not covered by the CFBAI in 2007. We term these bubble gum products thereafter the "Mars" bubble gum. Panels A and B of Figure 7 present the monthly advertising exposure measured by the GRP for the five age groups in the national market of "Mars" bubble gum and non-CFBAI participants' lollipops, respectively. Panel C of Figure 7 presents the monthly advertising expenditure for both "Mars" bubble gum and non-CFBAI participants' lollipops. The vertical line represents the Mars' original CFBAI implementation date (March 31, 2007). From Figure 7, we may reasonably attribute the decline in the advertising exposure to Mars' bubble gum to the decline in Mars' advertising expenditure. Notice that these two reductions coincide with Mars' original CFBAI implementation date, which is an ideal setup for our falsification check. Also, the two GRPs representing the advertising exposure of audience under 12 are always higher than the GRPs of other age groups, indicating that "Mars" bubble gum directed its advertising primarily to children under 12. Therefore, the "Mars" bubble gum products would have been regulated by the CFBAI if the CFBAI pledges were applicable to them.

We argue that the reduction in advertising exposure of the "Mars" bubble gum can be exogenous to the households, conditional on household-level demographic characteristics and DMA-level marketing conditions. First, based on Panels A and C of Figure 7, the reduction in advertising exposure seems to be a result of reductions in the company's advertising expenditure. Comparing Panel C of Figure 7 with Panel A of Figure 8, we also note that the reduced advertising expenditure does not seem to closely track households' relative purchase frequencies. Notice that a significant decline in Mars' advertising expenditure on bubble

gum occurred between June 2006 and October 2006. During this same period, the relative purchase frequency of Mars' bubble gum averaged across all households stayed relative stable. This suggests that the significant decline in Mars' advertising expenditure on bubble gum did not result from falling demand. Second, because all Mars bubble gum brands had been directing their advertising to children under 12 when Mars participated in the CFBAI in 2007, Wrigley—a leading firm in the gum market—was likely under pressure to join the CFBAI when it was still an independent entity. Moreover, in the U.K., where Wrigley has a strong market share, regulators announced a mandatory ban on child-directed advertising in November 2006. Given the market environment, it is possible that the "voluntary" reduction in advertising by "Mars" bubble gum was a result of anticipated involvement in self-regulation, not falling demand from households.

To explain the unobserved consumer taste for certain products, we use the DID approach. Unlike the previous analysis, we herein define a "fake CFBAI" treatment as a decrease in advertising exposure to "Mars" bubble gum products, which coincides with Mars' original CFBAI implementation that did not cover its bubble gum products. Before and after the fake treatment, households only purchasing "Mars" bubble gum constitute the treatment group. The control group includes households who only purchased lollipops made by non-CFBAI participants both before and after the fake treatment.

Figure 8 presents the relative purchase frequencies with the fake treatment occurring on March 31, 2007, on which date Mars fulfilled its original CFBAI pledges. We depict the average monthly relative purchase frequency for both the treatment group and the control group. Panel A shows the entire sample period, with the vertical line indicating the Mars' original CFBAI implementation date. Panels B and C respectively show the monthly relative purchase frequency averaged across households in a 9-month pre-treatment period from April to December 2006, and the same 9-month period post-treatment in 2007. In the pre-treatment period, the relative purchase frequencies of the treatment and the control group appear to be similar on average (even unconditional on household-level demographic characteristics and

DMA-level marketing conditions). In the post-treatment period In contrast, the two series diverge, with an evident decline in the relative purchase frequency for the treatment group and not for the control group.

We rely on the common-trend assumption to isolate the fake-treatment effect, given that it permits us to use the change over time in the relative purchase frequency of the control group as a counterfactual for change in the treatment group if it had received no (fake) treatment. Similarly, we indirectly check for the plausibility of the common-trend assumption by comparing the relative purchase frequency and the household-level demographic characteristics of the treatment group and the control group in the pre-treatment period. In Table 2C, the relative purchase frequencies of the treatment and the control group are not statistically different, as Panel B of Figure 8 suggests, with a p-value equal to 0.139. This similarity strengthens the plausibility of the common-trend assumption. We argue that it also strengthens the plausibility of the exogeneity of the reduction in advertising exposure with respect to the households.

Panel C of Figure 7 shows that, facing similar demand as indicated by similar relative purchase frequencies and similar household income between the treatment and the control group, the lollipop manufacturers continued their advertising around March 31, 2007 (the Mars' original CFBAI implementation date), but the manufacturers of "Mars" bubble gum chose to discontinue their advertising. Because a decline in advertising exposure is likely to result from a decline in advertising expenditure, the similarity between the treatment and the control groups (defined based on the decline in advertising exposure) is consistent with the plausibility that the treatment-control group assignment occurred exogenously to households in the pre-treatment period, unconditional on household-level demographic characteristics. Nonetheless, we still control for household-level observables in our regression model (in the second and third cases).

We present the summary statistics for the falsification check in Table 1B. We consider two samples: in the first, the pre-treatment period runs from April to September 2006, 6 months

before the fake treatment. The post-treatment period includes the same 6 calendar months in 2007, immediately after the fake treatment—Mars' original CFBAI implementation date (March 31, 2007). There are 369 households in the treatment group and 798 households in the control group. In the second sample, the pre-treatment and post-treatment periods are April to December 2006 and 2007, respectively. There are 524 households in the treatment group and 1,261 households in the control group. The summary statistics for the two samples are quite similar. In both samples, there are around 30% of households who purchased "Mars" bubble gum, which reflects the market share of "Mars" in the bubble gum and lollipop market. Bubble gum and lollipops are also "kiddie candies," because about half of the consumers have children under 12.

Table 8 presents the DID estimation results for the falsification check. For both samples, we report the results from the three specifications. In all specifications, we find a negative and statistically significant effect of the fake treatment on relative purchase frequency. This negative effect corresponds to a reduction in advertising exposure of a hypothetically mandatory (not voluntary) CFBAI. The effect is larger in the 6-month sample than in the 9-month sample, which could be due to some seasonal pattern around holidays. Specifically, in the third specification in which we include all household-level demographic characteristics, DMA-level marketing conditions, and DMA fixed effects, the effect is a decline of 1.586 and 0.817 percentage points in response to a decline in advertising exposure for the 6-month and the 9-month sample, respectively. In both cases, a decline in adverting exposure, which is possibly driven by a decline in firms' advertising expenditure not due to the CFBAI, can falsify the effect of a voluntary advertising restriction (such as the CFBAI) on household purchase decisions as measured by relative purchase frequency.

From Table 2C, we note that both "Mars" bubble gum and lollipops of non-CFBAI participants are not frequently purchased products prior to Mars' original CFBAI implementation date (March 31, 2007): the bubble gum relative purchase frequencies averaged across households and over the 6-month and the 9-month period are 3.369% and 2.477%,

respectively; the lollipop relative purchase frequencies averaged across households and over the 6-month and the 9-month period are 2.861% and 2.058%, respectively. Thus, as shown in Table 8, a decline of 1.586 percentage points (for the 6-month period) and 0.817 percentage points (for the 9-month period) are not trivial. Note that DID identifies the average effect of the treatment on the treated (ATT) as we explained in detail in Section 4. The falsified CFBAI effect (or the effect of an actual reduction in advertising exposure) represents an approximately 47% (for the 6-month sample) and 33% (for the 9-month sample) drop in the relative frequency of purchasing "Mars" bubble gum, if there were a voluntary advertising restriction such as the CFBAI. Also, as with the previous CFBAI effect analysis, the estimated effect of the relative purchase frequency in the pre-treatment period is consistently statistically significant and has a negative sign, indicating the existence of mean reversion in the household relative purchase frequency. Ignoring this control variable will likely overstate the treatment effect.

5.2 Summary

Combining the results of our falsification check with those of the actual CFBAI voluntary advertising restriction, we provide empirical evidence that supports a causal effect of advertising exposure on consumer purchase decisions as measured by relative purchase frequency and purchase volume in the candy category. Specifically, the CFBAI implementations by the top three candy manufacturers complied with the regulatory guideline, which did not effectuate actual reduction in children's exposure to advertising on their candy products, except for the not frequently purchased Cadbury Adams' bubble gum. Consistent with the causal link between advertising exposure and purchase decisions, the CFBAI implementation changed a firm's advertising practice, but it did not bring actual or sufficient changes in consumers' advertising exposure, and consequently failed to bring about its intended effect on changing consumers' dietary choice.

We next investigate whether reducing consumers' exposure to advertising indeed can af-

fect their purchase behavior. Using the DID approach, we attribute a decline in households' monthly relative frequency of purchasing a product (bubble gum) relative to a similar product (lollipop) to the reduction in their exposure to advertising on the product (bubble gum) relative to the other product (lollipop). Our empirical investigation shows that such a reduction in advertising exposure occurred largely due to a reduction in the firm's advertising expenditure in the absence of the firm's implementing the CFBAI. We thus have assembled empirical evidence suggesting that an advertising restriction, whether voluntary or mandatory, can affect a consumer's product-specific purchase decision, so long as such a restriction effectuates real changes in the consumer's exposure to the product's advertising.

6 Conclusion

Food and beverage advertising to children has been blamed for promoting unhealthy dietary choices and, consequently, contributing to the rising childhood obesity rate, despite a lack of conclusive scientific evidence justifying that blame. In the United States, the BBB established the CFBAI in 2006, a voluntary agreement with 16 major food and beverage companies having participated to date. The CFBAI represents a concerted effort of government agencies and the food and beverage industry aimed at encouraging children to make healthy dietary choice through changing the landscape of child-directed advertising. The CFBAI is based on the belief that restricting advertising to children will protect children from unhealthy products. However, studies on whether advertising affects consumer behavior still fall short of consistent empirical evidence. And the question of whether a self-regulation instead of a mandatory regulation can be effective is still contentious.

Our study presents the first empirical analysis of the impacts of the CFBAI more than three years after its launch. We first investigate whether CFBAI has been effective in changing consumers' food choices. We find that the CFBAI implementations of several leading companies have largely failed to reduce advertising exposure in the candy category, despite

full compliance. One exception is that consumers' exposure to advertising for Cadbury Adams' Bubblicious brand of bubble gum has been significantly reduced. However, the market share of this brand is small. With its current guidelines, CFBAI can only restrict advertising aired in child-directed programs, and the CFBAI participants are allowed to use their own definitions for child-directed programs, which are typically television programs whose estimated percentage of children in the audience exceeds a certain threshold. Most candy products—including the largest candy module, chocolate—were not advertised on such programs prior to the CFBAI implementations.[18] Consequently, we find little effect of these implementations on household food choice, because there is only a loose link between the TV programs that children get most of their advertising exposure from and the TV programs on which CFBAI participants reduced their advertising.

Next we examine whether changes in consumers' exposure to food advertising actually can affect their food choices. We study an actual reduction in advertising exposure, which occurred not because of but concurrent with the implementation date of a CFBAI participant. We find that this reduction in advertising exposure is likely to be exogenous to households. We further find that consumers are less likely to purchase a product when they are exposed to less advertising on the product. This study also shows how an actual reduction in advertising exposure, which is not due to CFBAI, can falsify the effect of a quite successful self-regulation such as CFBAI.

We find that CFBAI has not fully attained its goal of improving children's dietary choices via changes in firms' advertising practices. However, our empirical evidence supports a causal link between consumers' exposure to food advertising and their food choices, which has been the guiding principle of CFBAI. Our study suggests that strengthening the link between reducing advertising on child-directed programs and reducing children's actual advertising exposure should receive a high priority in designing and implementing CFBAI in the next stage.

[18] Coca-Cola and Pepsi did not advertise their carbonated beverages on their own-defined child-directed program prior to their participation in CFBAI, either.

Effective January 1, 2010, the CFBAI in its enhanced core principles announced that its participants now are required to devote 100% of their child-directed advertising to "better-for-you" products. This seems to be a step towards a more effective reduction in advertising exposure. As our empirical findings suggest, more stringent guidelines by the CFBAI to change the landscape of advertising directed to children seems to hold promise for bringing about real changes in children and consumers' dietary choices.

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Table 1A

Summary Statistics

Variables	Mars' Chocolate (T) Others' Chocolate (C)		Hershey's Chocolate (T) Others' Chocolate (C)
	Within 6 months before and after the CFBAI implementation date	Within 9 months before and after the CFBAI implementation date	Within 2 months before and after the CFBAI implementation date
CFBAI (1/0)	0.627	0.610	0.585
	(0.484)	(0.488)	(0.493)
Children under 12 (1/0)	0.279	0.263	0.293
	(0.580)	(0.563)	(0.597)
Household size	2.265	2.189	2.344
	(1.258)	(1.255)	(1.298)
Hispanic (1/0)	0.073	0.073	0.073
	(0.260)	(0.259)	(0.260)
White (1/0)	0.755	0.735	0.777
	(0.430)	(0.441)	(0.417)
Home owner (1/0)	0.799	0.796	0.811
	(0.401)	(0.403)	(0.391)
Income below $35,000 (1/0)	0.229	0.240	0.231
	(0.420)	(0.427)	(0.421)
Income between $35,000 and $99,999 (1/0)	0.566	0.547	0.571
	(0.496)	(0.497)	(0.495)
Female head unemployed (1/0)	0.324	0.312	0.349
	(0.468)	(0.463)	(0.476)
Female head part-time employed (1/0)	0.272	0.297	0.260
	(0.445)	(0.457)	(0.439)
Male head unemployed (1/0)	0.205	0.208	0.214
	(0.404)	(0.406)	(0.410)
Male head part-time employed (1/0)	0.350	0.363	0.341
	(0.477)	(0.481)	(0.474)
Married (1/0)	0.551	0.512	0.573

	(0.497)	(0.500)	(0.495)
Living with others (1/0)	0.149	0.151	0.152
	(0.356)	(0.358)	(0.359)
Change in relative purchase frequency	0.391	0.506	1.600
	(13.146)	(10.724)	(24.720)
Change in price paid	0.741	1.299	1.088
	(1.702)	(2.116)	(4.866)
Change in % coupon-used purchase	0.842	7.813	0.485
	(6.500)	(9.649)	(3.335)
Change in % on-sale product purchase	0.426	0.298	0.012
	(0.957)	(1.177)	(1.168)
Change in % on-display product purchase	0.079	0.066	0.082
	(0.277)	(0.346)	(0.313)
Number of households in the treatment group	2,644	1,970	2,618
Number of households in the control group	1,575	1,257	1,858
Number of observations	4,219	3,227	4,476

Note. Samples are from the Nielsen HomeScan data for the candy category between February 2006 and December 2008. Sample means and standard deviations (in parenthesis) are reported for each variable. The treatment group includes only households who bought the product (T) produced by a CFBAI participating firm both x months before and x months after it completed its CFBAI pledge (x = 6 or 9). Mars' implementation date is March 31, 2007. The 6-month (9-month) period before its implementation ranges from April to September (April to December), 2006 and the 6-month (9-month) period post its implementation spans from April to September (April to December), 2007. Hershey's implementation date is January 1, 2007. The 2-month periods before and after its implementation are February to March 2006 and February to March 2007 respectively. Cadbury Adam's implementation date is January 1, 2008. The 9-month period before its implementation spans from April to December 2007, and the 9-month period after its implementation spans April to December 2008. The control group includes only households who bought the product (C) produced by a non-CFBAI participant over the same time period as the treatment group. The "CFBAI" binary dummy variable (1/0) equals 1 if the firm implemented CFBAI, and 0 otherwise. The "Children under 12" binary dummy variable (1/0) equals 1 if there are any children under 12 in a household, and 0 otherwise. The "Income below $35,000" binary dummy variable (1/0) equals 1 if the annual household income is below $35,000 in 2008. The "Income between $35,000 and $99,999" binary dummy variable (1/0) equals 1 if the annual household income is between $35,000 and $99,999 in 2008. The "Married" binary dummy variable (1/0) equals 1 if the household head is married. The "Living with others" binary dummy variable (1/0) equals 1 if the household head lives with someone else. Changes between the average over all pre-treatment periods and the average over all the post-treatment periods are reported for the following variables: relative purchase frequency (at household level), price paid, % coupon-used purchase, % on-sale product purchase, and % on-display product purchase. The relative purchase frequency is product-specific, and it is the frequency of a household's purchasing the product relative to the household's total number of grocery shopping trips per month. All marketing variables, price paid, % coupon-used purchase, % on-sale product purchase, and % on-display product purchase are averages across all transactions made by households residing in a Designated Market Area (DMA).

Table 1B

Summary Statistics

Variable	"Mars" Bubble Gum (T) Others' Lollipop (C)		Cadbury's Bubble Gum (T) Others' Lollipop (C)
	Within 6 months before and after the CFBAI implementation date	Within 9 months before and after the CFBAI implementation date	Within 9 months before and after the CFBAI implementation date
CFBAI (1/0)	0.316	0.294	0.042
	(0.465)	(0.456)	(0.201)
Children under 12 (1/0)	0.519	0.455	0.425
	(0.694)	(0.682)	(0.650)
Household size	2.841	2.741	2.700
	(1.464)	(1.448)	(1.419)
Hispanic (1/0)	0.086	0.089	0.084
	(0.280)	(0.285)	(0.277)
White (1/0)	0.753	0.778	0.797
	(0.431)	(0.416)	(0.403)
Home owner (1/0)	0.827	0.841	0.836
	(0.378)	(0.366)	(0.371)
Income below $35,000 (1/0)	0.212	0.214	0.212
	(0.409)	(0.410)	(0.409)
Income between $35,000 and $99,999 (1/0)	0.589	0.582	0.580
	(0.492)	(0.493)	(0.494)
Female head unemployed (1/0)	0.361	0.368	0.368
	(0.480)	(0.482)	(0.482)
Female head part-time employed (1/0)	0.259	0.244	0.233
	(0.438)	(0.430)	(0.423)
Male head unemployed (1/0)	0.162	0.171	0.184
	(0.369)	(0.377)	(0.388)
Male head part-time employed (1/0)	0.299	0.309	0.322
	(0.458)	(0.462)	(0.467)
Married (1/0)	0.655	0.642	0.638
	(0.476)	(0.480)	(0.481)

Living with others (1/0)	0.161	0.161	0.166
	(0.368)	(0.368)	(0.372)
Change in relative purchase frequency	-0.064	-0.219	0.020
	(8.066)	(5.046)	(5.682)
Change in price paid	0.105	0.762	1.990
	(7.274)	(8.571)	(8.297)
Change in % coupon-used purchase	6.311	5.404	-6.186
	(9.323)	(13.642)	(11.389)
Change in % on-sale product purchase	-0.438	-0.752	0.133
	(1.900)	(1.783)	(1.370)
Change in % on-display product purchase	-0.220	-0.252	-0.096
	(0.610)	(0.732)	(0.479)
Number of households in the treatment group	369	524	57
Number of households in the control group	798	1,261	1,301
Number of observations	1,167	1,785	1,358

Note. Samples are from the Nielsen HomeScan data for the candy category between February 2006 and December 2008. Sample means and standard deviations (in parenthesis) are reported for each variable. The treatment group includes only households who bought the product (T) produced by a CFBAI participating firm both x months before and x months after it completed its CFBAI pledge (x = 6 or 9). Mars' implementation date is March 31, 2007. The 6-month (9-month) period before its implementation ranges from April to September (April to December), 2006 and the 6-month (9-month) period post its implementation spans from April to September (April to December), 2007. Hershey's implementation date is January 1, 2007. The 2-month periods before and after its implementation are February to March 2006 and February to March 2007 respectively. Cadbury Adam's implementation date is January 1, 2008. The 9-month period before its implementation spans from April to December 2007, and the 9-month period after its implementation spans April to December 2008. The control group includes only households who bought the product (C) produced by a non-CFBAI participant over the same time period as the treatment group. The "CFBAI" binary dummy variable (1/0) equals 1 if the firm implemented CFBAI, and 0 otherwise. The "Children under 12" binary dummy variable (1/0) equals 1 if there are any children under 12 in a household, and 0 otherwise. The "Income below $35,000" binary dummy variable (1/0) equals 1 if the annual household income is below $35,000 in 2008. The "Income between $35,000 and $99,999" binary dummy variable (1/0) equals 1 if the annual household income is between $35,000 and $99,999 in 2008. The "Married" binary dummy variable (1/0) equals 1 if the household head is married. The "Living with others" binary dummy variable (1/0) equals 1 if the household head lives with someone else. Changes between the average over all pre-treatment periods and the average over all the post-treatment periods are reported for the following variables: relative purchase frequency (at household level), price paid, % coupon-used purchase, % on-sale product purchase, and % on-display product purchase. The relative purchase frequency is product-specific, and it is the frequency of a household's purchasing the product relative to the household's total number of grocery shopping trips per month. All marketing variables, price paid, % coupon-used purchase, % on-sale product purchase, and % on-display product purchase are averages across all transactions made by households residing in a Designated Market Area (DMA).

Table 2A

Pre-CFBAI Implementation Comparisons

	Mean		*t* -test	
Variable	Treatment	Control	*t* -ratio	*p* -value
Cadbury's Bubble (T) vs. Others' Lollipop(C) : *9 months before the CFBAI implementation date*				
Average relative purchase frequency (%)	1.767	2.368	1.760	0.099
Children under 12 (1/0)	0.722	0.368	3.710	0.002
Household size	3.105	2.683	3.440	0.004
Hispanic (1/0)	0.175	0.080	-2.090	0.054
White (1/0)	0.596	0.806	-4.020	0.001
Home owner (1/0)	0.772	0.839	-1.980	0.066
Income below $35,000 (1/0)	0.298	0.208	1.510	0.152
Income between $35,000 and $99,999 (1/0)	0.491	0.584	-1.920	0.074
Female head unemployed (1/0)	0.421	0.366	0.800	0.436
Female head part-time employed (1/0)	0.211	0.234	-0.330	0.744
Male head unemployed (1/0)	0.158	0.185	-0.660	0.521
Male head part-time employed (1/0)	0.333	0.321	0.180	0.860
Married (1/0)	0.632	0.638	-0.120	0.910
Living with others (1/0)	0.246	0.162	1.380	0.189
Hershey's Chocolate (T) vs. Others' Chocolate (C): *2 months before the CFBAI implementation date*				
Average relative purchase frequency (%)	12.853	12.127	1.180	0.258
Children under 12 (1/0)	0.295	0.213	4.230	0.001
Household size	2.439	2.193	5.200	0.000
Hispanic (1/0)	0.069	0.078	0.930	0.367
White (1/0)	0.793	0.753	2.530	0.023
Home owner (1/0)	0.816	0.805	0.820	0.422
Income below $35,000 (1/0)	0.226	0.241	-1.430	0.173
Income between $35,000 and $99,999 (1/0)	0.573	0.563	0.820	0.426
Female head unemployed (1/0)	0.336	0.368	-2.010	0.063
Female head part-time employed (1/0)	0.261	0.262	-0.040	0.972
Male head unemployed (1/0)	0.195	0.236	-2.980	0.009
Male head part-time employed (1/0)	0.327	0.365	-2.170	0.046
Married (1/0)	0.593	0.539	3.030	0.008
Living with others (1/0)	0.155	0.146	0.840	0.412

Note. Samples are from the Nielsen HomeScan data for the candy category between February 2006 and December 2008. The treatment group includes only households who bought the product (T) produced by a CFBAI participating firm both x months before and x months after it completed its CFBAI pledge (x = 2 or 9). Mars' implementation date is March 31, 2007. The 6-month (9-month) period before its implementation ranges from April to September (April to December), 2006 and the 6-month (9-month) period post its implementation spans from April to September (April to December), 2007. Hershey's implementation date is January 1, 2007. The 2-month periods before and after its implementation are February to March 2006 and February to March 2007 respectively. Cadbury Adam's implementation date is January 1, 2008. The 9-month period before its implementation spans from April to December 2007, and the 9-month period after its implementation spans April to December 2008. The control group includes only households who bought the product (C) produced by a non-CFBAI participant over the same time period as the treatment group. The relative purchase frequency is product-specific, and it is the frequency of a household's purchasing the product relative to the household's total number of grocery shopping trips per month. The average relative purchase frequency is averaged over all the pre-CFBAI implementation periods. The "Children under 12" binary dummy variable (1/0) equals 1 if there are any children under 12 in a household, and 0 otherwise. The "Income below $35,000" binary dummy variable (1/0) equals 1 if the annual household income is below $35,000 in 2008. The "Income between $35,000 and $99,999" binary dummy variable (1/0) equals 1 if the annual household income is between $35,000 and $99,999 in 2008. The "Married" binary dummy variable (1/0) equals 1 if the household head is married. The "Living with others" binary dummy variable (1/0) equals 1 if the household head lives with someone else. The equality of the means between the treatment group and the control group is tested by a two-tailed t-test. Both the t-ratio and its p-value are reported.

Table 2B

Pre-CFBAI Implementation Comparisons

	Mean		*t* -test	
Variable	Treatment	Control	*t* -ratio	*p* -value
Mars' Chcolate (T) vs. Others' Chocolate (C): *6 months before the CFBAI implementation date*				
Average relative purchase frequency (%)	7.244	6.467	2.300	0.036
Children under 12 (1/0)	0.279	0.204	4.600	0.000
Household size	2.339	2.140	3.940	0.001
Hispanic (1/0)	0.068	0.081	1.370	0.192
White (1/0)	0.760	0.747	1.190	0.253
Home owner (1/0)	0.805	0.790	1.130	0.278
Income below $35,000 (1/0)	0.211	0.260	-4.040	0.001
Income between $35,000 and $99,999 (1/0)	0.579	0.543	2.620	0.019
Female head unemployed (1/0)	0.309	0.350	-2.780	0.014
Female head part-time employed (1/0)	0.273	0.270	0.210	0.836
Male head unemployed (1/0)	0.190	0.229	-3.250	0.005
Male head part-time employed (1/0)	0.333	0.379	-3.480	0.003
Married (1/0)	0.570	0.519	2.940	0.010
Living with others (1/0)	0.144	0.156	-1.230	0.238
Mars' Chocolate (T) vs. Others' Chocolate (C): *9 months before the CFBAI implementation date*				
Average relative purchase frequency (%)	6.479	5.507	3.060	0.008
Children under 12 (1/0)	0.266	0.190	5.280	0.000
Household size	2.288	2.034	5.390	0.000
Hispanic (1/0)	0.065	0.084	1.720	0.106
White (1/0)	0.732	0.740	-0.550	0.592
Home owner (1/0)	0.802	0.786	1.240	0.233
Income below $35,000 (1/0)	0.223	0.267	-3.410	0.004
Income between $35,000 and $99,999 (1/0)	0.559	0.527	2.080	0.055
Female head unemployed (1/0)	0.297	0.336	-3.310	0.005
Female head part-time employed (1/0)	0.297	0.295	0.200	0.847
Male head unemployed (1/0)	0.195	0.228	-2.510	0.024
Male head part-time employed (1/0)	0.350	0.383	-2.670	0.018
Married (1/0)	0.532	0.480	2.990	0.009
Living with others (1/0)	0.154	0.146	0.680	0.509

Note. Samples are from the Nielsen HomeScan data for the candy category between February 2006 and December 2008. The treatment group includes only households who bought the product (T) produced by a CFBAI participating firm both x months before and x months after it completed its CFBAI pledge (x = 6 or 9). Mars' implementation date is March 31, 2007. The 6-month (9-month) period before its implementation ranges from April to September (April to December), 2006 and the 6-month (9-month) period post its implementation spans from April to September (April to December), 2007. Hershey's implementation date is January 1, 2007. The 2-month periods before and after its implementation are February to March 2006 and February to March 2007 respectively. Cadbury Adam's implementation date is January 1, 2008. The 9-month period before its implementation spans from April to December 2007, and the 9-month period after its implementation spans April to December 2008. The control group includes only households who bought the product (C) produced by a non-CFBAI participant over the same time period as the treatment group. The relative purchase frequency is product-specific, and it is the frequency of a household's purchasing the product relative to the household's total number of grocery shopping trips per month. The average relative purchase frequency is averaged over all the pre-CFBAI implementation periods. The "Children under 12" binary dummy variable (1/0) equals 1 if there are any children under 12 in a household, and 0 otherwise. The "Income below $35,000" binary dummy variable (1/0) equals 1 if the annual household income is below $35,000 in 2008. The "Income between $35,000 and $99,999" binary dummy variable (1/0) equals 1 if the annual household income is between $35,000 and $99,999 in 2008. The "Married" binary dummy variable (1/0) equals 1 if the household head is married. The "Living with others" binary dummy variable (1/0) equals 1 if the household head lives with someone else. The equality of the means between the treatment group and the control group is tested by a two-tailed t-test. Both the t-ratio and its p-value are reported.

Table 2C

Pre-CFBAI Implementation Comparisons

	Mean		*t* -test	
	Treatment	Control	*t* -ratio	*p* -value
"Mars" Bubble Gum (T) vs. Others' Lollipop (C): *6 months before the CFBAI implementation date*				
Average relative purchase frequency (%)	3.369	2.861	1.560	0.139
Children under 12 (1/0)	0.689	0.379	6.150	0.000
Household size	3.184	2.683	6.260	0.000
Hispanic (1/0)	0.111	0.074	-2.100	0.053
White (1/0)	0.699	0.778	-3.250	0.005
Home owner (1/0)	0.791	0.843	-2.000	0.064
Income below $35,000 (1/0)	0.222	0.207	0.500	0.625
Income between $35,000 and $99,999 (1/0)	0.575	0.595	-0.750	0.464
Female head unemployed (1/0)	0.363	0.360	0.150	0.885
Female head part-time employed (1/0)	0.276	0.251	0.700	0.493
Male head unemployed (1/0)	0.154	0.165	-0.550	0.590
Male head part-time employed (1/0)	0.279	0.308	-0.860	0.405
Married (1/0)	0.678	0.644	0.860	0.404
Living with others (1/0)	0.182	0.152	1.240	0.235
"Mars" Bubble Gum (T) vs. Others' Lollipop (C): *9 months before the CFBAI implementation date*				
Average relative purchase frequency (%)	2.477	2.058	1.760	0.099
Children under 12 (1/0)	0.618	0.331	9.370	0.000
Household size	3.118	2.584	9.590	0.000
Hispanic (1/0)	0.107	0.082	-2.120	0.051
White (1/0)	0.712	0.805	-4.860	0.000
Home owner (1/0)	0.811	0.853	-2.010	0.062
Income below $35,000 (1/0)	0.210	0.216	-0.350	0.729
Income between $35,000 and $99,999 (1/0)	0.578	0.583	-0.230	0.822
Female head unemployed (1/0)	0.380	0.362	0.580	0.572
Female head part-time employed (1/0)	0.260	0.238	0.760	0.457
Male head unemployed (1/0)	0.143	0.183	-2.280	0.037
Male head part-time employed (1/0)	0.281	0.320	-1.810	0.090
Married (1/0)	0.662	0.634	1.250	0.231
Living with others (1/0)	0.189	0.150	2.140	0.049

Note. Samples are from the Nielsen HomeScan data for the candy category between February 2006 and December 2008. The treatment group includes only households who bought the product (T) produced by a CFBAI participating firm both x months before and x months after it completed its CFBAI pledge (x = 6 or 9). Mars' implementation date is March 31, 2007. The 6-month (9-month) period before its implementation ranges from April to September (April to December), 2006 and the 6-month (9-month) period post its implementation spans from April to September (April to December), 2007. Hershey's implementation date is January 1, 2007. The 2-month periods before and after its implementation are February to March 2006 and February to March 2007 respectively. Cadbury Adam's implementation date is January 1, 2008. The 9-month period before its implementation spans from April to December 2007, and the 9-month period after its implementation spans April to December 2008. The control group includes only households who bought the product (C) produced by a non-CFBAI participant over the same time period as the treatment group. The relative purchase frequency is product-specific, and it is the frequency of a household's purchasing the product relative to the household's total number of grocery shopping trips per month. The average relative purchase frequency is averaged over all the pre-CFBAI implementation periods. The "Children under 12" binary dummy variable (1/0) equals 1 if there are any children under 12 in a household, and 0 otherwise. The "Income below $35,000" binary dummy variable (1/0) equals 1 if the annual household income is below $35,000 in 2008. The "Income between $35,000 and $99,999" binary dummy variable (1/0) equals 1 if the annual household income is between $35,000 and $99,999 in 2008. The "Married" binary dummy variable (1/0) equals 1 if the household head is married. The "Living with others" binary dummy variable (1/0) equals 1 if the household head lives with someone else. The equality of the means between the treatment group and the control group is tested by a two-tailed t-test. Both the t-ratio and its p-value are reported.

Table 3

Estimated CFBAI Effects on Relative Purchase Frequency:

Cadbury's Bubble Gum (T) vs. Others' Lollipop (C)

Dependent variable:	Within 9 months before and after the CFBAI implementation		
D. relative purchase frequency (%)	(1)	(2)	(3)
CFBAI (1/0)	-0.350	-0.847^{+}	0.038
	(0.495)	(0.407)	(0.657)
L. relative purchase frequency		-0.814**	-0.814**
		(0.065)	(0.065)
Children under 12 (1/0)		-0.014	-0.024
		(0.168)	(0.170)
Household size		-0.055	-0.049
		(0.098)	(0.097)
Hispanic (1/0)		-0.467^{+}	-0.559*
		(0.234)	(0.204)
White (1/0)		0.414	0.432
		(0.359)	(0.371)
Home owner (1/0)		0.043	0.010
		(0.246)	(0.241)
Income below $35,000 (1/0)		-0.147	-0.176
		(0.503)	(0.545)
Income between $35,000 and $99,999 (1/0)		-0.220	-0.237
		(0.409)	(0.424)
Female head unemployed (1/0)		-0.167	-0.153
		(0.303)	(0.310)
Female head part-time employed (1/0)		0.115	0.183
		(0.281)	(0.281)
Male head unemployed (1/0)		-0.137	-0.128
		(0.463)	(0.465)
Male head part-time employed (1/0)		0.262	0.338
		(0.387)	(0.381)
Married (1/0)		-0.081	-0.065
		(0.536)	(0.541)
Living with others (1/0)		-0.219	-0.237
		(0.478)	(0.498)
L. price paid		-0.048^{+}	0.042
		(0.027)	(0.046)
D. price paid		-0.035^{+}	-0.160**
		(0.017)	(0.026)
L. % coupon-used purchase		-0.033	0.031
		(0.021)	(0.021)
D. % coupon-used purchase		-0.014	-0.037**
		(0.011)	(0.008)

L. % on-sale product purchase		0.356	0.194
		(0.220)	(0.431)
D. % on-sale product purchase		0.132	0.986**
		(0.167)	(0.217)
L. % on-display product purchase		0.053	-1.540*
		(0.358)	(0.530)
D. % on-display product purchase		-0.509	-1.721**
		(0.341)	(0.466)
Constant	0.035	1.953*	0.654
	(0.204)	(0.896)	(1.246)
DMA fixed effects	N	N	Y
Number of observations	1,358	1,358	1,358

Note. Samples are from the Nielsen HomeScan data for the candy category between February 2006 and December 2008. The treatment group includes only households who bought the product (T) produced by a CFBAI participating firm both 9 months before and 9 months after it completed its CFBAI pledge. Cadbury Adam's implementation date is January 1, 2008. The 9-month period before its implementation spans from April to December 2007, and the 9-month period after its implementation spans April to December 2008. The control group includes only households who bought the product (C) produced by a non-CFBAI participant over the same time period as the treatment group. The relative purchase frequency is product-specific, and it is the frequency of a household's purchasing the product relative to the household's total number of grocery shopping trips per month. The "CFBAI" binary dummy variable (1/0) equals 1 if the firm implemented CFBAI, and 0 otherwise. The "Children under 12" binary dummy variable (1/0) equals 1 if there are any children under 12 in a household, and 0 otherwise. The "Income below $35,000" binary dummy variable (1/0) equals 1 if the annual household income is below $35,000 in 2008. The "Income between $35,000 and $99,999" binary dummy variable (1/0) equals 1 if the annual household income is between $35,000 and $99,999 in 2008. The "Married" binary dummy variable (1/0) equals 1 if the household head is married. The "Living with others" binary dummy variable (1/0) equals 1 if the household head lives with someone else. All marketing variables, price paid, % coupon-used purchase, % on-sale product purchase, and % on-display product purchase are averages across all transactions made by households residing in a Designated Market Area (DMA). L.X represents the average of variable X over all pre-treatment periods. D.X represents the difference between the average of variable X over all post-treatment periods and the average of variable X over all pre-treatment periods. Cadbury Adams completed its CFBAI implementation on January 1, 2008. Standard errors (in parenthesis) are robust to DMA-level clustering.

+ Significant at the 10% level (two-tailed test).

* Significant at the 5% level (two-tailed test).

** Significant at the 1% level (two-tailed test).

Table 4
Estimated CFBAI Effects on Relative Purchase Frequency:
Mars' Chocolate (T) vs. Others' Chocolate (C)

	Within x months before and after the CFBAI implementation date					
Dependent variable:	x = 6 (months)			x = 9 (months)		
D. relative purchase frequency (%)	(1)	(2)	(3)	(1)	(2)	(3)
CFBAI (1/0)	0.978**	2.279**	2.104	-0.062	1.172^{+}	0.987
	(0.291)	(0.466)	(1.554)	(0.206)	(0.578)	(0.764)
L. relative purchase frequency		-0.845**	-0.846**		-0.702**	-0.701**
		(0.027)	(0.027)		(0.036)	(0.036)
Children under 12 (1/0)		-0.267	-0.272		-0.319	-0.331
		(0.338)	(0.333)		(0.276)	(0.265)
Household size		-0.257	-0.238		-0.149*	-0.130
		(0.178)	(0.181)		(0.076)	(0.080)
Hispanic (1/0)		-0.470	-0.532		-0.203	-0.237
		(0.465)	(0.443)		(0.693)	(0.700)
White (1/0)		-0.620	-0.615		-0.683	-0.781
		(0.445)	(0.435)		(0.570)	(0.587)
Home owner (1/0)		-0.224	-0.163		-0.084	-0.012
		(0.329)	(0.336)		(0.289)	(0.289)
Income below $35,000 (1/0)		-0.564	-0.485		-0.367	-0.425
		(0.584)	(0.594)		(0.424)	(0.436)
Income between $35,000 and $99,999 (1/0)		-0.108	-0.059		0.002	-0.038
		(0.388)	(0.396)		(0.460)	(0.489)
Female head unemployed (1/0)		1.090**	1.077**		1.216**	1.234**
		(0.294)	(0.297)		(0.329)	(0.332)
Female head part-time employed (1/0)		0.173	0.212		0.055	0.027
		(0.379)	(0.377)		(0.292)	(0.297)
Male head unemployed (1/0)		0.235	0.215		-0.020	0.020
		(0.293)	(0.301)		(0.388)	(0.387)
Male head part-time employed (1/0)		-0.113	-0.057		0.032	0.092
		(0.451)	(0.451)		(0.339)	(0.339)
Married (1/0)		-1.403**	-1.393**		-1.126*	-1.207*
		(0.449)	(0.449)		(0.431)	(0.427)
Living with others (1/0)		-0.960	-0.927		-0.687	-0.700
		(0.629)	(0.630)		(0.538)	(0.536)
L. price paid		0.110	0.182		0.090	-0.021
		(0.080)	(0.232)		(0.054)	(0.089)
D. price paid		0.089	0.039		0.068	-0.021
		(0.078)	(0.144)		(0.048)	(0.050)
L. % coupon-used purchase		-0.019	-0.061		-0.035	-0.034
		(0.039)	(0.057)		(0.027)	(0.026)
D. % coupon-used purchase		-0.022	-0.042		-0.050^{+}	-0.083**

		(0.018)	(0.036)		(0.024)	(0.015)
L. % on-sale product purchase		0.338*	-0.037		0.030	0.246
		(0.135)	(0.225)		(0.098)	(0.202)
D. % on-sale product purchase		-0.557**	-0.612*		-0.150	-0.101
		(0.162)	(0.210)		(0.139)	(0.098)
L. % on-display product purchase		-0.690	-0.436		0.593	-0.965
		(0.726)	(1.246)		(0.571)	(0.572)
D. % on-display product purchase		1.262	2.003		1.058*	0.226
		(0.759)	(2.049)		(0.481)	(1.354)
Constant	-0.222	4.483**	6.412	0.544*	4.001*	6.560+
	(0.232)	(1.435)	(5.109)	(0.251)	(1.458)	(3.118)
DMA fixed effects	N	N	Y	N	N	Y
Number of observations	4,219	4,219	4,219	3,227	3,227	3,227

Note. Samples are from the Nielsen HomeScan data for the candy category between February 2006 and December 2008. The treatment group includes only households who bought the product (T) produced by a CFBAI participating firm both x months before and x months after it completed its CFBAI pledge (x = 6 or 9). Mars' implementation date is March 31, 2007. The 6-month (9-month) period before its implementation ranges from April to September (April to December), 2006 and the 6-month (9-month) period post its implementation spans from April to September (April to December), 2007. Hershey's implementation date is January 1, 2007. The control group includes only households who bought the product (C) produced by a non-CFBAI participant over the same time period as the treatment group. The relative purchase frequency is product-specific, and it is the frequency of a household's purchasing the product relative to the household's total number of grocery shopping trips per month. The "CFBAI" binary dummy variable (1/0) equals 1 if the firm implemented CFBAI, and 0 otherwise. The "Children under 12" binary dummy variable (1/0) equals 1 if there are any children under 12 in a household, and 0 otherwise. The "Income below $35,000" binary dummy variable (1/0) equals 1 if the annual household income is below $35,000 in 2008. The "Income between $35,000 and $99,999" binary dummy variable (1/0) equals 1 if the annual household income is between $35,000 and $99,999 in 2008. The "Married" binary dummy variable (1/0) equals 1 if the household head is married. The "Living with others" binary dummy variable (1/0) equals 1 if the household head lives with someone else. All marketing variables, price paid, % coupon-used purchase, % on-sale product purchase, and % on-display product purchase are averages across all transactions made by households residing in a Designated Market Area (DMA). L.X represents the average of variable X over all pre-treatment periods. D.X represents the difference between the average of variable X over all post-treatment periods and the average of variable X over all pre-treatment periods. Mars completed its CFBAI implementation on March 31, 2007. Standard errors (in parenthesis) are robust to DMA-level clustering.

+ Significant at the 10% level (two-tailed test).

* Significant at the 5% level (two-tailed test).

** Significant at the 1% level (two-tailed test).

Table 5
Estimated CFBAI Effects on Relative Purchase Frequency:
Hershey's Chocolate (T) vs. Others' Chocolate

Dependent variable:	Within 2 months before and after the CFBAI implementation date		
D. relative purchase frequency (%)	(1)	(2)	(3)
CFBAI (1/0)	-0.060	1.367	0.963
	(0.762)	(0.826)	(0.991)
L. relative purchase frequency		-1.076**	-1.076**
		(0.016)	(0.016)
Children under 12 (1/0)		-0.594^{+}	-0.577^{+}
		(0.319)	(0.308)
Household size		-0.144	-0.106
		(0.213)	(0.205)
Hispanic (1/0)		-0.623	-0.869
		(0.681)	(0.815)
White (1/0)		1.585**	1.608**
		(0.515)	(0.501)
Home owner (1/0)		0.633	0.408
		(0.728)	(0.684)
Income below $35,000 (1/0)		-2.165*	-2.082*
		(0.830)	(0.890)
Income between $35,000 and $99,999 (1/0)		-1.149	-1.078
		(0.748)	(0.774)
Female head unemployed (1/0)		-0.327	-0.278
		(0.571)	(0.569)
Female head part-time employed (1/0)		-1.352^{+}	-1.345^{+}
		(0.691)	(0.705)
Male head unemployed (1/0)		1.952^{+}	1.975^{+}
		(1.078)	(1.094)
Male head part-time employed (1/0)		-0.576	-0.530
		(0.481)	(0.493)
Married (1/0)		-6.363**	-6.363**
		(0.868)	(0.879)
Living with others (1/0)		-3.096*	-3.151*
		(1.085)	(1.095)
L. price paid		0.006	-0.118
		(0.136)	(0.189)
D. price paid		0.075	-0.006
		(0.084)	(0.109)
L. % coupon-used purchase		-0.396*	-0.546*
		(0.166)	(0.254)
D. % coupon-used purchase		-0.121^{+}	-0.114
		(0.066)	(0.075)

L. % on-sale product purchase		1.472**	2.320**
		(0.483)	(0.623)
D. % on-sale product purchase		0.340	0.763
		(0.437)	(0.488)
L. % on-display product purchase		-3.966	-3.820
		(2.939)	(4.370)
D. % on-display product purchase		-0.213	-1.302
		(0.716)	(0.809)
Constant	1.635**	17.580**	17.530**
	(0.506)	(1.507)	(1.505)
DMA fixed effects	N	N	Y
Number of observations	4,476	4,476	4,476

Note. Samples are from the Nielsen HomeScan data for the candy category between February 2006 and December 2008. The treatment group includes only households who bought the product (T) produced by a CFBAI participating firm both 2 months before and 2 months after it completed its CFBAI pledge. Hershey's implementation date is January 1, 2007. The 2-month periods before and after its implementation are February to March 2006 and February to March 2007 respectively. The control group includes only households who bought the product (C) produced by a non-CFBAI participant over the same time period as the treatment group. The relative purchase frequency is product-specific, and it is the frequency of a household's purchasing the product relative to the household's total number of grocery shopping trips per month. The "CFBAI" binary dummy variable (1/0) equals 1 if the firm implemented CFBAI, and 0 otherwise. The "Children under 12" binary dummy variable (1/0) equals 1 if there are any children under 12 in a household, and 0 otherwise. The "Income below $35,000" binary dummy variable (1/0) equals 1 if the annual household income is below $35,000 in 2008. The "Income between $35,000 and $99,999" binary dummy variable (1/0) equals 1 if the annual household income is between $35,000 and $99,999 in 2008. The "Married" binary dummy variable (1/0) equals 1 if the household head is married. The "Living with others" binary dummy variable (1/0) equals 1 if the household head lives with someone else. All marketing variables, price paid, % coupon-used purchase, % on-sale product purchase, and % on-display product purchase are averages across all transactions made by households residing in a Designated Market Area (DMA). L.X represents the average of variable X over all pre-treatment periods. D.X represents the difference between the average of variable X over all post-treatment periods and the average of variable X over all pre-treatment periods. Hershey's completed its CFBAI implementation on January 1, 2007. Standard errors (in parenthesis) are robust to DMA-level clustering.

+ Significant at the 10% level (two-tailed test).

* Significant at the 5% level (two-tailed test).

** Significant at the 1% level (two-tailed test).

Table 6
Estimated CFBAI Effects on Volume Purchased:
Mars' Chocolate (T) vs. Others' Chocolate (C)

	Within x months before and after the CFBAI implementation date					
Dependent variable:	x = 6 (months)			x = 9 (months)		
D. volume purchased (ounce)	(1)	(2)	(3)	(1)	(2)	(3)
CFBAI (1/0)	0.179	2.186**	2.390*	-0.016	1.557*	4.895**
	(0.247)	(0.305)	(0.857)	(0.231)	(0.532)	(1.601)
L. volume purchased (ounce)		-0.531**	-0.531**		-0.403*	-0.402*
		(0.116)	(0.117)		(0.177)	(0.178)
Children under 12 (1/0)		-0.115	-0.117		-0.089	-0.086
		(0.194)	(0.193)		(0.163)	(0.164)
Constant	-0.179^{+}	-1.208^{+}	-3.171	-0.007	1.370*	-11.040*
	(0.091)	(0.633)	(2.525)	(0.087)	(0.590)	(4.073)
Household demographics variables	N	Y	Y	N	Y	Y
L. marketing and D. marketing variable	N	Y	Y	N	Y	Y
DMA fixed effects	N	N	Y	N	N	Y
Number of observations	4,222	4,222	4,222	3,227	3,227	3,227

Note. Samples are from the Nielsen HomeScan data for the candy category between February 2006 and December 2008. The treatment group includes only households who bought the product (T) produced by a CFBAI participating firm both x months before and x months after it completed its CFBAI pledge (x = 6 or 9). Mars' implementation date is March 31, 2007. The 6-month (9-month) period before its implementation ranges from April to September (April to December), 2006 and the 6-month (9-month) period post its implementation spans from April to September (April to December), 2007. The control group includes only households who bought the product (C) produced by a non-CFBAI participant over the same time period as the treatment group. The volume purchased (in ounce) is product-specific, and it is the total volume (in ounce) of a household's purchasing the product summed up from the household's total number of grocery shopping trips per month. The "CFBAI" binary dummy variable (1/0) equals 1 if the firm implemented CFBAI, and 0 otherwise. The "Children under 12" binary dummy variable (1/0) equals 1 if there are any children under 12 in a household, and 0 otherwise. Household demographic variables include the following: 1) the "income below $35,000" binary dummy variable (1/0) equal to 1 if the annual household income is below $35,000 in 2008; 2) the "income between $35,000 and $99,999" binary dummy variable (1/0) equal to 1 if the annual household income is between $35,000 and $99,999 in 2008; 3) the "married" binary dummy variable (1/0) equal to 1 if the household head is married; and 4) the "living with others" binary dummy variable (1/0) equal to 1 if the household head lives with someone else. The marketing variables, including price paid, % coupon-used purchase, % on-sale product purchase, and % on-display product purchase, are averages across all transactions made by households residing in a Designated Market Area (DMA). L.X represents the average of variable X over all pre-treatment periods. D.X represents the difference between the average of variable X over all post-treatment periods and the average of variable X over all pre-treatment periods. Mars completed its CFBAI implementation on March 31, 2007. Standard errors (in parenthesis) are robust to DMA-level clustering.

+ Significant at the 10% level (two-tailed test).

* Significant at the 5% level (two-tailed test).

** Significant at the 1% level (two-tailed test).

Table 7
Estimated CFBAI Effects on Volume Purchased
Hershey's Chocolate (T) vs. Others' Chocolate (C)

Dependent variable:	Within 2 months before and after the CFBAI implementation		
D. volume purchased (ounce)	(1)	(2)	(3)
CFBAI (1/0)	0.345	1.958**	3.259**
	(0.387)	(0.398)	(0.875)
L. volume purchased (ounce)		-0.866**	-0.867**
		(0.034)	(0.034)
Children under 12 (1/0)		-0.489	-0.494
		(0.353)	(0.351)
Constant	0.559*	0.321	3.992
	(0.211)	(1.491)	(2.450)
Household demographics variables	N	Y	Y
L. marketing and D. marketing variables	N	Y	Y
DMA fixed effects	N	N	Y
Number of observations	4,600	4,600	4,600

Note. Samples are from the Nielsen HomeScan data for the candy category between February 2006 and December 2008. The treatment group includes only households who bought the product (T) produced by a CFBAI participating firm both 2 months before and 2 months after it completed its CFBAI pledge. Hershey's implementation date is January 1, 2007. The 2-month periods before and after its implementation are February to March 2006 and February to March 2007 respectively. The control group includes only households who bought the product (C) produced by a non-CFBAI participant over the same time period as the treatment group. The volume purchased (in ounce) is product-specific, and it is the total volume (in ounce) of a household's purchasing the product summed up from the household's total number of grocery shopping trips per month. The "CFBAI" binary dummy variable (1/0) equals 1 if the firm implemented CFBAI, and 0 otherwise. The "Children under 12" binary dummy variable (1/0) equals 1 if there are any children under 12 in a household, and 0 otherwise. Household demographic variables include the following: 1) the "income below $35,000" binary dummy variable (1/0) equal to 1 if the annual household income is below $35,000 in 2008; 2) the "income between $35,000 and $99,999" binary dummy variable (1/0) equal to 1 if the annual household income is between $35,000 and $99,999 in 2008; 3) the "married" binary dummy variable (1/0) equal to 1 if the household head is married; and 4) the "living with others" binary dummy variable (1/0) equal to 1 if the household head lives with someone else. The marketing variables, including price paid, % coupon-used purchase, % on-sale product purchase, and % on-display product purchase, are averages across all transactions made by households residing in a Designated Market Area (DMA). L.X represents the average of variable X over all pre-treatment periods. D.X represents the difference between the average of variable X over all post-treatment periods and the average of variable X over all pre-treatment periods. Hershey's completed its CFBAI implementation on January 1, 2007. Standard errors (in parenthesis) are robust to DMA-level clustering.

+ Significant at the 10% level (two-tailed test).

* Significant at the 5% level (two-tailed test).

** Significant at the 1% level (two-tailed test).

Table 8
Estimated CFBAI Effects on Relative Purchase Frequency:
"Mars" Bubble Gum (T) vs. Others' Lollipop (C)

	Within x months before and after the CFBAI implementation date					
Dependent variable:	x = 6 (months)			x = 9 (months)		
D. relative purchase frequency (%)	(1)	(2)	(3)	(1)	(2)	(3)
CFBAI (1/0)	-1.553**	-1.703^{+}	-1.586*	-1.050**	-1.400**	-0.817^{+}
	(0.324)	(0.948)	(0.729)	(0.164)	(0.475)	(0.437)
L. relative purchase frequency		-0.902**	-0.912**		-0.732**	-0.736**
		(0.094)	(0.098)		(0.071)	(0.073)
Children under 12 (1/0)		-0.515	-0.556		-0.307*	-0.305*
		(0.302)	(0.333)		(0.157)	(0.159)
Household size		-0.178	-0.149		-0.027	-0.024
		(0.102)	(0.095)		(0.058)	(0.056)
Hispanic (1/0)		-0.130	-0.603		-0.141	-0.232
		(0.390)	(0.354)		(0.269)	(0.307)
White (1/0)		-0.008	0.141		-0.215	-0.178
		(0.377)	(0.409)		(0.224)	(0.238)
Home owner (1/0)		0.183	0.269		0.079	0.083
		(0.418)	(0.447)		(0.260)	(0.255)
Income below $35,000 (1/0)		0.455	0.607		0.216	0.222
		(1.093)	(1.125)		(0.405)	(0.408)
Income between $35,000 and $99,999 (1/0)		-0.152	-0.024		0.001	0.002
		(0.324)	(0.359)		(0.152)	(0.158)
Female head unemployed (1/0)		0.422*	0.321		0.145	0.113
		(0.175)	(0.212)		(0.116)	(0.131)
Female head part-time employed (1/0)		0.047	0.060		-0.083	-0.080
		(0.464)	(0.481)		(0.175)	(0.172)
Male head unemployed (1/0)		-0.124	-0.151		0.026	0.022
		(0.760)	(0.800)		(0.234)	(0.237)
Male head part-time employed (1/0)		0.642	0.529		0.448	0.459
		(0.487)	(0.476)		(0.258)	(0.271)
Married (1/0)		0.339	0.211		-0.048	-0.012
		(1.213)	(1.229)		(0.584)	(0.589)
Living with others (1/0)		0.452	0.388		0.084	0.125
		(1.233)	(1.279)		(0.624)	(0.628)
L. price paid		-0.0407	0.0537		-0.017	0.031
		(0.054)	(0.042)		(0.022)	(0.018)
D. price paid		-0.080	-0.032		-0.050*	-0.017
		(0.064)	(0.044)		(0.021)	(0.026)
L. % coupon-used purchase		-0.052	-0.096^{+}		-0.032^{+}	-0.016
		(0.070)	(0.047)		(0.017)	(0.022)
D. % coupon-used purchase		0.003	-0.007		-0.001	0.004

		(0.039)	(0.024)		(0.010)	(0.013)
L. % on-sale product purchase		0.153	-0.796**		0.157*	-0.157*
		(0.215)	(0.186)		(0.068)	(0.065)
D. % on-sale product purchase		0.105	-0.404**		0.180**	-0.013
		(0.126)	(0.102)		(0.054)	(0.070)
L. % on-display product purchase		-0.605	-0.804		-0.582**	-0.212
		(0.550)	(1.181)		(0.189)	(0.277)
D. % on-display product purchase		0.159	-0.274		-0.269	0.232
		(0.733)	(0.897)		(0.167)	(0.201)
Constant	0.427	3.671	5.740**	0.089	2.056+	2.387*
	(0.248)	(2.441)	(1.408)	(0.141)	(1.051)	(0.865)
DMA fixed effects	N	N	Y	N	N	Y
Number of observations	1,167	1,167	1,167	1,785	1,785	1,785

Note. Samples are from the Nielsen HomeScan data for the candy category between February 2006 and December 2008. The treatment group includes only households who bought the product (T) produced by a CFBAI participating firm both x months before and x months after it completed its CFBAI pledge (x = 6 or 9). Mars' implementation date is March 31, 2007. The 6-month (9-month) period before its implementation ranges from April to September (April to December), 2006 and the 6-month (9-month) period post its implementation spans from April to September (April to December), 2007. The control group includes only households who bought the product (C) produced by a non-CFBAI participant over the same time period as the treatment group. The relative purchase frequency is product-specific, and it is the frequency of a household's purchasing the product relative to the household's total number of grocery shopping trips per month. The "CFBAI" binary dummy variable (1/0) equals 1 if the firm implemented CFBAI, and 0 otherwise. The "Children under 12" binary dummy variable (1/0) equals 1 if there are any children under 12 in a household, and 0 otherwise. The "Income below $35,000" binary dummy variable (1/0) equals 1 if the annual household income is below $35,000 in 2008. The "Income between $35,000 and $99,999" binary dummy variable (1/0) equals 1 if the annual household income is between $35,000 and $99,999 in 2008. The "Married" binary dummy variable (1/0) equals 1 if the household head is married. The "Living with others" binary dummy variable (1/0) equals 1 if the household head lives with someone else. All marketing variables, price paid, % coupon-used purchase, % on-sale product purchase, and % on-display product purchase are averages across all transactions made by households residing in a Designated Market Area (DMA). L.X represents the average of variable X over all pre-treatment periods. D.X represents the difference between the average of variable X over all post-treatment periods and the average of variable X over all pre-treatment periods. Mars completed its CFBAI implementation on March 31, 2007. Standard errors (in parenthesis) are robust to DMA-level clustering.

+ Significant at the 10% level (two-tailed test).

* Significant at the 5% level (two-tailed test).

** Significant at the 1% level (two-tailed test).

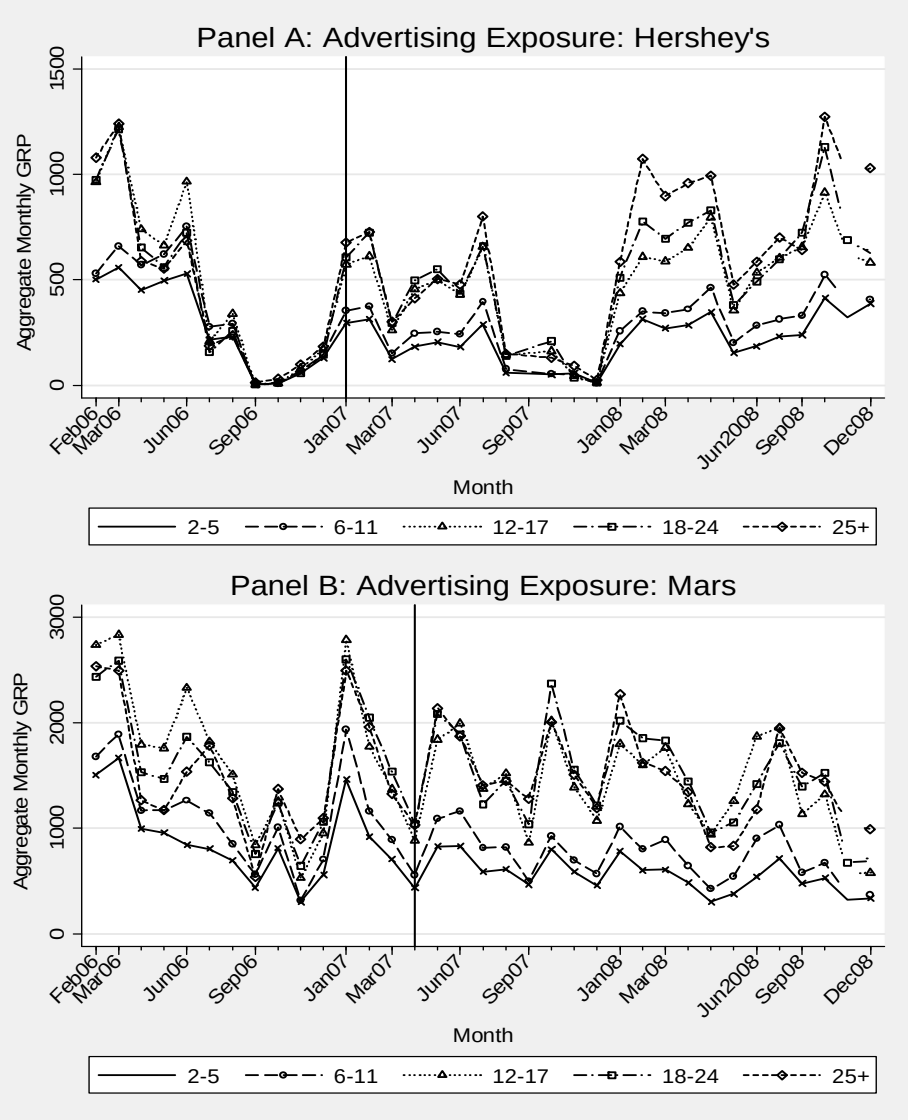
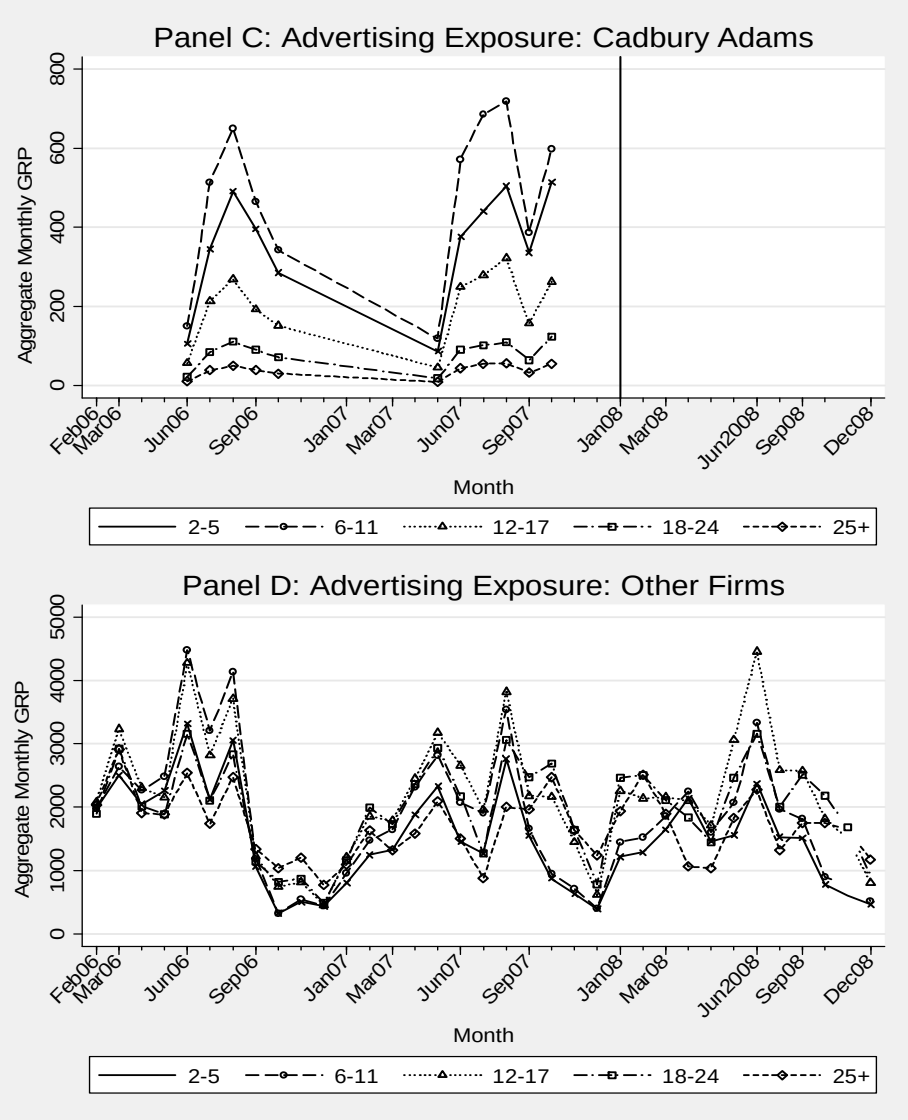


Figure 1. Advertising Exposure by Company

Note. Depicted in the panels are the series of company-specific aggregate monthly Gross Rating Points (GRP) for audience of the following five age groups: 2-5, 6-11, 12-17, 18-24, and over 25. In Panels A, B, and C and for each of the three companies that implemented their CFBAI pledges during the sample period, aggregate monthly GRP is the sum of GRP from advertising aired on cable, network, syndicated, and spot television in the national market on all products produced by the company and covered by its pledge. In Panel D, aggregate monthly GRP is the sum of GRP from advertising aired on cable, network, syndicated, and spot television in the national market on all products produced by all but the three companies. The vertical line indicates the implementation date for each company.



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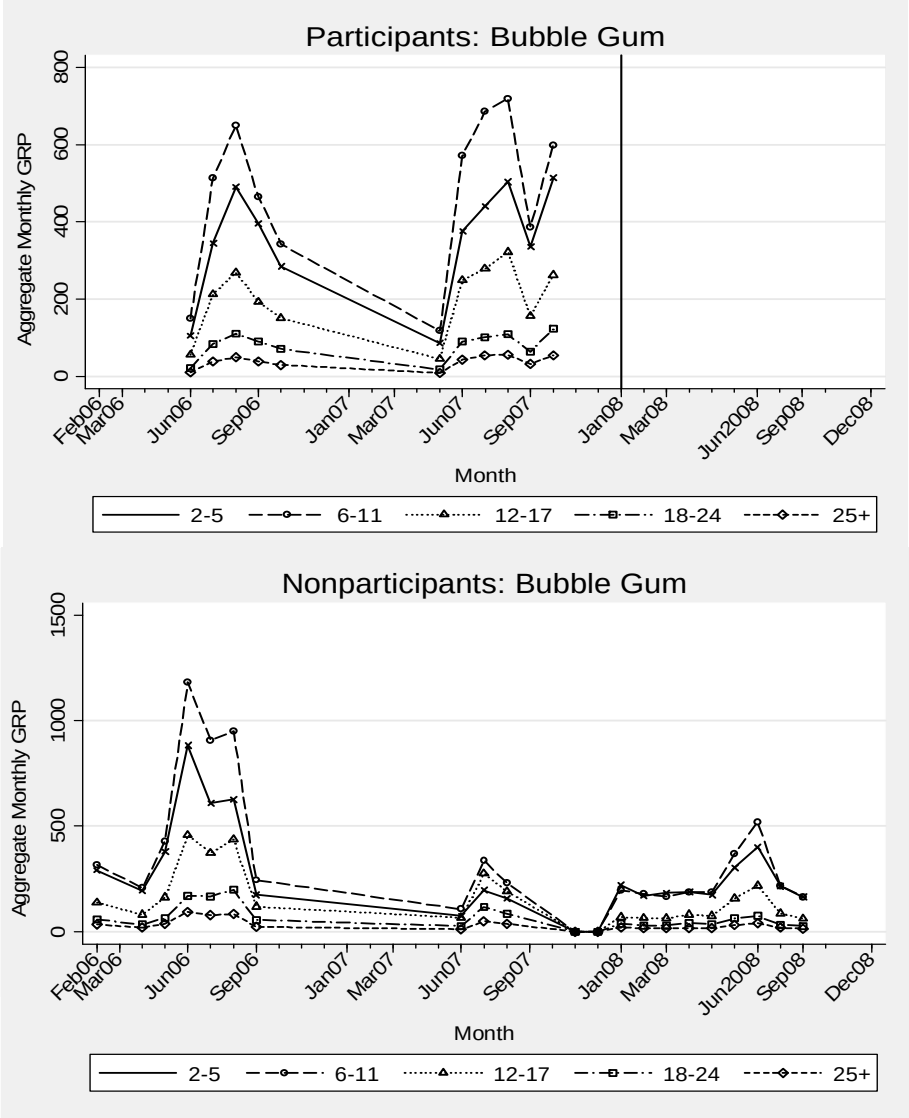
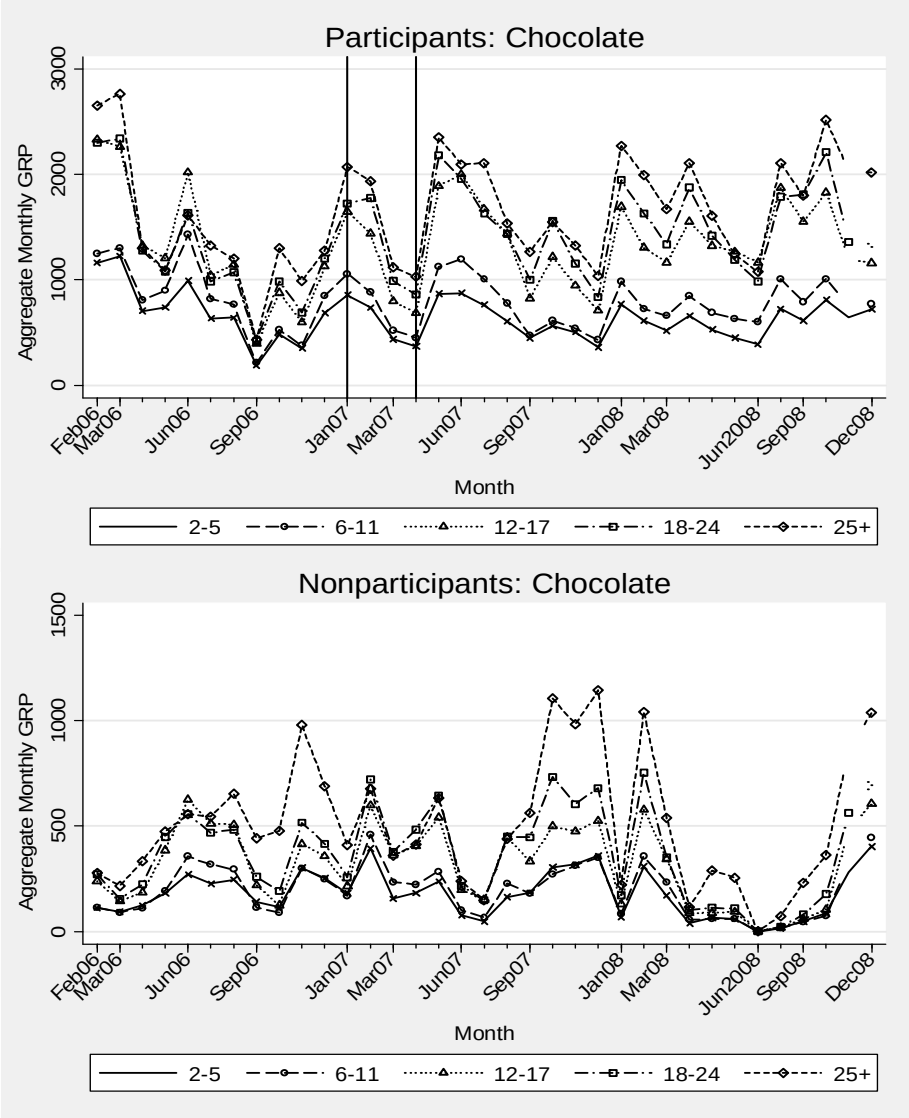


Figure 2. Advertising Exposure by Module and by CFBAI Participation Status

Note. Depicted in the panels are the series of module-specific aggregate monthly Gross Rating Points (GRP) for audience of the following five age groups: 2-5, 6-11, 12-17, 18-24, and over 25. For each of the module, we plot aggregate monthly GRP for products manufactured by the participants and covered by their pledges, and also for products manufactured by all other firms. Aggregate monthly GRP is the sum of GRP from advertising aired on cable, network, syndicated, and spot television in the national market on all relevant products. The vertical line indicates the implementation date applicable to the product (module) of CFBAI participants.



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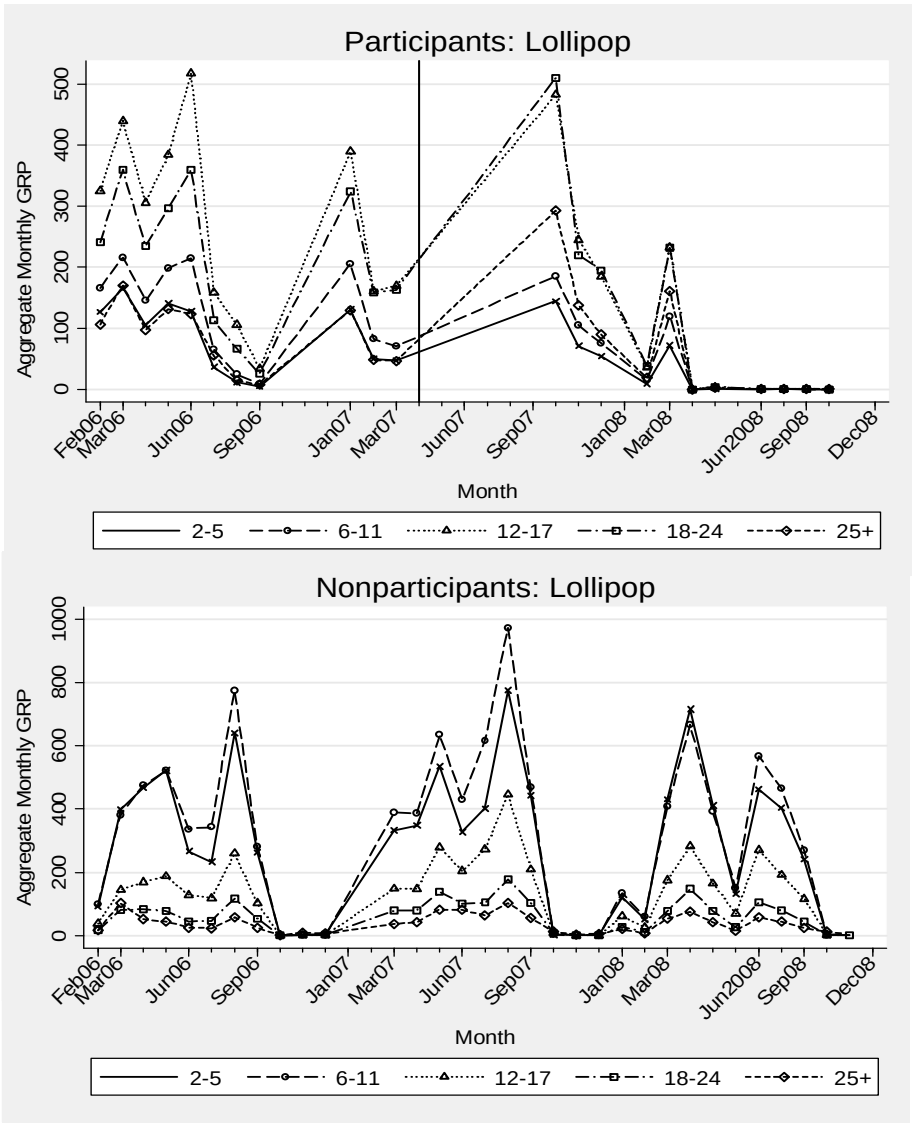

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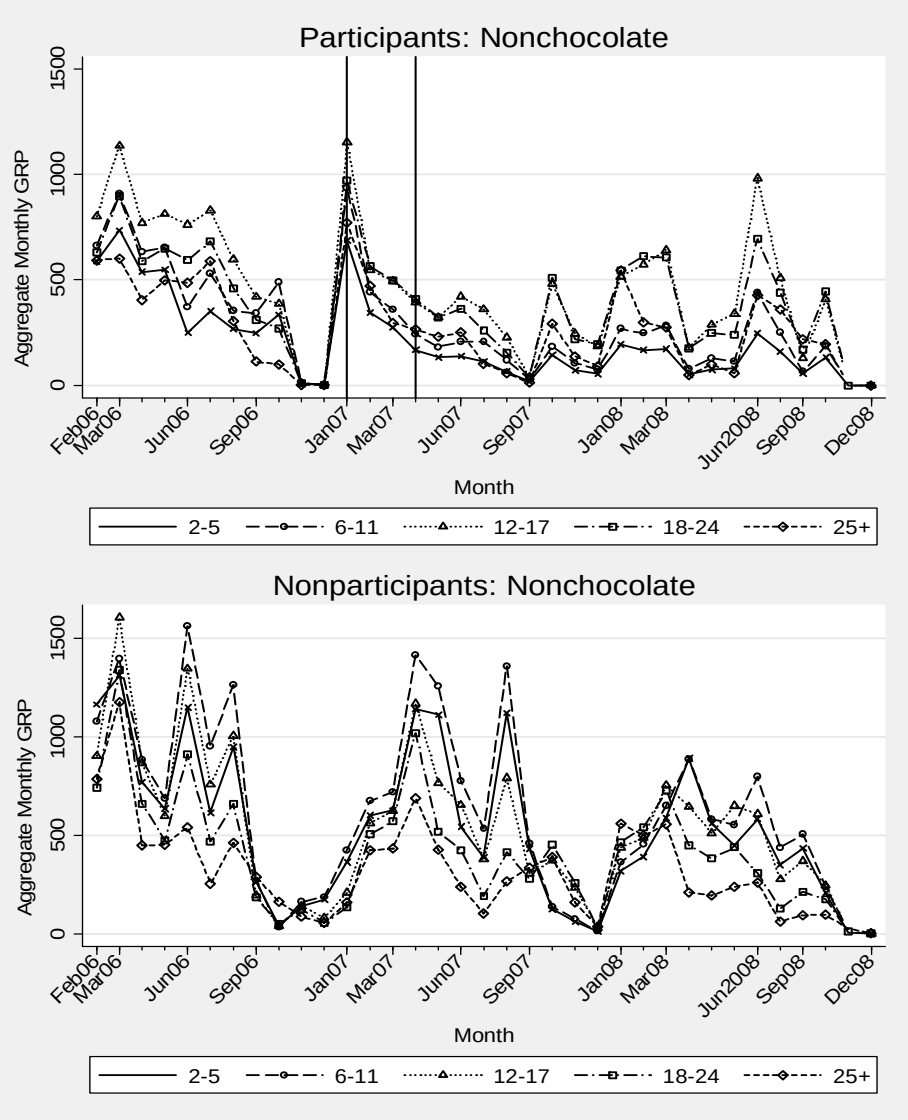

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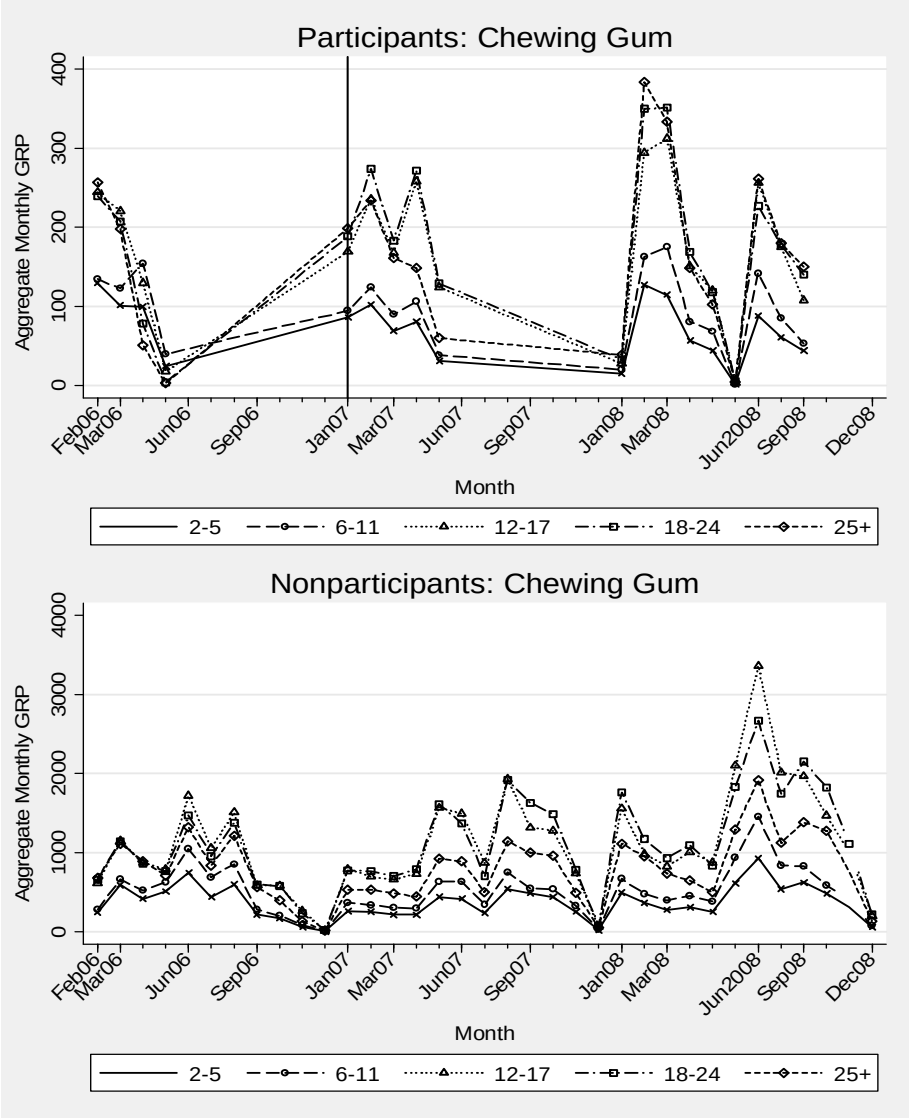

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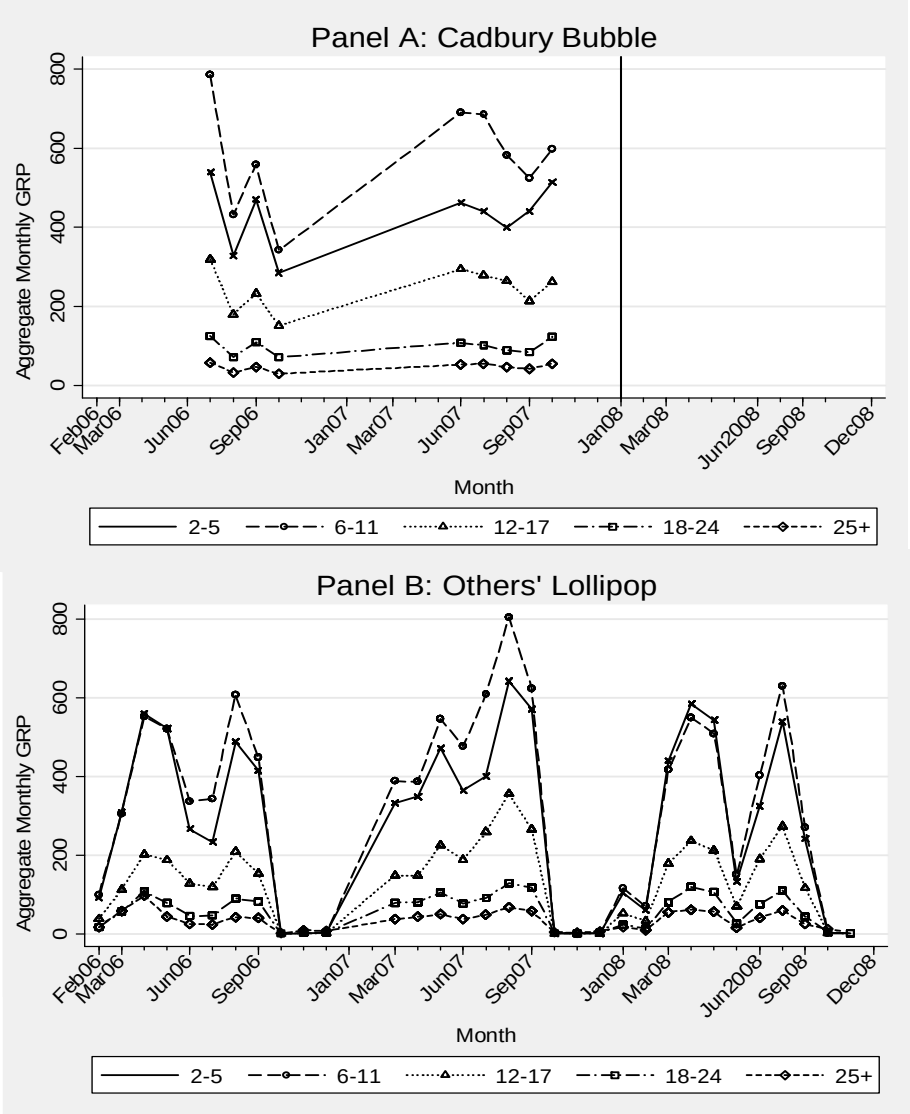


Figure 3. Advertising Exposure: Cadbury Bubble Gum vs. Others' Lollipop
Note. Depicted in the panels are the series of product-specific and company-specific aggregated monthly Gross Rating Points (GRP) for audience of the following five age groups: 2-5, 6-11, 12-17, 18-24, and over 25. Aggregated monthly GRP is the sum of GRP from advertising aired on cable, network, syndicated, and spot television in the national market. The GRP in Panel A is the sum of GRP for all bubble gum brands produced by Cadbury Adams. The GRP in Panel B is the sum of GRP for all lollipop brands produced by all non-CFBAI participants. The vertical line represents the date (January 1, 2008) on which Cadbury Adams fulfilled its CFBAI commitment.

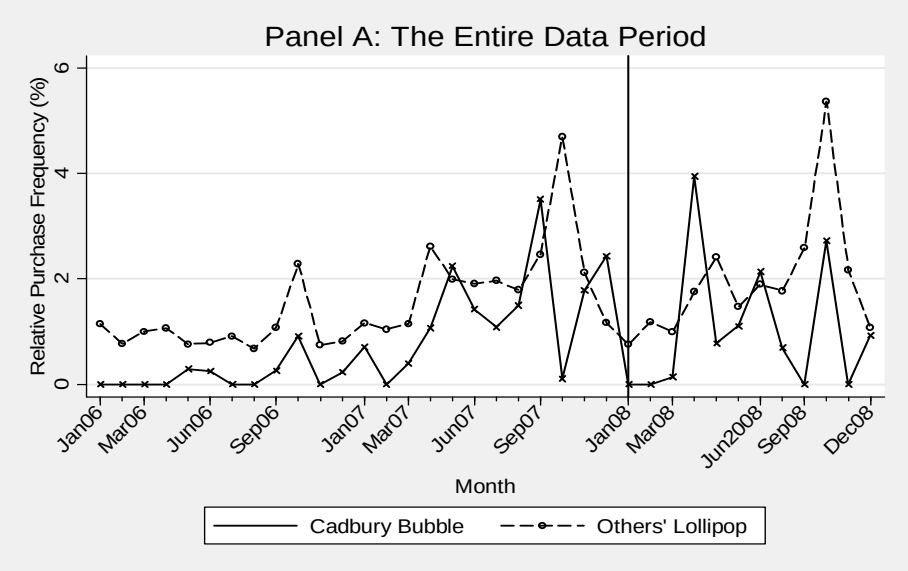


Figure 4. Relative purchase frequency: Cadbury Bubble Gums vs. Others' Lollipops

Note. Relative purchase frequency is the frequency of a household's purchasing a specific product relative to the household's total number of grocery shopping trips per month. The vertical line represents the date (January 1, 2008) on which Cadbury Adams fulfilled its CFBAI commitment.

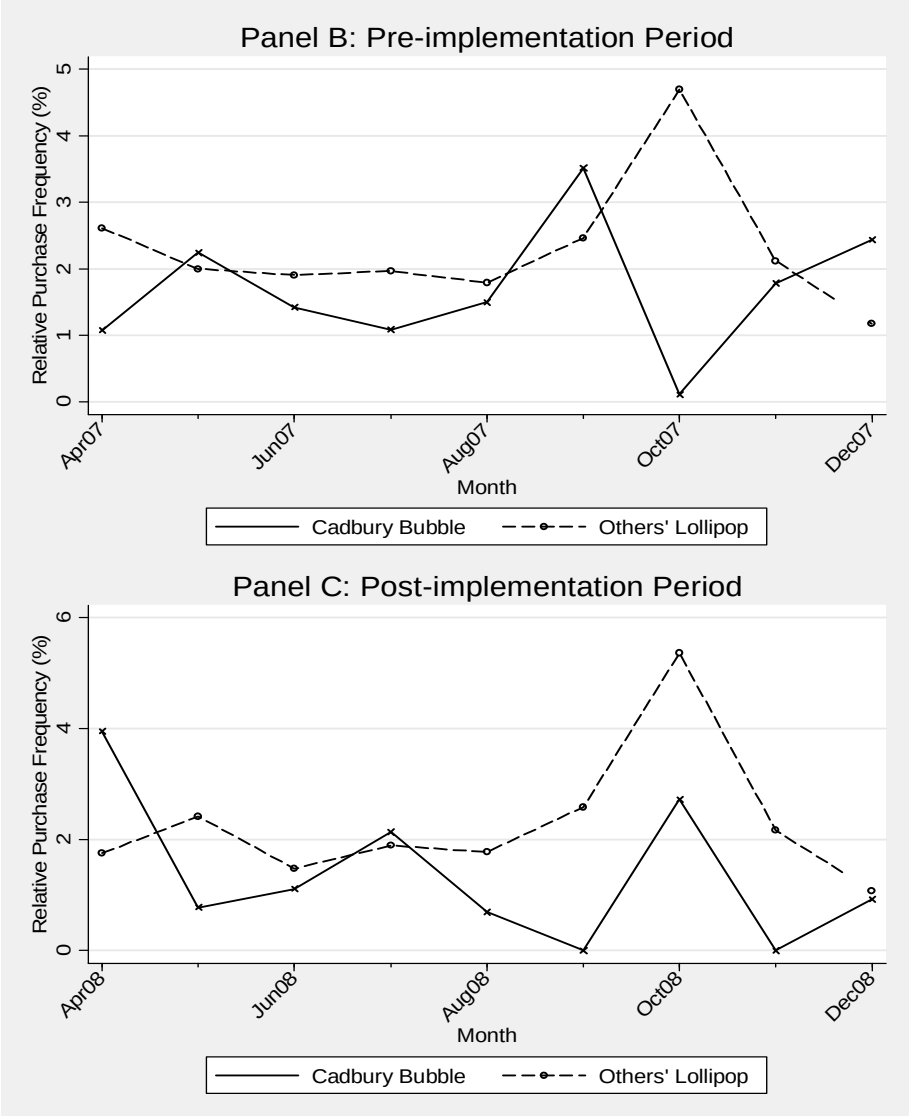


Figure 4. Relative purchase frequency: Cadbury Bubble Gums vs. Others' Lollipops
Note. Relative purchase frequency is the frequency of a household's purchasing a specific product relative to the household's total number of grocery shopping trips per month.

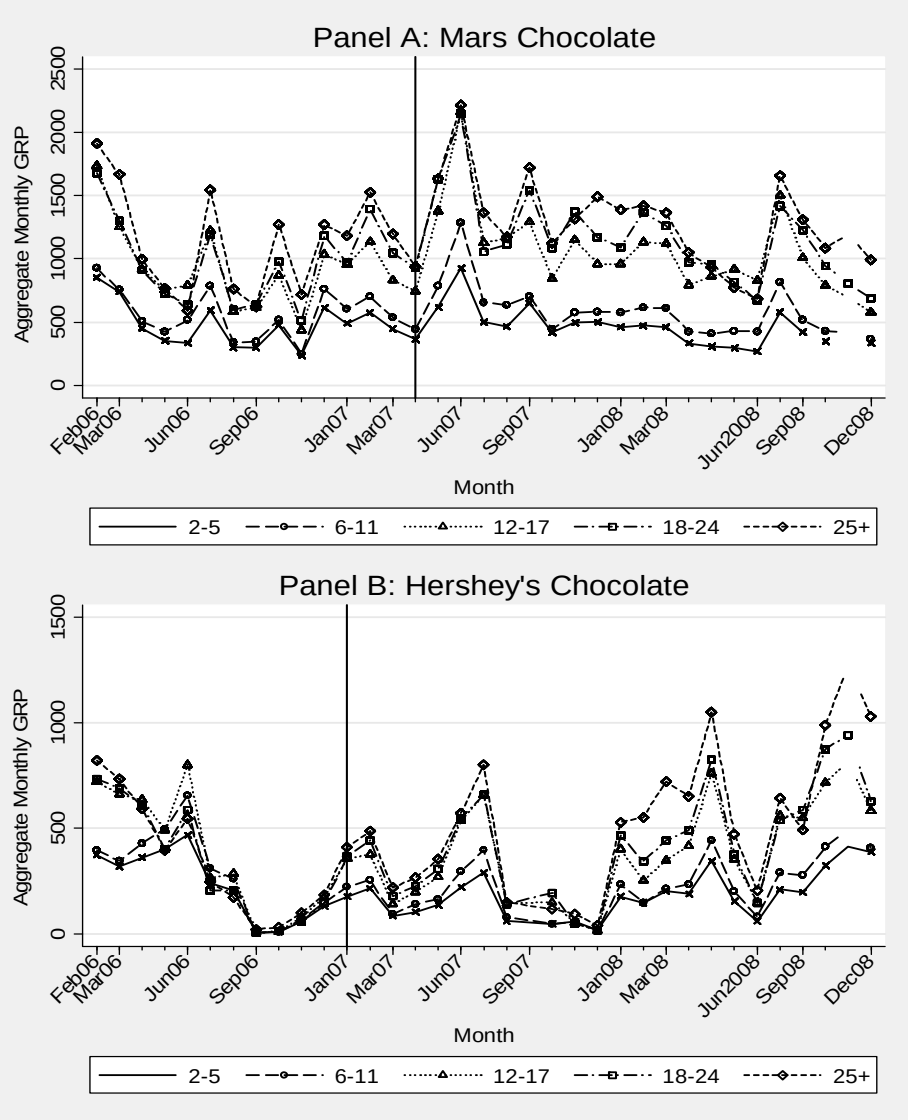
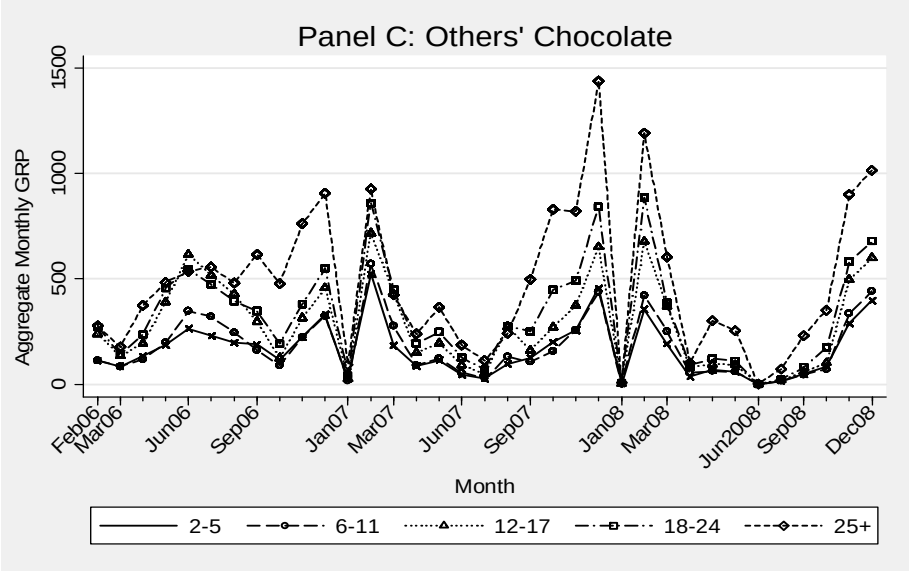


Figure 5. Advertising Exposure: Chocolate

Note. Depicted in the panels are the series of module-specific aggregated monthly Gross Rating Points (GRP) for audience of the following five age groups: 2-5, 6-11, 12-17, 18-24, and over 25. Aggregated monthly GRP is the sum of GRP from advertising aired on cable, network, syndicated, and spot television in the national market for all candy products in a module. The vertical lines indicate the dates (March 31, 2007 and January 1, 2007) on which the companies (Mars and Hershey's, respectively) fulfilled their CFBAI commitment.



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Note. Depicted in the panels are the series of module-specific aggregated monthly Gross Rating Points (GRP) for audience of the following five age groups: 2-5, 6-11, 12-17, 18-24, and over 25. Aggregated monthly GRP is the sum of GRP from advertising aired on cable, network, syndicated, and spot television in the national market for all candy products in a module.

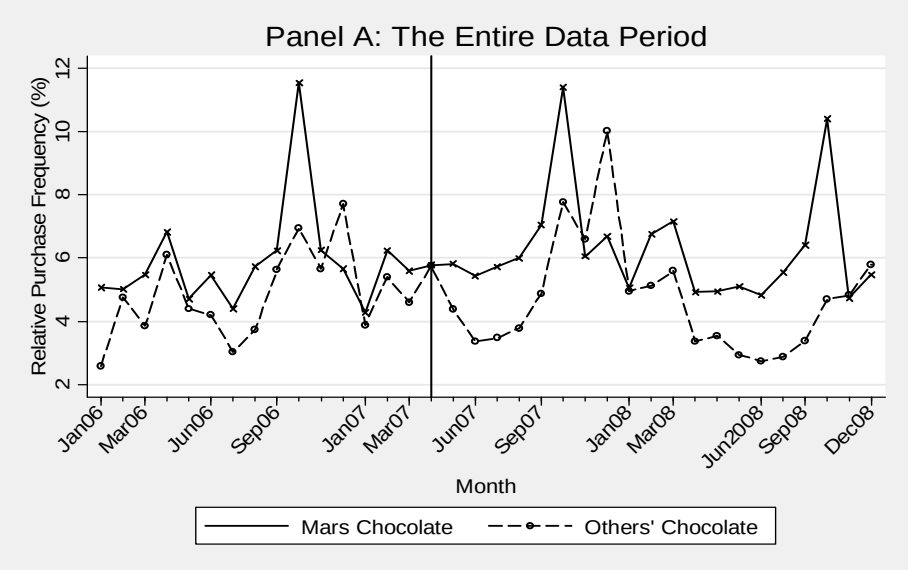

Figure 6. Relative Purchase Frequency: Mars Chocolate vs. Others' Chocolate
Note. Relative purchase frequency is the frequency of a household's purchasing a specific product relative to the household's total number of grocery shopping trips per month. The vertical line represents the date (March 31, 2007) on which Mars fulfilled its CFBAI commitment.

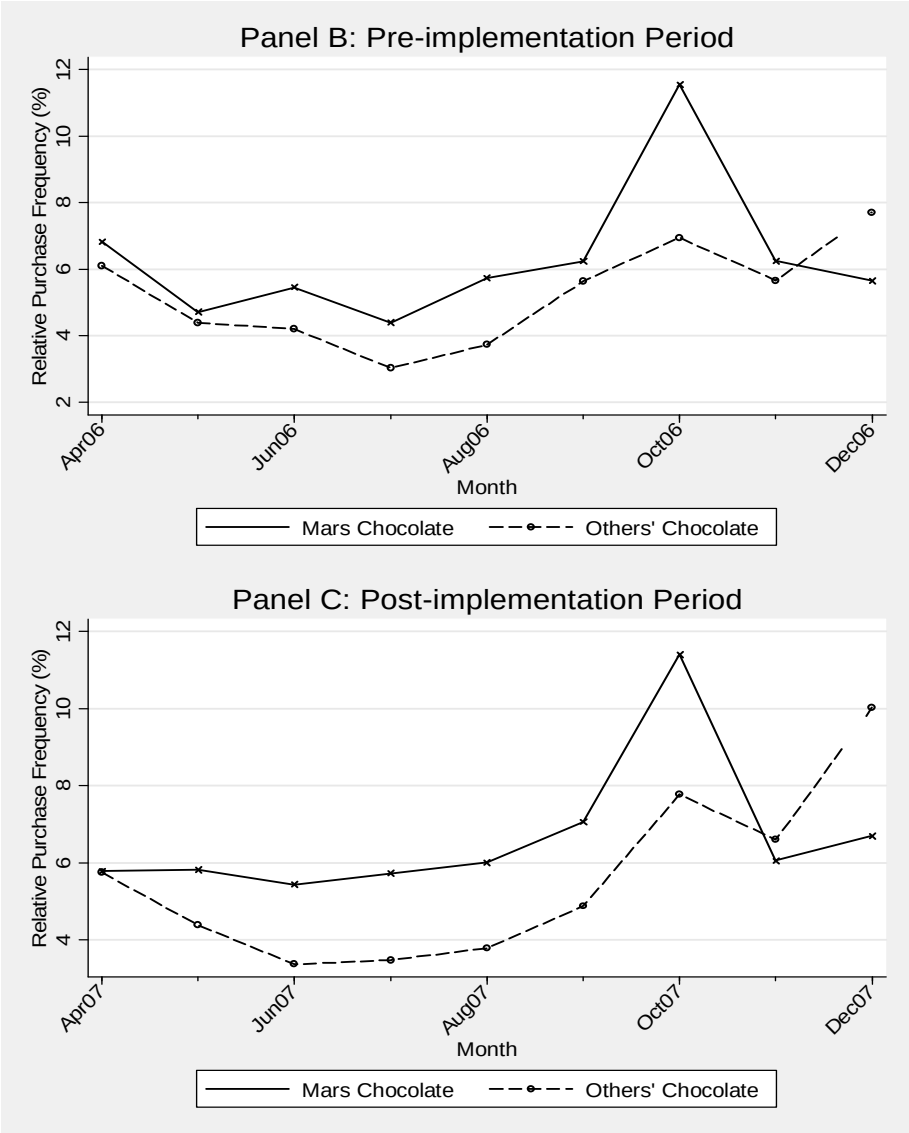

Figure 6. Relative Purchase Frequency: Mars Chocolate vs. Others' Chocolate

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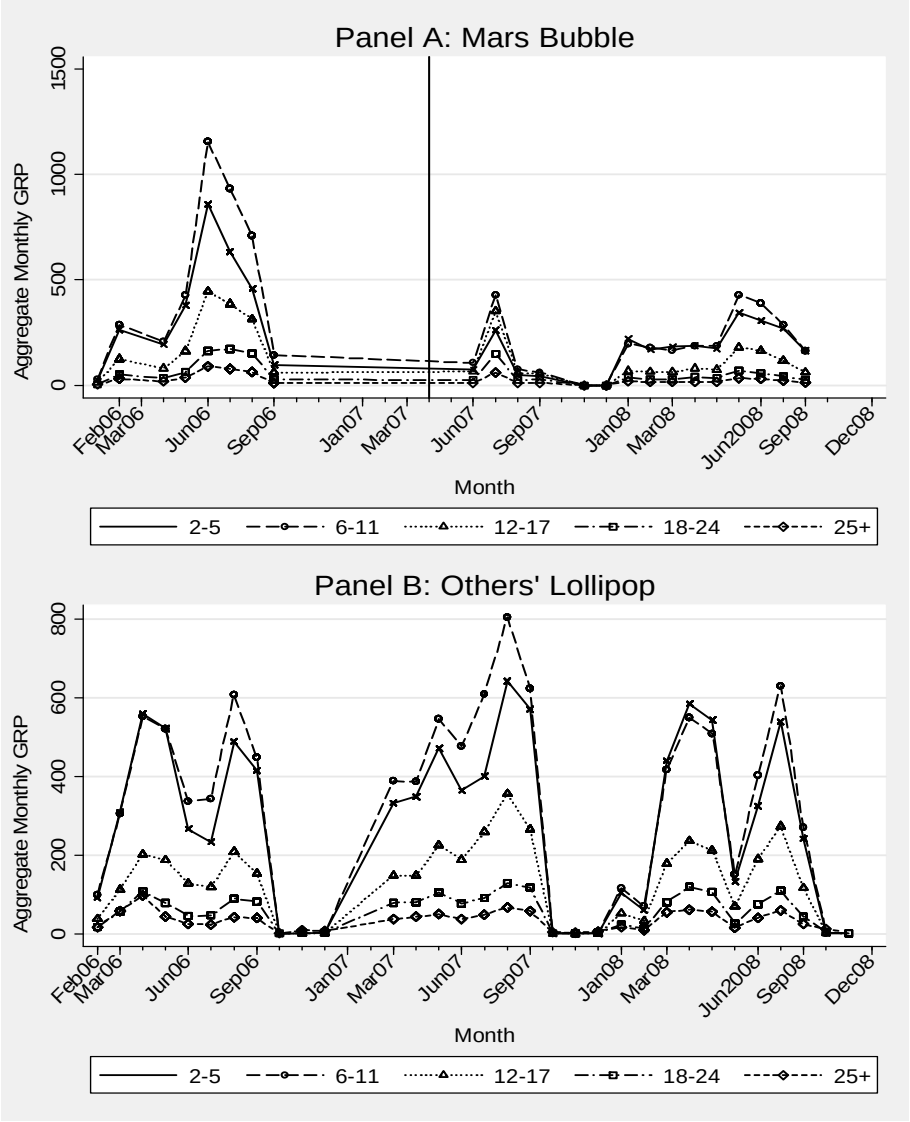

Figure 7. Advertising Exposure: "Mars" Bubble Gum vs. Others' Lollipop

Note. Depicted in the panels are the series of product-specific and company-specific aggregated monthly Gross Rating Points (GRP) for audience of the following five age groups: 2-5, 6-11, 12-17, 18-24, and over 25. Aggregated monthly GRP is the sum of GRP from advertising aired on cable, network, syndicated, and spot television in the national market. Mars implemented its original CFBAI pledges on March 31, 2007. It acquired the William Wrigley Jr. Company on April 28, 2008 and expanded its CFBAI pledge to include bubble gum brands of Wrigley, which became a subsidiary in January, 2010. We herein refer "Mars" bubble gum to all bubble gum brands under current Mars since its acquisition of the Wrigley. The GRP in Panel A is the sum of GRP for all "Mars" bubble gum brands. The GRP in Panel B is the sum of GRP for all lollipop brands produced by all non-CFBAI participants.

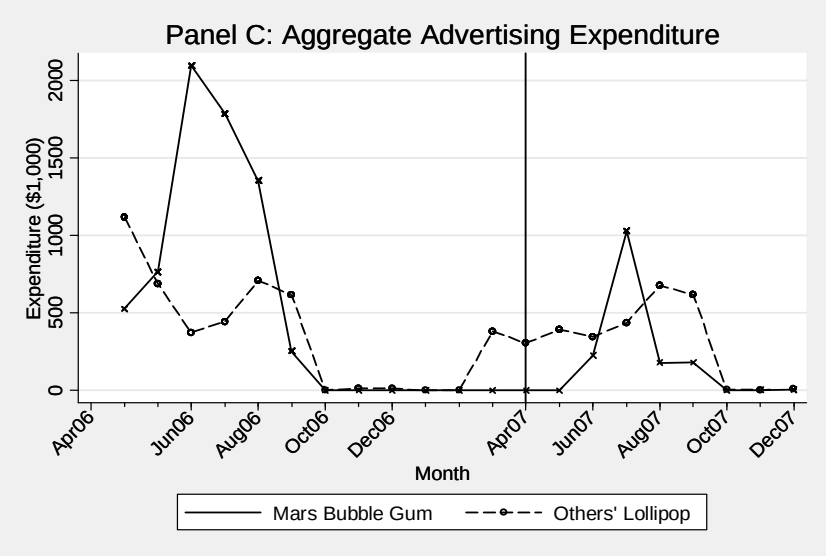

Figure 7. Advertising Expenditure: "Mars" Bubble Gum vs. Others'

Note. Depicted in the panels are the series of product-specific and company-specific aggregated monthly advertising expenditure. Aggregated monthly advertising expenditure is the sum of expenditure (in $1,000 unit) spent on advertising aired on cable, network, syndicated, and spot television in the national market for audience of all ages across all brands of a company. The vertical line represents the date (March 31, 2007) on which Mars fulfilled its original CFBAI commitment. Mars acquired the William Wrigley Jr. Company on April 28, 2008 and expanded its CFBAI pledge to include bubble gum brands of Wrigley, which became a subsidiary in January 2010. We herein refer "Mars" bubble gum to all bubble gum brands under current Mars since its acquisition of the Wrigley.

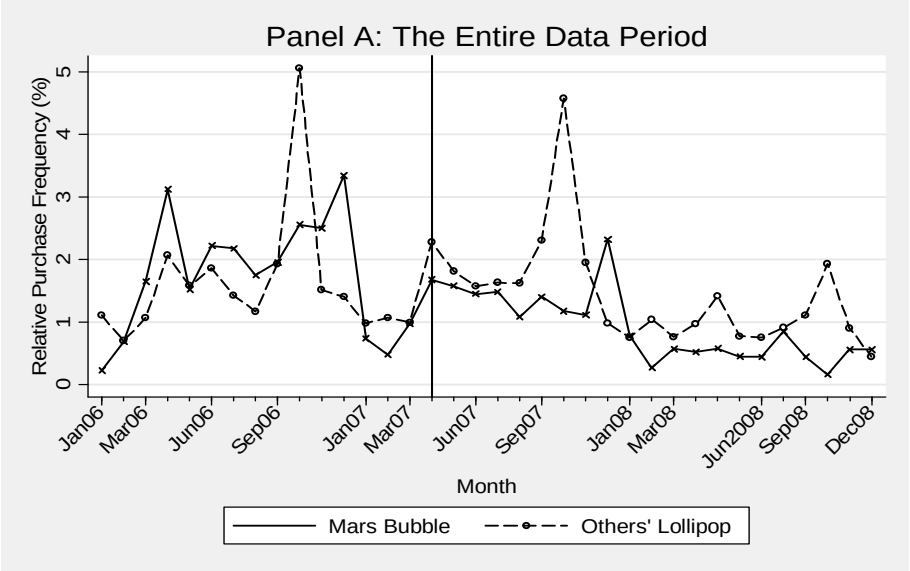

Figure 8. Relative Purchase Frequency: "Mars" Bubble Gums vs. Others' Lollipop

Note. Relative purchase frequency is the frequency of a household's purchasing a specific product relative to the household's total number of grocery shopping trips per month. The vertical line represents the date (March 31, 2007) on which Mars fulfilled its original CFBAI commitment. Mars acquired the William Wrigley Jr. Company on April 28, 2008 and expanded its CFBAI pledge to include bubble gum brands of Wrigley, which became a subsidiary in January, 2010. We herein refer "Mars" bubble gum to all bubble gum brands under current Mars since its acquisition of the Wrigley.

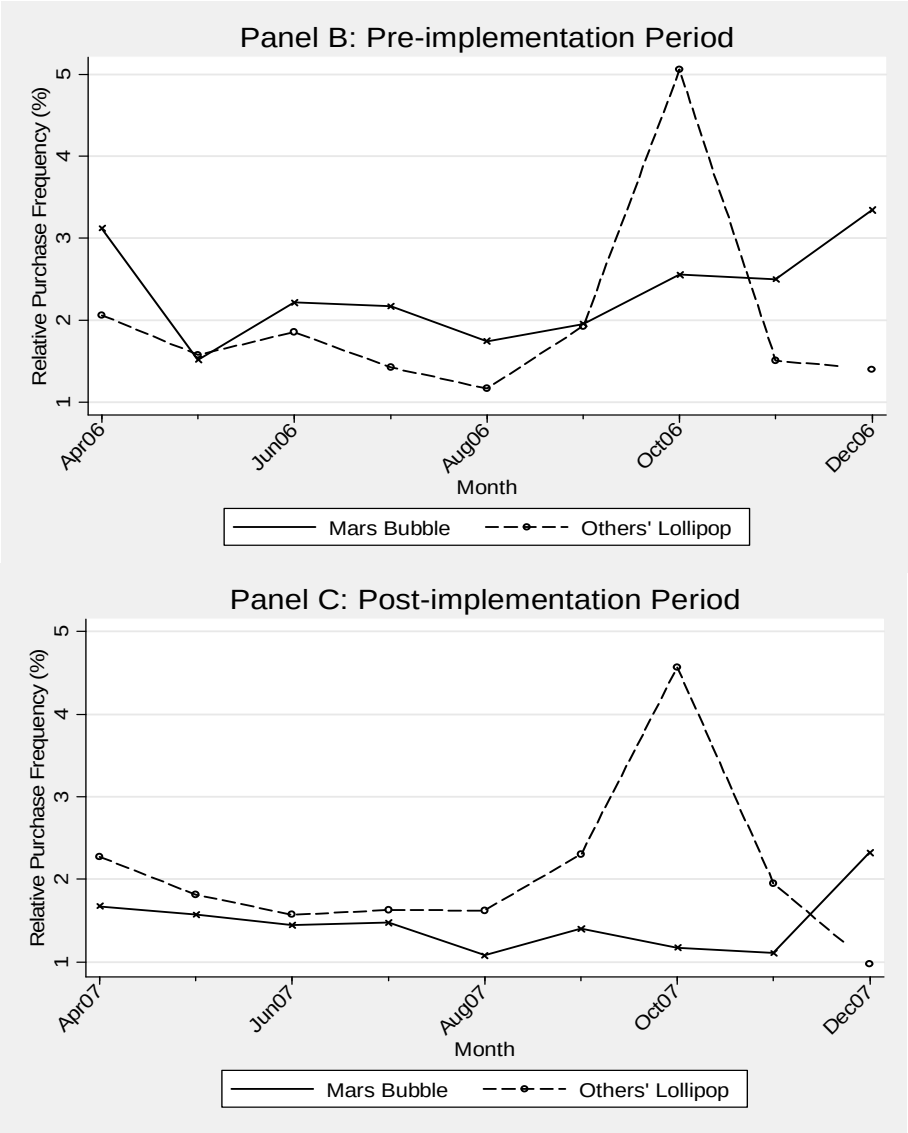

Figure 8. Relative Purchase Frequency: "Mars" Bubble Gums vs. Others' Lollipop
Note. Relative purchase frequency is the frequency of a household's purchasing a specific product relative to the household's total number of grocery shopping trips per month. Mars acquired the William Wrigley Jr. Company on April 28, 2008 and expanded its CFBAI pledge to include bubble gum brands of Wrigley, which became a subsidiary in January, 2010. We herein refer "Mars" bubble gum to all bubble gum brands under Mars after its acquisition of the Wrigley.

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