Government Advertising in Market-Based Public Programs: Evidence from the Health Insurance Marketplace

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January 31, 2020

Abstract

This paper studies marketing activities by the government and private firms in the Affordable Care Act health insurance marketplaces. By exploiting detailed TV advertising data that provide information on advertising messages, we first document that the government tends to advertise in markets with unhealthy populations, whereas private insurers advertise more in markets with healthy populations. Then, we estimate the impact of government and private advertising on enrollment by exploiting discontinuities of TV advertising markets. We find that government advertising has a market expansion effect, whereas private advertising tends to steal consumers from other insurers. Finally, by using the estimated equilibrium model of marketplaces, we explore the impact of alternative designs of government advertising. We find that government advertising alleviate excessive advertising competitions by insurers.

JEL Codes: I1, I3, L1, M3.
Keywords: health insurance, government advertising, advertising competition

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1 Introduction

The government often conducts marketing and outreaching activities for public programs. In *traditional* public programs, such as Medicaid, the Supplemental Nutrition Assistance Program (SNAP), and Supplemental Security Income Program, where the government directly provides the benefit to enrollees, low take-up among eligible populations is pervasive (Currie (2006)). Common explanations for the low take-up are the lack of information about eligibility and transaction costs associated with enrollment. As such, government marketing activities are considered to be one of the most important polices to efficiently deliver public programs (Aizer (2007); Finkelstein and Notowidigdo (2019)).

Government marketing activities are also substantial in *market-based* public programs, where benefits are provided by private firms in regulated markets. Market-based public programs have become common in health insurance, education, and mortgages.[1] In evaluating marketing activities in market-based public programs, a natural question is whether these activities should be still done by the government or instead by private firms. First, private firms often conduct a substantial amount of marketing activities in market-based programs (e.g., Cebul et al. (2011) and Aizawa and Kim (2018) for health insurance and Hastings et al. (2017) for privatized pension). Thus, need for government marketing activities crucially depends on social efficiency of private marketing activities. Second, the government and private firms may have different objectives. The government may have redistributive motives and target certain individuals, which may justify its marketing activities regardless of market imperfection. Given the growing importance of market-based public programs, these knowledge will be crucial for a number of public policy debates. For example, a recent large cut of federal marketing budget for Affordable Care Act's (ACA) health insurance marketplace has spurred interests in implications of government marketing activities on the stability and efficiency of the marketplace.[2]

In this paper, we study the effects of marketing activities by the government and private insurers in the ACA health insurance marketplace. We focus on advertising as a main marketing and outreaching tool. Advertising consists of the largest component of government marketing activities (Kosar (2016)), and it typically accounts for a much larger

[1] For example, market-based health insurance programs include health insurance marketplace under the Affordable Care Act, Medicare Advantage (Medicare benefits offered through private insurers), and Medicare Part D (prescription drug benefits). An example for education benefits is a charter school. Moreover, the Home Affordable Refinance Programs was set up in 2009 to help underwater homeowners to refinance their mortgages, but refinancing was possible only with private lenders.

[2] Before 2018, the federal government spent $100 million for the marketing activities for the marketplaces. This magnitude was comparable to advertising spending by private insurers for the marketplaces based on the data from Campaign Media Analysis Group at the Kantar Media. In 2018, however, the federal government drastically cut its spending to $10 million.

portion of program budgets for health insurance programs than other public programs. Moreover, the ACA marketplaces is an important policy relevant context given the aforementioned budget cut for federal advertising for the marketplace. We first document facts about how the government and private insurers target their advertising. Then, we estimate the impact of government and private advertising on health plan enrollments. Finally, we examine the equilibrium impacts of changing government marketing.

We begin our analysis by documenting patterns of how the government (both federal and state) and private insurers target advertising with detailed advertising data. We focus on two dimensions of targeting: geography and advertising contents. We obtain advertising data from Kantar Media, which contain rich measures of contents of advertising, including transcripts of actual advertisements. This information enables us to categorize advertisements into different categories, including whether the advertisement provides information on available financial assistance under the ACA, whether the advertisement provides information about the open enrollment period, etc.

Then, we show that the government advertising is targeted very differently from private advertising. By using county-level health characteristics from County Health Rankings (CHR) by the Robert Wood Johnson Foundation and American Community Survey (ACS), we find that the government tends to advertise in markets with less healthy individuals. In contrast, private insurers tend to advertise markets with healthier individuals. These patterns are consistent with the view that the government aims toincrease enrollment with less healthy individuals who value health insurance more. In contrast, private insurers may have incentives to engage in risk selection, i.e., attracting healthier and more profitable consumers. Moreover, we find that contents of advertising by federal and state governments tend to emphasize the affordability of health plans through marketplaces. However, main messages of private advertising are more dispersed, and they tend to emphasize quality and various insurance option provided by private plans. These findings highlight that the government and private insurers have clearly different incentives about which types of consumers they want to attract.

Next, we estimate a model for consumer demand for ACA health plans to study effectiveness of advertising by the government and private insurers. We obtain enrollment data for federal marketplaces from Center for Medicare and Medicaid Services (CMS) and state-based marketplaces from California (Covered California) and New York (NY State of Health). In our model, we allow that the advertising by the federal and state governments and private insurers may have different effects on the decision to purchase health insurance. We also allow that the demand effect of advertising depends on the content of advertising. For identification of advertising's effect on demand, we implement a border

identification strategy (e.g., Shapiro (2018), Spenkuch and Toniatti (2018), and Moshary (2017)): specifically, we exploit a discontinuity of advertising spending across TV advertising markets to address endogeneity of advertising.

We find that the government advertising, especially by the federal government, has a market expansion effect by increasing overall enrollment. Quantitatively, we estimate the demand elasticity with respect to government advertising to be about 0.04, which is comparable to findings in advertising by private insurers for many products, including health insurance. Because government advertising is targeted to markets with unhealthy populations, it may increase enrollment of individuals with higher willingness to pay for health insurance.

We also find that government advertising is more effective in earlier years in marketplace, when there was probably a much greater share of individuals new to marketplaces. This finding suggests that advertising likely reduces transaction costs of potential buyers of marketplace plans, who were likely uninsured before marketplaces became available. Those potential buyers were unlikely to be very familiar with a process of applying for health insurance.

In contrast, we find that advertising by private insurers has a limited market expansion effect, although it increases enrollments for insurers that conduct advertising. This is consistent with the view that advertising from different companies just results in business stealing without expanding the total number of individuals enrolling for ACA health plans. These results suggest that government advertising may be more effective than private advertising in reducing transaction costs of consumers to enroll in marketplaces or increasing public awareness of the marketplaces.

We also examine which messages in each advertisement are effective in increasing enrollment in health insurance marketplaces. We find that federal advertising emphasizing financial assistance (e.g., the presence of significant premium subsidies) and the open enrollment period contributes to an increase in enrollment. Interestingly, for private insurers, we find that advertising emphasizing own brands or quality of their own insurance plans are much more effective. Thus, the ACA related information can increase the takeup rate when they are provided by the federal government rather than private insurers.

Finally, we study alternative designs of government advertising in an equilibrium model of health insurance marketplace. We examine how changes in government advertising across markets affect market outcomes by taking into account the possibility that private insurers endogenously adjust their marketing activities. For this purpose, we specify the supply side of the health insurance marketplace, where insurers optimally

choose the level of advertising spending to maximize their profits. In the first part of analysis, we first recover the perceived marginal benefit of advertising by private insurers by using observed advertising spending and our demand estimates. In the second part of analysis, we conduct counterfactual experiments to evaluate various designs of government advertising. We find that decreasing government advertising leads to significant increases in private advertising spending. However, we also find that overall market-level enrollment changes very little regardless of whether we allow private insurers to respond to changes in government advertising. This finding is consistent with the demand model estimate that shows little market-expansion effects of private advertising and that a large part of private advertising is likely to be wasteful of resources. Therefore, our result suggests that government advertising is a more efficient marketing tool in market-based public programs if private advertising just shifts consumers among firms.

Our research contributes to the three strands of literature. First, this paper contributes to an active literature on government interventions that increase take-up of public programs. Several studies evaluate marketing and outreach activities designs for public programs. Aizer (2007) explores the effectiveness of a California outreach campaign on Medicaid take-up rates. More recently, Finkelstein and Notowidigdo (2019) conduct a randomized experiment to understand the effectiveness of information provisions for the eligibility for SNAP. These papers focus on the effectiveness of government outreach in traditional public/welfare programs, whereas ours focuses on designs of marketing and outreach by the government in a *market-based* public program. Very recently, Domurat et al. (2019) and Goldin et al. (2019) examine the effect of government direct mailing to the potential consumers on their insurance take-up behaviors in marketplaces. Complementary to the two papers, this paper studies how a market equilibrium responds to government marketing.

Second, this paper is related to the literature investigating market design of health insurance markets. The literature has extensively focused on pricing/product regulations and subsidy designs/risk adjustment, e.g., Hackmann et al. (2015) and Handel et al. (2015) for pricing regulations; Shepard (2016) and Ho and Lee (2019) for medical network provider regulations; Brown et al. (2014) for risk adjustment; Cabral et al. (2018), Curto et al. (2014), Duggan et al. (2016), Tebaldi (2017), andPolyakova and Ryan (2019) for capitation payments or subsidy designs.

We contribute to this literature by studying an equally important yet under-studied policy design tool: a design of marketing and outreach activities by the government. In fact, several studies (Cebul et al. (2011) and Aizawa and Kim (2018)) argue the importance of marketing activities by private insurers in determining market outcomes in

health insurance markets. Very recently, several studies in the health policy literature (e.g., Karaca-Mandic et al. (2017) and Gollust et al. (2018)) document a positive association between government advertising and decreases in the number of uninsured individuals in the context of the ACA.[3] Compared with these studies, the main theme of our study is to assess the efficiency of government marketing activities in private markets by building an equilibrium framework that accounts for interactions between government and private marketing activities. To cleanly identify and estimate the impact of advertising, we build on recent methodological advancement in the marketing literature (e.g., Shapiro (2018) and Spenkuch and Toniatti (2018)) and use an advertising market border identification approach. Using this approach with detailed enrollment data, we provide a number of new estimates, including the impact of advertising on insurer-level enrollment, their heterogeneous impacts, the effectiveness of contents of advertising, and business stealing/spillover effects of private advertising. These estimates, combined with equilibrium model, will be crucial in understanding inter-dependence between government and private insurers in terms of marketing activities.

Third, it contributes to the literature on advertising. Recently, researchers have studied the effects of advertising by private companies in an equilibrium framework for different contexts: Goeree (2008) for the personal computer; Dubois et al. (2018) for junk food; Gordon and Hartmann (2016) and Moshary (2017), and Spenkuch and Toniatti (2018) for U.S. elections; Shapiro (2018) and Sinkinson and Starc (2018) for pharmaceuticals; and Hastings et al. (2017) for privatized pension. More recently, Shapiro et al. (2019) estimate the effect of advertising on consumer demand in a variety of products. This paper adds to this literature by providing causal estimates of advertising by not only by private firms but also by the government. Moreover, we investigate an interaction between government and private advertising.

2 Background on the Health Insurance Marketplace

Health Insurance Marketplace is a federal/state-based health insurance program for the non-elderly (people aged less than 65) in the United States. It was established in 2014 as a part of the ACA. The marketplaces are designed to provide health insurance coverage for non-elderly uninsured individuals, which is close to 20% of the U.S. population. In the marketplace, private insurers offer a variety of health insurance options, and the federal government offers premium and cost sharing subsidies to low-income enrollees. Each

[3]Barry et al. (2018) also analyze how the content of ACA advertising over time and discuss whether they are designed to attract young and healthy individuals.

insurance product is usually categorized based on their "metal" plans, which provide different levels of coverage generosity: Bronze, Silver, Gold, and Platinum. Individuals can decide to purchase health insurance during the open enrollment period, typically starting in the beginning of October that precedes the year when the new coverage begins. Each health plan is an annual health insurance contract, and individuals need to decide whether to enroll every year.

Rating Regions. Each state is divided into geographical rating regions, groups of counties or zip codes. Within each geographical rating region, importantly, insurers are not allowed to explicitly discriminate their pricing and product offering based on consumer's health status. Insurers can still charge different premiums based on an individual's age and smoking status under a pre-specified rule: specifically, the maximum premium ratio between the oldest and the youngest must be equal to a factor of 3; the smoker's insurance premium is 1.5 times as high as non-smokers.

Consumer Subsidies. Consumers who purchase health insurance are offered generous premium subsidies from the federal government. The amount of the subsidy depends on household income. Subsidies are available only if household incomes are between 138% and 400% of the federal poverty level. Among these households, a household with a lower income receives a more generous premium subsidy. If a household income is below 138% of the federal poverty level, then individuals are not eligible for the subsidies because they would be eligible for Medicaid.[4] Consumers who purchase silver plans in marketplaces also receive income-dependent cost sharing subsidies. Overall, the government spends close to $40 billion per year on premium and cost-sharing subsidies.

Risk Adjustment System. The ACA created several programs to mitigate insurer's incentives to selectively enroll healthy and low-cost individuals (i.e., risk selection). Most importantly, the ACA introduced a risk adjustment system that give transfers to insurers that attract a greater number of unhealthy individuals than the market average.[5] A distinct feature of the risk adjustment under the ACA is budget neutrality. In other words, insurers with a greater number of unhealthy populations than other insurers in the same

[4]This is the case when the state government expands Medicaid under the ACA. If the state government does not expand Medicaid under the ACA, then consumers are qualified for subsidies as long as a household income is between 100% and 400% of the federal poverty level. If a household income is below 100%, then they are still not qualified for the marketplace subsidies.

[5]The ACA used to incorporate two additional features into the risk adjustment program: re-insurance and risk corridors. However, both have been terminated by the end of 2016.

state would receive transfers from other insurers; insurers with a larger portion of healthy populations than other insurers would instead have to provide payments to other insurers.[6]

This design of the ACA risk adjustment system may be relevant in our context. Even if advertising from private insurers primarily steals healthy consumers from other insures, then gains from risk selection through advertising will be diminished by the risk adjustment system. Under the risk adjustment system, an insurer with a better risk pool than other insurers will have to make a payment to other insurers, which offsets potential benefits from attracting consumers with better health risks.

Marketplace Administration and Marketing. State governments have three options to administer health insurance marketplace under the ACA. First, they can participate in health insurance marketplaces operated by the U.S. Department of Health and Human Services (HHS), called federally facilitated marketplace. Second, they can create own state health insurance marketplaces (state marketplaces). Third, they can partner with the federal health insurance marketplace (partnership marketplaces). Each marketplace model gives a different level of flexibility to states in designing their own exchanges. For example, under different models, states are given different levels of different ability to maintain control over their marketplace and tailor consumer outreach and assistance to their populations. Moreover, states face different funding and resource constraints under different models.[7]

Under the state marketplace model, states have full responsibility for running consumer assistance functions of their marketplaces, which include direct marketing to consumers about their marketplaces through paid advertising on various media such as TV. These activities are partially supported through federal funding. In federally facilitated marketplaces, in contrast, the federal government is responsible for conducting these functions. The federal government conducts a significant amount of marketing activities for the health insurance marketplace.

[6]This design is different from other health insurance markets, such as Medicare Advantage, where amounts of risk adjustment transfers do not depend on a relative composition of enrollees' health risks across insurers in the same market. In non-ACA health insurance markets, an insurer's payment from a risk adjustment system typically depends only on its own enrollees' risk profile, regardless of risk compositions of enrollees in other insurers.

[7]https://www.healthaffairs.org/do/10.1377/hpb20130718.132696/full/

3 Data and Summary Statistics

This paper combines data from multiple sources. We use the health insurance enrollment data for 2014–2018 from the Center for Medicare and Medicaid Services (CMS) to construct market shares for insurers. We also obtain detailed information on advertising from Kantar Media. This data set provides occurrence-level TV advertising information on advertisements by private insurers and the federal and state governments for 2013–2018 (both on Spot TV and Network TV). Finally, we acquire plan characteristics from the CMS.[8]

3.1 Data Sources

3.1.1 Firm- and Market-Level Data

Our analysis combines enrollment data of federal marketplaces and the two largest state-based marketplaces from California and New York. In each year, the CMS releases enrollment data for health insurance marketplaces for 38 states that are administered by the federal government. These 38 states have either federally facilitated marketplaces or partnership marketplaces. Most of enrollees in these marketplaces purchase plans through the online website "healthcare.gov". The CMS constructs a database of detailed information about enrollment at the insurer-county level for each year from 2014 to 2018. The database also provides a breakdown of enrollments by gender, age, household income, and smoking status.

In addition to these marketplaces, we also obtain enrollment data from the two largest state exchanges from California and New York. Like the federal data, the data from the two states provide total enrollments for each insurer and county in each year. However, the data from California and New York do not provide a breakdown of enrollments by different demographic groups unlike the federal data.

In order to construct market shares for each insurer in a county, we obtain the county-level market size from the American Community Survey (ACS). Specifically, following Tebaldi (2017) and Polyakova and Ryan (2019), we define the market size of each county as the sum of the number of uninsured individuals and those who individually purchased health insurance, instead of obtaining it from their employers. This number measures the number of people who would potentially purchase plans from marketplaces.

We also obtain county-level health characteristics from County Health Rankings by

[8]The current analysis does not utilize the large cut to the federal government's marketing budget in 2017 because the enrollment data affected by the budget cut has not been released yet.

the Robert Wood Johnson Foundation (CHR). CHR provides information about county-level health characteristics, such as the fraction of populations with poor or fair health or the populations with diabetes.[9]

The CMS also releases detailed plan characteristics for plans sold through "Healthcare.Gov" in the 38 states. These include information about premiums and financial characteristics, such as metal level (Bronze, Silver, Gold, and Platinum) as well as detailed benefit information (e.g., dental coverage).

3.1.2 Advertising Data

Our advertising data is from Campaign Media Analysis Group at the Kantar Media. The data contains advertising spending, duration, and gross rating points (GRP) at each advertisement occurrence level. Each advertisement is on either spot TV or network TV. Data on spot TV advertisements are available at the designated market area (DMA) level, while data on network TV advertisements are at the national level.

We use the per-capita advertising spending as our main measure of analysis. Although our data suggest the strong positive correlation among GRP, spending, and duration, using GRP will more precisely inform us consumer exposure of advertising. Unfortunately, GRP is not reported for most of network TV advertising. In order to construct an advertising measure based on spot and network TVs, we follow Shapiro (2018) and use advertising spending in our analysis.

The database also provides detailed characteristics of each advertisement. For example, we can precisely observe a video of an actual advertisement through a weblink for each advertisement in the database. Moreover, we can observe who sponsored each advertisement and the exact time of when each advertisement is placed.

Identifying Advertisement Types For our analysis, we ideally want to identify which advertisements are related to marketplaces. For this purpose, we exploit the detailed information from the database. Specifically, by transcribing each advertisement, we identify (i) which advertisements are related to marketplaces, (ii) which advertisements just pro-

[9]Note that health measures reported in each survey year are based on outcomes in previous years. For example, the county-level self-reported health status reported in survey years from 2016 to2018 is based on the actual self-reported health status as of two years ago. In other words, the data from 2016 to 2018 provides information about self-reported status from 2014 to 2016. Because the data do not provide information about health status in 2017 or later, we assign health status from 2016 to later years when creating a measure of health status for each county and year. We do not believe that our results are sensitive to the way we construct the county-level health measure because actual county-based health status is likely to be very persistent over time. We also experimented with an alternative way to construct the health measure by calculating the average health status for each county across years. We find our main results robust.

mote a private insurer's brand generally, and (iii) which advertisements are about health plans in specific markets other than marketplaces such as Medicare-related plans. Using the Amazon Web Service, we transcribed each advertisement in our database, which allows us to identify different types of advertisements based on keywords. In our analysis, we only consider advertisement types (i) and (ii) and exclude type (iii).

We have slightly different ways to identify types of advertisements depending on types of advertisement sponsors: the federal government, state governments, and private insurers. First, for the federal advertisement, we initially select advertisements sponsored by HHS.[10] Among such advertisements, we identify marketplace-related advertisements by checking whether "Healthcare.gov" was mentioned in an advertisement based on transcripts. Because there are only a little more than 100 distinct advertisements by HHS, we also verified our classification visually watching each individual advertisement video. Type (ii) advertisements are likely non-existent for federal advertising, and we do not consider it. Lastly, we exclude any advertisements of type (iii), for example ones about Medicare by HHS, from our sample.

Second, for advertising by state governments, we identify names of sponsors that match names of state exchanges such as Covered California and New York State of Health. Like federal advertising, we identified advertisements of type (i) from these sponsors based on their transcripts and visual inspections of advertisement videos. We also do not consider type (ii) advertisements from these sponsors.

Third, for private advertising, it is difficult to rely on visual inspections to classify advertisements into different types because there are thousands of distinct advertisements. Thus, we mainly rely on transcripts. For these advertisements, we consider type (i) and (ii) in our sample and exclude type (iii). Based on the transcripts, we initially identify advertisements containing keywords related to type (iii) such as Medicare Advantage, Medicare Part D, Medigap, employer-sponsored insurance, etc. Then we exclude any of such advertisements from the sample. Among the rest of the sample, we identify specific keywords related to marketplace plans such as healthcare reform, open enrollment, financial assistance, etc. Then we classify advertisements with such keywords as type (i), and the rest of advertisements in the sample are classified as type (ii).

[10] We also checked whether there are other federal sponsors who would place marketplace-related advertisements. However, the federal advertising seems to be done exclusively by HHS.

3.2 Summary Statistics

First, we document the volume of marketplace advertising by each sponsor type. Figure 1 reports monthly time-series patterns of advertising spending by governments and insurers. We find that private ACA-related advertising is somewhat larger than advertising by state and federal governments. However, the magnitude of total government advertising (both federal or state combined) is still sizable, which is usually more than 100 million dollars per year. This magnitude can be comparable to the total private advertising for health insurance (both ACA and non-ACA advertisements combined). Importantly, almost all ACA-related advertising, regardless of whether they are private or governments, are placed around open enrollment periods of health insurance marketplaces. This pattern is different from non-ACA private advertising, which shows similar monthly spending over the year.

In 2017, the federal government decided to cut their total marketing budget for 2018 to only 10 million dollars. As seen from the figure, the TV advertising by the federal government is almost to zero. Interestingly, at the same time, there is a large increase in both ACA and non-ACA private advertising. As a result, the total volume of advertising associated with marketplaces is roughly unchanged from 2017. Because there are many other changes that may induce an increase in private advertising in 2018, we do not interpret that this relationship as a causal. However, this data pattern motivates us to study interactions between government and private advertising in Section 6.

Figures 2 and 3 present in which DMAs different sponsor types did their advertising for the 2014 open enrollment period. First, the figures show that the federal and state governments advertised in very different DMAs. This is simply because that state advertising is done mainly in DMAs with state marketplaces, while the federal government advertised mainly in DMAs with federally facilitated marketplaces plus some national TV advertising. Second, the same figures also show that the distribution of government and private advertising spending differ significantly across DMAs. For example, compared with private insurers, the federal government advertise extensively in Arizona and Florida.

Table 1 documents summary statistics of market characteristics depending on government and private advertising spending. In the table, we combine advertising by the federal and state governments to calculate the total government advertising spending. The table shows that both government and private advertising spending are larger in DMAs with a greater number of potential buyers of marketplace plans (i.e. market size).

Figure 1: Time Series of Advertising Spending

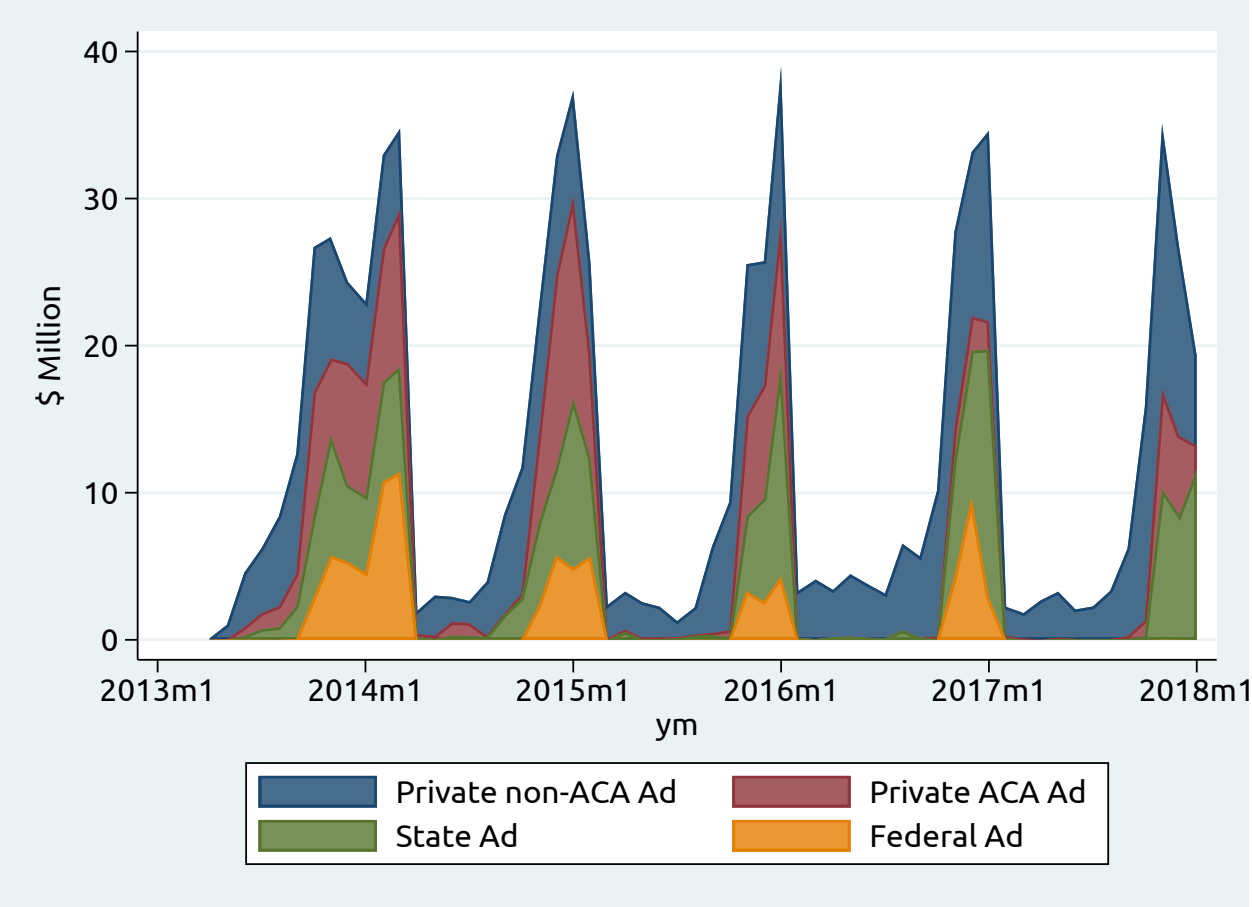
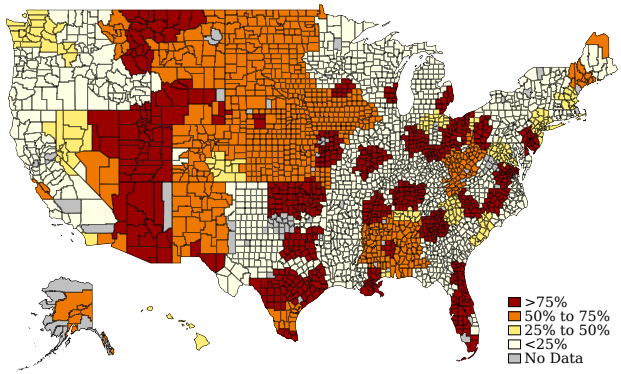
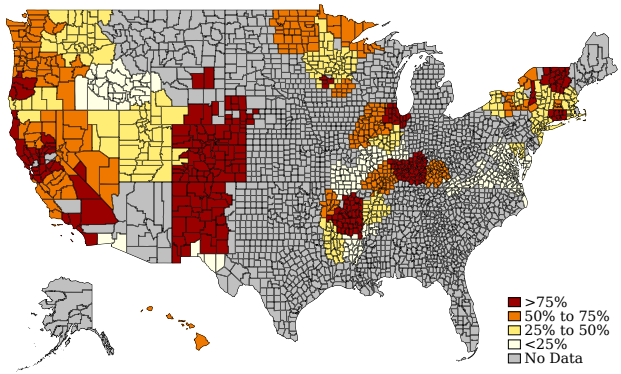


Figure 2: Geographical Patterns of Gov Advertising

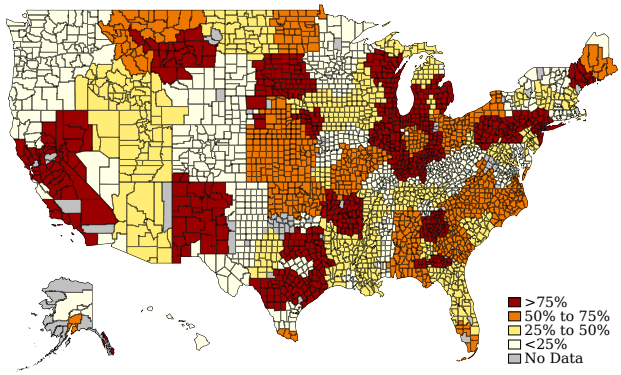


(a) Fed Ad per Capita



(b) State Ad per Capita

Figure 3: Geographical Patterns of Private Advertising



However, they are not perfectly correlated with each other. Comparing Columns (4)–(6), it is apparent that government advertising spending does not monotonically increases as private spending increases.

Table 1: Summary Statistics at DMA-Year Level

	By Gov Ad Expenditure per Capita			By Private Ad Expenditure per Capita		
	(1)	(2)	(3)	(4)	(5)	(6)
	<25%	$\geq$ 25% & <75%	$\geq$ 75%	<25%	$\geq$ 25% & <75%	$\geq$ 75%
Gov Ad per Capita ($)	0.14	5.50	12.05	5.13	4.80	6.31
Priv Ad per Capita ($)	4.96	3.06	5.71	0.00	6.83	10.72
No. of Insurers	3.52	2.97	4.24	2.90	3.73	4.37
Share of Poor or Fair Health	0.17	0.17	0.16	0.17	0.17	0.17
Market Size (100,000)	1.37	1.80	5.11	1.22	2.28	5.23
% FPL $\leq$ 138	0.25	0.23	0.22	0.22	0.25	0.24
% FPL from 138 to 250	0.25	0.25	0.24	0.25	0.25	0.25
% FPL from 250 to 400	0.21	0.22	0.22	0.22	0.21	0.21
% FPL > 400	0.29	0.30	0.32	0.31	0.29	0.30
% age $\leq$ 18	0.14	0.15	0.15	0.15	0.14	0.15
% age from 18 to 34	0.36	0.35	0.35	0.35	0.36	0.35
% age from 35 to 54	0.32	0.32	0.32	0.31	0.32	0.33
% age $\geq$ 55	0.18	0.19	0.18	0.19	0.17	0.17
N. Obs.	262	326	196	395	193	196

Source: Kantar Media 2014–2017.

Table 2 shows the summary statistics of contents of advertisements depending on sponsor types (the federal and state governments, and private insurers). With transcripts of advertisements in our sample, we first consider several relevant topics in our context, including whether an advertisement mentions the healthcare reform, marketplaces, the open enrollment period, being uninsured, financial penalty of not having health insurance, financial assistance under the ACA, or pricing information (affordability) of health insurance. We then tabulate the proportion of advertisements that mention keywords related to each topic. Details on how these variables are constructed are in Appendix B.

Here are our findings. First, topics that advertisements focused on have changed over

years. Federal advertising did not specifically mention the open enrollment period or financial assistance in 2014, whereas more than a half of federal advertising mentioned the open enrollment period in 2016. Second, topics that are commonly discussed in both government and private advertisements are the open enrollment period and financial assistance under the ACA. Third, we find that a half of advertising by private insurers provide contents related to the ACA. Non-ACA-related private advertising typically emphasize an insurer's brands and the quality of its plans.

Table 2: Ad Contents

	Year = 2014			Year = 2015			Year = 2016		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Private	Federal	State	Private	Federal	State	Private	Federal	State
% Any ACA-related	0.52	1.00	1.00	0.51	1.00	1.00	0.40	1.00	1.00
% Healthcare Reform	0.39	0.38	0.07	0.07	0.00	0.00	0.05	0.00	0.00
% Marketplace	0.05	1.00	1.00	0.11	1.00	1.00	0.10	1.00	1.00
% Open Enrollment	0.26	0.04	0.07	0.37	0.01	0.20	0.24	0.64	0.26
% Uninsured	0.01	0.05	0.31	0.04	0.00	0.01	0.03	0.00	0.07
% Penalty	0.04	0.00	0.01	0.20	0.00	0.01	0.15	0.00	0.04
% Financial Assistance	0.21	0.12	0.47	0.41	0.22	0.39	0.27	0.59	0.21
N. Obs.	351,702	166,137	164,663	263,131	27,907	101,562	184,549	39,134	106,754

Source: Kantar Media 2014–2017.

4 Suggestive Evidence for Targeting Advertising

In this section, we carry out preliminary analyses to explore how advertising by governments and private insurers are targeted. In order to obtain further insights on whether geographical targeting of advertising, which is shown earlier, is related to market characteristics (e.g., income and health distributions), we estimate the following regression:

$$\ln(1 + ad_{mt}^{\tau}) = X_{mt}\gamma + \xi_t + \epsilon_{mt}. \tag{1}$$

The dependent variable ad_{mt}^{τ} represents advertising spending per capita by sponsor type $\tau \in \{f, s, p\}$, which is the federal government (f), state government (s), or private insurer (p). Explanatory variables X_{mt} include various market-level characteristics such as the market size, the number of insurers, distributions of ages and household incomes of potential consumers in each DMA, and DMA-level average health characteristics. Next, ξ_t refers to year fixed effects. We hypothesize that the advertising may be targeted based on these market-level characteristics.

Table 3 presents our preliminary estimates of geographical targeting of federal, state, and private advertising. Columns (1)–(4) report results for federal advertising, state ad-

Table 3: Targeting of Advertising: Aggregate Results

	(1) Federal ACA	(2) State ACA	(3) Priv All	(4) Priv. ACA
Share of Poor or Fair Health	0.866***	2.189	-1.694*	-0.997**
	(0.299)	(2.041)	(0.897)	(0.491)
No. of Insurers	0.014**	0.070**	0.084***	0.029***
	(0.006)	(0.029)	(0.016)	(0.007)
Market Size (100,000)	0.023***	0.014	0.024***	0.017***
	(0.005)	(0.012)	(0.007)	(0.004)
% age $\leq$ 18	0.371	-0.791	-1.449	-0.132
	(0.318)	(1.711)	(0.912)	(0.478)
% age from 18 to 34	-0.205	0.257	-0.375	0.328
	(0.274)	(1.269)	(0.770)	(0.377)
% age from 35 to 54	-0.364	-2.795	-0.604	-0.006
	(0.399)	(1.771)	(1.042)	(0.523)
% FPL $\leq$ 138	-0.124	-3.371***	0.779	0.796***
	(0.204)	(0.949)	(0.565)	(0.266)
% FPL from 138 to 250	-0.092	-0.127	-0.065	0.313
	(0.230)	(1.304)	(0.666)	(0.376)
% FPL from 250 to 400	0.344	1.443	0.128	0.545
	(0.286)	(1.313)	(0.630)	(0.335)
N. Obs.	476	302	983	983
Adj. R^2	0.225	0.207	0.156	0.194

footnote: the standard error is clustered at the DMA level.

vertising, the total advertising by private insurers, and only ACA-related advertising by private insurers, respectively. We find that the coefficient for the share of unhealthy individuals in a county is positive for both federal and state advertising and statistically significant for federal advertising. Thus, federal advertising tends to be targeted toward the markets with larger shares of unhealthy individuals. In contrast, the coefficient is negative for private advertising. Especially, ACA-related private advertising tends to be targeted to healthier markets. We also find that both government advertising and private advertising are targeted to markets with greater populations and greater numbers of insurers. We do not find most of the coefficient estimates for shares of different demographic groups in a market statistically significant.[11]

[11]Note that the coefficient for the share of individuals with incomes below 138% of the FPL is negative and statistically significant. This result is consistent with the possibility that Medicaid was fully expanded in those states with positive advertising. In this case, individuals with such incomes are no longer qualified for financial assistance from marketplaces. Thus, the states with positive advertising are unlikely to rely on marketplaces to enroll those individuals.

In the Online Appendix, we report additional findings from more detailed content-level advertising targeting patterns. Especially, using the list of contents in Table 2, we investigate how per-capita advertising spending for each content is targeted to different geographical markets. Table 13, 14, and 15 in the Appendix presents estimation results for content-level federal, state, private advertising respectively. We find that there are meaningful heterogeneity in targeting of each advertising content. For example, we find that the coefficients for the share of unhealthy individuals are positive and significant for federal advertising emphasizing the open enrollment period or the financial assistance from marketplaces. For private advertising, we find that the coefficients for the share of unhealthy individuals are almost always negative.

Overall, we find that government advertising, especially federal advertising, and private advertising are targeted to different markets. These results are indicative of different objectives in enrolling consumers between government and private insurers. Unhealthy individuals presumably would benefit more from gaining health insurance. Thus, if advertising reduces the cost of signing up for a marketplace plan, government advertising may increase the take-up rate of individuals who would benefit most from the marketplace. This may be a rational choice for the federal government if it aims to redistribute welfare to unhealthy individuals and is primarily interested in enhancing welfare for unhealthy individuals that would be uninsured without the marketplace. In contrast, private insurers may just want to increase profits.

There are several reasons why private insurers may want to target advertising to markets with greater share of healthier individuals. First, it may be because of risk selection. Because the plan premium should be the same between healthy and unhealthy individuals within each rating area, insurers may have greater profits from enrolling healthy consumers, thereby targeting advertising to healthier markets Of course, importance of this channel depends on how much the risk adjustment reduces such incentives, as discussed in Section 2. Second, it is possible that healthy consumers are more responsive to advertising. If healthy consumers face smaller search or application costs, they may respond more to advertising. For example, in the context of employer-sponsored health insurance, Handel (2013) finds that switching costs (inertia) of health insurance choice is slightly larger for individuals with chronic conditions. Moreover, in the context of Medicare Advantage, Aizawa and Kim (2018) find that healthy individuals are more responsive to advertising. In this case, insurers would have incentives to advertise more in healthier markets even if healthy and unhealthy individuals are equally profitable for insurers.

Overall, our findings clearly show that governments and private insurers have differ-

ent incentives with respect to advertising. However, at this stage, it is not clear whether advertising from different types of entities is effective in increasing enrollments. In next sections, we estimate impacts of advertising on consumer demand.

5 The Impact of Advertising on Consumer Demand

5.1 Market-level Analysis

To examine the effect of government and private advertising on consumer demand, we first examine their impact on market-level enrollments. The primary objective of this analysis is to understand whether advertising has any meaningful effects on market expansion.

5.1.1 Identification: Border Strategy

In estimating the effects of advertising, endogeneity of advertising is a usual concern. Private insurers may choose to advertise more in markets where expected profits from advertising are large, and they may have higher expected profits in some markets because of unobserved heterogeneity in consumer demand. For example, some insurers may have better brand images in certain markets and concentrate their advertising campaigns in such markets. In contrast, it is not very clear whether the government implements a very sophisticated targeting strategy. If the government is sophisticated, it is not very clear whether the government targets markets with high or low demands for insurance. Depending on how advertising and demand for insurance is correlated, a naive regression of a county-level enrollment on advertising may lead to under- or over-estimation of the effects of advertising.

In order to address the endogeneity of advertising, we build on the works by Shapiro (2018), Tuchman (2016), Moshary (2017), Aizawa and Kim (2018), and Spenkuch and Toniatti (2018), and implement a border identification approach.[12] The border identification strategy exploits a discontinuity of advertising expenditures across a border between DMAs. This discontinuity arises because Federal Communications Commission regulations grant media companies local broadcast rights at the DMA level A DMA typically contains a major city and surrounding counties. Thus, there are "border counties" in an outer part of a DMA that are located right next to at least one county in a different DMA. The border strategy relies on the regulation-induced discontinuities in exposure to

[12]The main idea behind this type of border approach is already seen in a seminal work by Holmes (1998)

advertising across neighboring border counties in the same state but in different DMA. To implement the border strategy, we first identify pairs of adjacent border counties that belong to different DMAs. We define a border pair b to be a distinct pair of two border counties in two distinct DMAs.

The main identifying assumption of the border strategy is that there is no unobserved heterogeneity in demand across two adjacent counties within each b in each year (t). With this assumption, unobserved heterogeneity in demand will be absorbed by fixed effects for each pair of b and t. With the fixed effects, differences in enrollments across border counties within a border pair will be attributed to differences in advertising spending across the corresponding DMA border.

In order to see whether the identifying assumption is plausible, we compare observed characteristics of border counties depending on advertising spending within border pairs. If the assumption is true, advertising should be exogenous to observable characteristics of border counties, and we would expect to find that market characteristics are similar across border counties with different advertising spending within border pairs.

Table 4 compares market characteristics between border counties with low and high government and private advertising spending, where the government advertising is defined to be the sum of federal and state advertising. For the first two columns, we collect border counties with lower government advertising spending within each of border pairs in Column (1) and border counties with higher government advertising spending within each of border areas in Column (2). We excluded border pairs with zero government advertising in both sides of borders from the table. For Columns (3) and (4), we group border counties similarly based on market-level private advertising spending.

The table shows that the two groups of markets are very similar in terms of market characteristics except for advertising spending. First, the number of insurers selling marketplace plans, the degree of market concentration (shown by HHI), and the market size are very similar between border counties with low and high advertising spending. Moreover, distributions of incomes and ages of individuals who would purchase marketplace plans are also very similar between the two groups of border counties. Lastly, health statuses shown by market-level shares of individuals with various health conditions are also almost identical between the two groups of border counties. These results suggest that the identifying assumption is plausible. Moreover, these results suggest that the targeting of advertising we documented in Section 4 is likely to be driven by non-border counties, which do not share advertising market borders.

An important caveat about the border strategy is that estimated effects of advertising may be only valid to border counties. Thus, it might be difficult to extrapolate the esti-

Table 4: Comparing Either Side of Border Areas

	Gov Ad		Priv Ad	
	(1)	(2)	(3)	(4)
	Low	High	Low	High
Fed Spend ($)	0.218	0.515	0.248	0.280
	(0.199)	(0.487)	(0.344)	(0.391)
State Spend ($)	0.180	0.374	0.158	0.212
	(0.574)	(0.995)	(0.630)	(0.734)
Priv Spend ($)	0.665	0.821	0.431	1.399
	(1.161)	(1.336)	(0.804)	(1.740)
No. of Insurers	2.654	2.679	2.569	2.668
	(1.472)	(1.518)	(1.432)	(1.476)
HHI among Insuers	0.686	0.688	0.699	0.680
	(0.241)	(0.244)	(0.240)	(0.242)
Log of Market Size	8.485	8.533	8.457	8.506
	(1.226)	(1.266)	(1.206)	(1.281)
% FPL $\leq$ 138	0.242	0.240	0.246	0.246
	(0.089)	(0.086)	(0.089)	(0.089)
% FPL from 138 to 250	0.251	0.254	0.251	0.250
	(0.059)	(0.060)	(0.059)	(0.059)
% FPL from 250 to 400	0.216	0.215	0.210	0.212
	(0.061)	(0.062)	(0.060)	(0.059)
% FPL > 400	0.290	0.291	0.292	0.291
	(0.092)	(0.091)	(0.093)	(0.091)
% age $\leq$ 18	0.143	0.144	0.139	0.140
	(0.052)	(0.054)	(0.051)	(0.053)
% age from 18 to 34	0.331	0.330	0.332	0.335
	(0.064)	(0.067)	(0.066)	(0.066)
% age from 35 to 54	0.330	0.330	0.333	0.331
	(0.051)	(0.053)	(0.050)	(0.051)
% age $\geq$ 55	0.195	0.195	0.195	0.195
	(0.053)	(0.052)	(0.053)	(0.053)
% Poor or Fair Health	0.178	0.176	0.182	0.182
	(0.051)	(0.050)	(0.051)	(0.052)
Poor Physical Health Day	3.942	3.933	3.998	3.987
	(0.814)	(0.801)	(0.793)	(0.799)
Poor Mental Health Day	3.834	3.855	3.897	3.886
	(0.739)	(0.726)	(0.708)	(0.730)
Obesity	0.315	0.314	0.320	0.319
	(0.042)	(0.042)	(0.042)	(0.043)
Diabetes Prevalence	0.115	0.115	0.118	0.118
	(0.024)	(0.023)	(0.024)	(0.024)
Healthcare Cost (in $1000s)	9.514	9.538	9.691	9.678
	(1.492)	(1.382)	(1.475)	(1.429)
N. Obs.	5,533	5,533	7,438	7,438

mated effects to non-border counties, which are excluded from the estimation sample. To ascertain how serious this issue is in our setting, we compare market-level characteristics between border and non-border counties. Table 5 presents market-level characteristics between border and non-border counties. The table shows that although there are differences between the two groups of counties, the differences are not very large. For example, the differences in the number of insurers and HHIs do not exceed 10% of their unconditional averages. Moreover, the distributions of ages and income groups are also not very different between border and non-border counties. Lastly, the differences in county-level health statuses also do not exceed 10% of their unconditional averages. The result suggests that although estimates from the border strategy will not be exactly the same as ones based on the entire data sample, the estimates are unlikely to be very different from ones based on the entire sample.

Finally, one important advantage of our border strategy is that it allows us to identify the effect of advertising separately from other ways in which the government or insurers can increase enrollments. For example, the government may conduct outreaching activities beside advertising. However, our identification strategy is unlikely affected by such outreaching activities because such activities are not likely to discretely change across TV advertising market borders.

5.1.2 Effects of Advertising on Market-level Enrollments

We estimate the following county-level regression with the border strategy:

$$\ln(s_{bct}) = \sum_{k \in K} \ln(1 + ad^k_{bm(c)t})\beta_k + \boldsymbol{x_{bct}\gamma} + \xi_{bt} + \xi_{r(c)t} + \xi_{bc} + \epsilon_{bct}. \tag{2}$$

The dependent variable refers to the log of the share of individuals that enrolled in marketplace plans in border pair b, county c, and year t. On the right hand side, $ad^k_{bm(c)t}$ refers to the advertising expenditure of type k per potential marketplace enrollee in border pair b, DMA $m(c)$ to which county c belongs, and year t. Advertising of type k refers to advertising by different entities. In the main specification, $K = \{f, s, mp\}$. First, $ad^f_{bm(c)t}$ and $ad^s_{bm(c)t}$ denote to advertising by the federal government and state governments, respectively. Second, $ad^{mp}_{bm(c)t}$ denotes market-level private advertising, which is the sum of advertising expenditures by all insurers in each DMA and each year. In some specifications, we include advertising of other types to control for additional variables that also vary discretely across DMA borders: insurance navigators (nv) and political advertising on the Affordable Care Act by democrats (dem) and republicans (rep). Note that

Table 5: Comparing Border and Non-Border Counties

	(1) Border Counties	(2) Non-Border Counties	(3) Overall
No. of Insurers	2.685	2.451	2.540
	(1.559)	(1.415)	(1.476)
HHI among Insuers	0.676	0.716	0.700
	(0.243)	(0.242)	(0.243)
Log of Market Size	8.754	8.376	8.521
	(1.623)	(1.241)	(1.412)
% FPL $\leq$ 138	0.229	0.240	0.236
	(0.082)	(0.087)	(0.085)
% FPL from 138 to 250	0.246	0.250	0.248
	(0.056)	(0.059)	(0.058)
% FPL from 250 to 400	0.219	0.215	0.217
	(0.056)	(0.061)	(0.059)
% FPL > 400	0.306	0.294	0.299
	(0.087)	(0.090)	(0.089)
% age $\leq$ 18	0.152	0.141	0.145
	(0.052)	(0.053)	(0.053)
% age from 18 to 34	0.338	0.330	0.333
	(0.063)	(0.064)	(0.064)
% age from 35 to 54	0.323	0.331	0.328
	(0.051)	(0.052)	(0.052)
% age $\geq$ 55	0.187	0.197	0.193
	(0.051)	(0.054)	(0.053)
% Poor or Fair Health	0.166	0.180	0.175
	(0.048)	(0.051)	(0.051)
Poor Physical Health Day	3.745	3.986	3.894
	(0.797)	(0.813)	(0.815)
Poor Mental Health Day	3.656	3.884	3.796
	(0.741)	(0.719)	(0.736)
Obesity	0.309	0.318	0.315
	(0.042)	(0.042)	(0.042)
Diabetes Prevalence	0.109	0.118	0.114
	(0.022)	(0.024)	(0.024)
Healthcare Cost (in $1000s)	9.544	9.636	9.601
	(1.529)	(1.479)	(1.499)
N. Obs.	5,165	8,334	13,499

TV advertising decisions are typically made on the basis of a DMA-year pair, which contains several counties. Thus, we assume individuals in different counties but in the same DMA are exposed to the same advertising level. We add one to the advertising variables before taking the logarithm because there are markets with zero advertising spending by the government or private insurers. Because both dependent and independent variables are in logarithm, coefficients β_{d0} and β_{d1} are elasticities of county-level demand by a demographic group d for marketplace plans with respect to government and private advertising, respectively.

Next, x_{bct} refers to a set of time-varying characteristics for each a county-year pair (ct). We include the number of insurers and its quadratic term. Moreover, we include three fixed effects to control for unobserved heterogeneity in demand flexibly: first, ξ_{bt} refers to fixed effects for a pair of a border pair (b) and time (t), which captures any time-varying factors that affect enrollments for the entire border pair. Second, ξ_c refers to county fixed effects, which controls for any time-invariant unobserved characteristics for each border county. Lastly, $\xi_{r(c)t}$ refers to fixed effects for a pair of the rating area $r(c)$ and time t. A rating area is typically a collection of counties where an insurer sets common characteristics for their plans. With $\xi_{r(c)t}$, we control for any effects of plan characteristics on enrollments, although we do not explicitly include specific plan characteristics in the regression.

5.1.3 Estimation Results

Table 6 presents regression results from various specifications. As we move from Column (1) to Column (4), we add additional fixed effects or control variables. Columns (3) and (4) include all of the three fixed effects in Equation (2), and Column (4) includes advertising of additional types. Standard errors in all specifications are clustered at the level of DMA and time because main advertising variables vary at this level.

In all specification, the coefficient estimates for advertising by the federal government are positive and statistically significant, and their magnitudes do not vary very much across different specifications. Based on the estimates in Column (3), we find that a 1% increase in federal advertising leads to a 0.045% increase in market-level shares of individuals that enrolled in marketplace. Extrapolating the coefficient to larger changes, if the federal government doubles advertising spending, then the market-level share will increase by 4.5%. Given the unconditional average of market-level shares is 0.2, a 4.5% increase is equal to an increase in the market-level share by 0.9 percentage points. Although the magnitude seems modest, it is still largely consistent with typical findings in the marketing literature estimating elasticity of demand with respect to advertising. For

example, Shapiro (2018) estimates advertising elasticity of 0.04 in prescription pharmaceuticals.

In contrast, the coefficient estimates for advertising by state governments are only marginally significant only in Column (1), for which we include the smallest set of fixed effects. One reason why advertising by state governments are not very effective is because state governments tend to rely more on other consumer assistance programs to provide information for state marketplaces, which may reduce the importance of advertising. Because consumers can learn about marketplaces through other programs, additional information consumers can obtain solely form advertising might be limited in this case. For the federally facilitated marketplaces, in contrast, advertising may play more important role because they do not provide many other assistance programs.

Next, we find that private advertising is not very effective in increasing market-level enrollments. Like advertising by state governments, private advertising is marginally significant only in Column (1). This result suggests that private advertising is quite limited in expanding the total marketplace enrollments. There are two possibilities that result in this limited effect of private advertising. First, private advertising is not effective for demand for an insurer. Although this possibility raises a question why a rational insurer would waste resources on advertising, a few papers already found that the effect of advertising on a firm's own demand is quite limited.[13] Second, even if private advertising is effective in increasing demand for insurers, it does so by stealing consumers from other insurers. In this case, private advertising may have only a limited market-expansion effect. In the next section, we will estimate the effect of advertising on individual insurer demand to further investigate this issue.

In Column (5), we include additional types of advertising in the regression to control for other factors that also vary discretely across DMA borders: advertising by insurance navigators, political advertising on the ACA by democrats and republicans. The coefficient estimates for the three main advertising variables do not change vary much with the additional variables. Interestingly, the estimated effects of the political advertising are consistent with how each party views the ACA. On the one hand, democratic advertising increases the market-level enrollment, and its effect is comparable to federal advertising. On the other hand, the point estimate for republican advertising is negative but statistically insignificant.

[13]For example, see Blake et al. (2015), Lewis and Rao (2015), and Sinkinson and Starc (2018).

Table 6: The Effects of Advertising on Market-level Enrollments

	(1)	(2)	(3)	(4)
Log of Fed Spend	0.051**	0.040***	0.045**	0.045**
	(0.025)	(0.015)	(0.022)	(0.022)
Log of State Spend	0.043*	0.040	-0.026	-0.024
	(0.025)	(0.042)	(0.051)	(0.048)
Log of Priv Spend	0.018*	0.003	0.020	0.022
	(0.011)	(0.011)	(0.015)	(0.014)
Log of Navi Spend				-0.007
				(0.094)
Log of Dem Spend				0.050***
				(0.017)
Log of Rep Spend				-0.010
				(0.008)
No. of Insurers	0.047***	0.007	0.010	0.011
	(0.018)	(0.012)	(0.016)	(0.016)
No. of Insurers × No. of Insurers	-0.001	0.001	0.001	0.000
	(0.002)	(0.001)	(0.002)	(0.002)
BorderYear FE	Y	Y	Y	Y
County FE		Y	Y	Y
RatingYear FE			Y	Y
N. Obs.	18,862	18,812	18,154	18,154
Adj. R^2	0.778	0.940	0.946	0.947

5.2 Demand Model

Next, we analyze the impact of advertising on enrollment at the insurer level. This analysis will help us understand whether private insurer advertising still increases own enrollment. Moreover, this demand model will be a basis to examine the equilibrium impacts of government advertising, which requires an equilibrium model of health insurance marketplace.

5.2.1 Utility Specification

Consider individual i who lives in a market ct, which is based on county-year pair. The number of marketplace insurers available in each market is denoted by J_{ct}. Because the outside side option is always available, a consumer has a total of $J_{ct} + 1$ options. The consumer optimally chooses the insurer by maximizing own utility.[14] We assume that the consumer obtains indirect utility u_{ijct} from insurer $j > 0$ as follows:

$$u_{ijct} = \sum_{k \in K} \ln(1 + ad^k_{jm(c)t})\beta_k + \xi_{jct} + \epsilon_{ijct} \tag{3}$$

[14]Because plan-level enrollment data is available, it is possible to model plan choice within insurers. Because the effects of advertising on market- and insurer-level demand are the first order channels, we leave this extension as a future work.

An individual's insurer choice is affected by the amount of advertising in various categories $ad^k_{jm(c)t}$, where each category is defined over advertising sponsor and advertising content. It is also affected by non-advertising utility from an insurer (ξ_{jct}).[15] The set of advertising categories we consider in the main specification is a collection of the total spending by different advertising sponsors: $K = \{f, s, p, r\}$. As in the market-level analysis, $ad^f_{jm(c)t}$ and $ad^s_{jm(c)t}$ denote advertising by the federal government and state governments, respectively. Although these two variables have the j subscript, they do not change across insurers within the same DMA and year. Thus, advertising by governments will affect demands for all insurers in the same way. In other words, if advertising by governments increases an insurer's market shares, it will increase all other insurers' market shares as well, thereby expanding the total enrollment in marketplace plans.

Next, $ad^p_{jm(c)t}$ denotes advertising by insurer j, which varies over insurers within the same market. An import difference from the market-level analysis is that we consider $ad^p_{jm(c)t}$ instead of market-level private advertising ($ad^{mp}_{m(c)t}$). Note that with our framework, an insurer j's advertising will inherently have business-stealing effects. In other words, its advertising will increase its own market share while rivals' market shares will decrease. Thus, the effect on the total enrollment can be limited even if private advertising is as effective as government advertising in increasing demand for an individual insurer. To allow for a more flexible substitution pattern among insurers with respect to private advertising, we include advertising by an insurer's rivals (r) in some specifications such that $ad^r_{jm(c)t} = \sum_{h \neq j} ad^p_{hm(c)t}$. The coefficient for$ad^r_{jm(c)t}$ will determine whether private advertising just steals business from rivals or has has positive spillover to rivals. On the one hand, if the coefficient is positive and large enough, then private advertising can increase not only the own insurer's demand but also rivals' demand, thereby leading to a market expansion. On the other hand, if the coefficient is positive but not large enough or even negative, private advertising will have a business-stealing effect.

Lastly, we include additional types in K some specifications to control for other variables that also discretely vary at DMA borders. As in the market-level regression, we consider advertising by insurance navigators ($ad^{nv}_{jm(c)t}$) and political advertising by democrats ($ad^{dem}_{jm(c)t}$) and republicans ($ad^{rep}_{jm(c)t}$).

The non-advertising utility (ξ_{jct}) denote utility from standard characteristics of an insurer's plans such as premiums, generosity of coverage, provider networks, and so

[15] We assume that advertising affects demand through the indirect utility function in our model. Alternatively, one can model specific channels through which advertising affects demand – for example, a consumer's awareness of a product, providing experience characteristics of product quality, or enhancing the prestige or image of a product. We do not take this approach, however, because separately identifying different effects of advertising is challenging with our data.

on. For the purpose of this paper, it is not very crucial to estimate how much utility depends on plan characteristics although understanding how the characteristics affect a consumer's choice is important in general. Thus, we do not explicitly model how each plan characteristic affects utility. Also, note that variables in the utility function do not include the subscript for border pair (b) because we will first write a general model for demand for insurers for now. When we estimate the model, we will also employ the border strategy, where we will add the subscript for border areas (b) to appropriate variables.

A consumer's outside option ($j = 0$) is to stay as uninsured or insured with an off-marketplace plan, from which a consumer receives utility of u_{i0ct}:

$$u_{i0ct} = \epsilon_{i0ct}. \tag{4}$$

Note that δ_{0ct} is normalized to 0 for all ct because only the relative utilities can be identified in a discrete choice model. Lastly, ϵ_{ijlct} is an individual i's preference shock for each plan. We assume that ϵ_{ijlct} is independently and identically distributed as the Type I extreme value distribution.

5.2.2 Identification and Estimation

To estimate the model, we exploit the one-to-one mapping between each insurer's market share and the deterministic part of u_{ijlct} given in Equation (3) as in Berry (1994). Define $\delta_{jct} \equiv u_{ijct} - \epsilon_{ijct}$. Then it is easy to show, based on the assumption on ϵ_{ijlct}, that

$$\delta_{jct} = \ln(s_{jct}) - \ln\left(\sum_{j'>0} s_{j'ct}\right),$$

where s_{jct} denotes insurer $j's$ empirical market share. We will denote the empirical counterpart of δ_{jct} by $\hat{\delta}_{jlct}$. Then the estimating equation is given by:

$$\hat{\delta}_{jct} = \sum_{k \in K} \ln(1 + ad^k_{jm(c)t})\beta_k + \xi_{jct}. \tag{5}$$

Notice that estimating coefficients in Equation (5) simply requires running a linear regression. However, estimating the coefficients with a ordinary least squared regression is likely to result in biases in our advertising coefficients (β_k) because of endogeneity of advertising, which was discussed earlier in Section 5.1.1. Thus, we employ the border strategy to estimate the coefficients.

Border Strategy at the Insurer Level Consider an insurer j in county c in border pair b. With the border strategy, we assume that the insurer's non-advertising utility is

$$\xi_{jbct} = \xi_{jbt} + \xi_{jr(c)t} + \xi_c + \Delta\xi_{jbct}. \tag{6}$$

First, ξ_{jbct} refers to fixed effects for insurer j, border pair b, and year t. They capture any common factor that affects demand for insurer j in both counties in border pair b in year t. Second, $\xi_{jr(c)t}$ refers to fixed effects for insurer j, rating area $r(c)$,and year t. These fixed effects control for the effects of plan characteristics on utility because an insurer must offer the same characteristics within a rating area and a year. Third, ξ_c refers to county fixed effects, which capture any factor that commonly affects demands for insures in a county throughout years. Lastly, $\Delta\xi_{jbct}$ denotes the remaining component in ξ_{jbct}.

Combining Equations (5) and (6), we have the following estimating equation with the border strategy.

$$\hat{\delta}_{jbct} = \sum_{k \in K} \ln(1 + ad^k_{jbm(c)t})\beta_k + \xi_{jbt} + \xi_{jr(c)t} + \xi_c + \Delta\xi_{jbct} \tag{7}$$

The identifying assumption is that any of the advertising variables is not correlated with the structural error term $\Delta\xi_{jbct}$.

5.2.3 Estimation Results

Table 7 presents estimates of coefficients in the utility function described in Equation (3) with different specifications. As we move from Column (1) to Column (5), we add additional fixed effects or control variables. Columns (3)–(5) include all of the three fixed effects in Equation (6), and Column (4) and (5) include advertising of additional types. Standard errors in all specifications are clustered at the level of DMA and year because main advertising variables vary at this level.

In all specifications, private advertising is effective in increasing demand for an insurer. This is in contrast to our finding that market-level private advertising has limited effects on market-level enrollments at most. Even when we include rivals' advertising (Columns (4) and (5)), the estimate for rivals' advertising is not statistically significant. This suggests that private advertising does not have positive spillover to rivals. Instead, private advertising will have the business-stealing effect. Based on the estimate from Column (3), which contains the most extensive set of fixed effects, the average elasticity of insurer-demand with respect to advertising is 0.04 among insurers with positive adver-

Table 7: Estimated Coefficients in Insurer-Level Demand Model

	(1)	(2)	(3)	(4)	(5)
Log of Fed Spend	0.023	0.084*	0.115**	0.117**	0.120**
	(0.050)	(0.045)	(0.051)	(0.051)	(0.051)
Log of State Spend	0.161**	0.046	-0.024	-0.014	-0.012
	(0.065)	(0.086)	(0.071)	(0.072)	(0.073)
Log of Priv Spend	0.209***	0.270***	0.124***	0.106***	0.104***
	(0.032)	(0.045)	(0.039)	(0.040)	(0.040)
Log of Rival Spend				-0.037	-0.040
				(0.038)	(0.038)
Log of Navi Spend					-0.004
					(0.173)
Log of Dem Spend					0.046
					(0.032)
Log of Rep Spend					0.011
					(0.015)
No. of Insurers	-0.375***	-0.401***	-0.383***	-0.379***	-0.375***
	(0.038)	(0.042)	(0.050)	(0.051)	(0.051)
No. of Insurers × No. of Insurers	0.020***	0.026***	0.026***	0.026***	0.025***
	(0.004)	(0.004)	(0.005)	(0.005)	(0.005)
FirmBorderYear FE	Y	Y	Y	Y	Y
County FE		Y	Y	Y	Y
FirmRatingYear FE			Y	Y	Y
N. Obs.	39,758	39,726	38,272	38,272	38,272
Adj. R^2	0.833	0.866	0.929	0.929	0.930

Note: the estimation uses data from 2014-2018.

tising spending.[16] As discussed earlier, this estimate is largely consistent with typical findings in the marketing literature estimating the advertising elasticity of demand. For example, Shapiro (2018) estimates advertising elasticity of 0.04 in prescription pharmaceuticals.

How do we reconcile this finding with our finding with the market-level regression that private advertising has limited market expansion effects? It is important to note that an increase in demand for an insurer due to advertising does not necessarily result in market expansion. If demand for an insurer increases at the expense of its rivals, private advertising will have limited effects on market expansion.

The estimates for advertising by federal and state governments are consistent with our finding with the market-level regression. The federal advertising is effective in increasing demands for all insurers, whereas advertising by state governments is not very effective. Our finding from the insurer-level demand model highlights different roles of advertising by the federal government and private insurers. Federal advertising increases market-level enrollments, whereas private advertising mainly results in changes in distributions of enrollments among insurers with a limited effect on market-level enrollments.

[16]Because the elasticity becomes zero for insurers with zero advertising spending, we only calculated the number among insurers with positive advertising.

Effects of Advertising in New vs. Mature Markets One question regarding our is whether advertising will be as effective in the future when the insurance marketplace is not a new market any longer. One rationale for the government to be engaged in advertising for the marketplace is because the market is new. Because consumers may face some transaction costs of obtaining coverage through marketplaces (e.g., the lack of awareness about the open enrollment period), the government may want to spend more resources to increase the enrollment in early years. This channel may be especially relevant in the first few years because most of potential buyers are relatively new enrollees who have never obtained coverage from the health insurance marketplaces.[17]

On the one hand, it may be rational for the government to reduce advertising spending when the marketplace become more mature. Once consumers enroll for plans for first few years, they may just stick to the plan, and advertising might not be very necessary to induce them to keep enrolled for marketplace plans. Thus, advertising may become less effective when marketplaces become more mature, and then the government may want to gradually reduce its advertising spending. On the other hand, if there is a steady influx of new customers to marketplaces in each year, then advertising will be effective to some extent even when marketplaces are more mature. Then the government may want keep marketing health insurance marketplaces to help the new customer to enroll for marketplace plans. Therefore, whether the government should continue advertising does depend on whether the government advertising will be effective in the long run.

We examine whether the effect of advertising has decreased over time. We compare the estimates in Table 6, which are based on data up to 2018, with estimates with data up to 2016 and 2017 separately. Although this comparison is based on relatively small differences in time, if advertising is effective only in early years of the health insurance marketplace, we should expect that our estimates will decrease rapidly over years.

Our finding is reported in Table 8. This table indicates that the effectiveness of government advertising indeed decreased over time, although we still find non-negligible magnitudes in 2018. Of course, a more precise answer on this question will need a longer time horizon. However, our estimates at least suggest importance of government advertising in mitigating transaction costs for consumers especially in early years of the marketplace.

[17]These individuals include not only permanently uninsured individuals but also newly uninsured individuals who might have had employer-sponsored health insurance before and probably did not obtain insurance individually.

Table 8: The Effects of Advertising: New vs Mature Markets

	(1) 2016	(2) 2017	(3) 2018
Log of Fed Spend	0.132**	0.124**	0.115**
	(0.056)	(0.052)	(0.051)
Log of State Spend	0.032	0.070	-0.024
	(0.085)	(0.073)	(0.071)
Log of Priv Spend	0.096**	0.124***	0.124***
	(0.041)	(0.041)	(0.039)
No. of Insurers	-0.254***	-0.382***	-0.383***
	(0.058)	(0.057)	(0.050)
No. of Insurers × No. of Insurers	0.011**	0.025***	0.026***
	(0.005)	(0.006)	(0.005)
FirmBorderYear FE	Y	Y	Y
County FE	Y	Y	Y
FirmRatingYear FE	Y	Y	Y
N. Obs.	26,754	32,946	38,272
Adj. R^2	0.932	0.929	0.929

5.3 Additional Results

Previous results establish that advertising by the federal government and private insurers are effective in increasing market- or insurer-level enrollments. In this subsection, we examine heterogeneous effects of advertising. First, we will investigate whether advertising with certain contents are more effective. Then, we will investigate advertising is more effect for consumers with certain characteristics.

5.3.1 Contents in Advertisements

We now examine whether advertising with certain contents in are more effective. For this analysis, we group advertisements into different types depending on which information they provide. Then we calculate expenditures for each type and estimate how effective each type is. We consider the following the two most common types of information provided in advertisements: financial assistance and the open enrollment period.

We run a separate regression for each information type. For financial assistance, we define $ad^{k_{FA1}}_{jm(c)t}$ to be advertising expenditures per potential enrollee of type k providing information on financial assistance. We also define $ad^{k_{FA0}}_{jm(c)t} \equiv ad^{k}_{jm(c)t} - ad^{k_{FA1}}_{jm(c)t}$. In other words, it denotes advertising expenditures per potential enrollee of type k not providing information on financial assistance. Then we estimate the regression described by Equation (7) with $K = \{f_{FA1}, f_{FA0}, s_{FA1}, s_{FA0}, p_{FA1}, p_{FA0}\}$. For the open enrollment period, we also define advertising variables in a similar way ($ad^{k_{OP1}}_{jm(c)t}$ and $ad^{k_{OP1}}_{jm(c)t}$) and estimate Equation (7) with $K = \{f_{OP1}, f_{OP0}, s_{OP1}, s_{OP0}, p_{OP1}, p_{OP0}\}$.

Table 9 shows coefficient estimates with subsamples containing data up to different

years. First, we find that federal advertising providing information about financial assistance is more effective than other types of federal advertising in 2016 (Column (1)). The magnitude is much larger than the coefficient for federal advertising in the baseline specification (β_f in Equation 3). However, the magnitudes are lower with subsamples up to 2017 and 2018. Although it is much larger than the estimate in the baseline specification, it is not statistically significant in Column (2) or (3) because of larger standard errors. The estimates for federal advertising providing information about the open enrollment period exhibit a similar pattern: the largest in Column (4) and smaller in Columns (5) and (6). These patterns are consistent with our result with respect to new vs mature markets, reported in Table 8. Specific information provided by federal government advertising is likely the most valuable in early years of the marketplace. As the market becomes more mature, consumers are increasingly more likely to be already aware of such information.

In contrast, the same types of advertising by private insurers are not nearly as effective as federal advertising. None of the estimates for either type is statistically significant in any subsamples, and their magnitudes are typically much lower than the coefficient estimate for private advertising in the baseline specification (β_p in Equation 3). This result suggests that private insurers are not effective in increasing enrollments with informative advertising, and it is consistent with our earlier finding that private advertising has limited effects on market-level enrollments. If private advertising was very effect in providing general information about the marketplace, we would expect that it would has positive spillovers to rivals' enrollments and have greater impacts on market-level enrollments.[18] Moreover, the fact that the effective of private advertising did not decrease over time as shown in Table 8 also suggests that information provision is not likely how private advertising increased an insurer's enrollment.

5.3.2 Health Status

We now investigate whether the effect of advertising is different depending on health status. Although one would need data on individual health status and enrollment for this analysis, we do not have such data. Instead, we will use a county-level health status. Specifically, we use the share of individuals in fair or poor health based on self-report health status. To estimate heterogeneous effects of advertising with respect to the county-level health measure, we interact the health variable with each of the advertising types ($K = \{f, s, p\}$) in Equation (7).

Table 10 presents the coefficient estimates. To property interpret the estimates, note

[18] For example, Shapiro (2018) and Sinkinson and Starc (2018) find spillovers of advertising in the context of prescription drugs.

Table 9: Coefficient Estimates for Advertising Contents

	Financial Assistance			Open Enrollment		
	(1) 2016	(2) 2017	(3) 2018	(4) 2016	(5) 2017	(6) 2018
Log of Fed Spend (contents)	0.509**	0.302	0.259	0.502*	0.348*	0.325*
	(0.248)	(0.188)	(0.177)	(0.275)	(0.199)	(0.188)
Log of Fed Spend (rest)	0.047	0.064	0.063	0.073	0.069	0.061
	(0.048)	(0.048)	(0.049)	(0.048)	(0.047)	(0.049)
Log of State Spend (contents)	0.114	0.121	0.174	-0.102	0.016	0.083
	(0.088)	(0.113)	(0.112)	(0.237)	(0.124)	(0.102)
Log of State Spend (rest)	0.024	0.059	-0.072	0.098	0.116	-0.040
	(0.101)	(0.078)	(0.082)	(0.100)	(0.093)	(0.087)
Log of Priv Spend (contents)	0.082	0.033	0.021	0.062	0.008	0.002
	(0.062)	(0.056)	(0.051)	(0.068)	(0.061)	(0.055)
Log of Priv Spend (rest)	0.093*	0.146***	0.150***	0.106*	0.166***	0.168***
	(0.054)	(0.052)	(0.049)	(0.059)	(0.056)	(0.052)
No. of Insurers	-0.250***	-0.379***	-0.381***	-0.254***	-0.380***	-0.382***
	(0.058)	(0.057)	(0.051)	(0.057)	(0.057)	(0.050)
No. of Insurers × No. of Insurers	0.011**	0.025***	0.026***	0.011**	0.025***	0.026***
	(0.005)	(0.006)	(0.005)	(0.005)	(0.006)	(0.005)
BorderYear FE	Y	Y	Y	Y	Y	Y
County FE	Y	Y	Y	Y	Y	Y
RatingYear FE	Y	Y	Y	Y	Y	Y
N. Obs.	26,754	32,946	38,272	26,754	32,946	38,272
Adj. R^2	0.932	0.929	0.930	0.932	0.929	0.930

Note: the estimation uses data from 2014-2018.

that the health measure has the mean of 0.18 and the standard deviation of 0.05 in the estimation sample. The only statistically significant interaction term is the one with private advertising. A standard deviation increase in the share of individuals with fair or poor health decreases the coefficient for private advertising by 0.06. In other words, private advertising is more effective in regions with greater shares of individuals with better health. Given that the coefficient estimate for the average effect is 0.124 (Column (3) in Table (7)), the estimate for the heterogeneous effect is economically significant.

This result suggests that insurers might want to target advertising to markets with a greater share of healthy individuals because advertising is potentially more responsive in such markets (Aizawa and Kim (2018)).

5.3.3 Age and Income

In our main specification, we do not allow possible heterogeneous effects across consumers with different demographic characteristics. To examine which consumers are more responsive to advertising, we examine whether the effect of advertisingdepends on different age and income groups. Specifically, we estimate Equation (7) for each age and income group. In these regressions, we exclude California and New York from the sample because we do not have data on enrollments by demographic groups in the two

Table 10: Heterogeneous Effects Depending on Market-level Health Status

	(1) 2016	(2) 2017	(3) 2018
Log of Fed Spend	0.123	0.166	0.024
	(0.234)	(0.206)	(0.212)
Share of Fair or Poor Health × Log of Fed Spend	0.050	-0.239	0.536
	(1.201)	(1.039)	(1.117)
Log of State Spend	0.130	0.099	0.180
	(0.216)	(0.207)	(0.193)
Share of Fair or Poor Health × Log of State Spend	-0.483	-0.130	-1.105
	(1.172)	(1.267)	(1.178)
Log of Priv Spend	0.352***	0.318***	0.343***
	(0.120)	(0.118)	(0.114)
Share of Fair or Poor Health × Log of Priv Spend	-1.415**	-1.067*	-1.189**
	(0.569)	(0.580)	(0.561)
Share of Fair or Poor Health	0.059	-0.190	-0.428
	(0.964)	(0.959)	(0.957)
No. of Insurers	-0.255***	-0.382***	-0.382***
	(0.058)	(0.057)	(0.050)
No. of Insurers × No. of Insurers	0.011**	0.025***	0.026***
	(0.005)	(0.006)	(0.005)
FirmBorderYear FE	Y	Y	Y
County FE	Y	Y	Y
FirmRatingYear FE	Y	Y	Y
N. Obs.	26,722	32,914	38,240
Adj. R^2	0.932	0.929	0.930

Note: the estimation uses data from 2014-2018.

states. The main results are reported in Table 11.

We find the modest heteroegeneity in advertising impacts across demographic groups. For example, we find that both federal are much more effective for individuals aged 35 or older, while private advertising is almost equally effective for all age groups.

With respect to income groups, we find that advertising is more effective for individuals with lower incomes. These consumers face the lower net premium due to the premium subsidies which are larger for low-income population. Thus, they can be more responsive to advertising.

5.3.4 Interaction between Government and Private Advertising

The previous specifications assume that there are no complementarity between government and private advertising for their demand effects. We conducted an additional analysis by adding interaction terms between government and private advertising in the demand model. In Figure 16 in the Online Appendix, we show that these interactions terms tend to be insignificant and close to zero at the point estimates. This result suggests that federal advertising may not generate much compositional changes of enrollment across insurers.

Table 11: Coefficient Estimates by Demographic Group

	Age			Income		
	(1) 18 to 34	(2) 35 to 54	(3) $\geq$ 55	(4) $\leq$ 138k	(5) 138k to 250k	(6) 250k to 400k
Log of Fed Spend	0.030	0.093**	0.091*	0.104*	0.088	0.080
	(0.047)	(0.043)	(0.053)	(0.054)	(0.072)	(0.061)
Log of State Spend	-0.175	-0.120	-0.146	-0.015	0.000	-0.243**
	(0.127)	(0.093)	(0.103)	(0.140)	(0.181)	(0.116)
Log of Priv Spend	0.118**	0.105***	0.117***	0.116**	0.087*	0.026
	(0.053)	(0.040)	(0.043)	(0.047)	(0.046)	(0.044)
No. of Insurers	-0.341***	-0.431***	-0.427***	-0.323***	-0.436***	-0.399***
	(0.056)	(0.055)	(0.059)	(0.062)	(0.075)	(0.062)
No. of Insurers $\times$ No. of Insurers	0.021***	0.031***	0.027***	0.023***	0.036***	0.027***
	(0.006)	(0.006)	(0.006)	(0.008)	(0.009)	(0.007)
FirmBorderYear FE	Y	Y	Y	Y	Y	Y
County	Y	Y	Y	Y	Y	Y
FirmRatingYear FE	Y	Y	Y	Y	Y	Y
N. Obs.	35,864	35,772	35,662	35,578	34,258	35,538
Adj. R^2	0.894	0.914	0.911	0.899	0.895	0.891

Note: the estimation uses data from 2014-2018.

6 Counterfactual Experiments

In order to analyze various design questions of government marketing activities, it is crucial to account for an endogenous response of private insurers. We first lay out the supply-side of our equilibrium model and estimation strategy. Then, we describe how to conduct counterfactual experiments.

6.1 Supply-Side Model of Advertising in Health Insurance Marketplaces

In the model, we assume that each insurer j chooses advertising ad^p_{jmt} in DMA-year mt. To simplify the analysis, we take insurance companies' geography choices and product characteristics, including pricing, as exogenous in these counterfactuals. Let π_{jmt} be the average flow profit of insurer j by enrolling an individual in a DMA market $m$in year t, net of claim costs to insure this consumer, without considering the cost of advertising. Then, an insurer's annual profit at DMA market is expressed as:

$$\Pi_{jmt} = \pi_{jmt} q_{jmt}(\boldsymbol{ad^p_{mt}}, \boldsymbol{ad^g_{mt}}) - C_{jmt}(ad^p_{jmt}), \tag{8}$$

where q_{jmt} is the DMA level consumer demand of insurer j given the advertising by the federal government (ad^f_{mt}), state governments (ad^s_{mt}), and all of private insurers ($\boldsymbol{ad^p_{mt}}$), and $C(\cdot)$ is the cost of advertising by insurer j (ad^p_{jmt}). We use the demand model given by Equation (3) and the coefficient estimates given by Column (3) in Table (7). Note that

π_{jmt} captures not only the premium revenue and expected reimbursement costs for this enrollee but also other relevant ACA policies such as risk adjustment. Instead of fully specifying different components that determine profitability, we focus on endogenous responses by insurers through advertising in our counterfactual analysis. Moreover, we also make several simplifying assumptions. First, private insurers only choose the total advertising spending at each DMA market. Second, we abstract potential heterogeneity in profits from consumers with different characteristics. Although it is certainly possible to relax both assumptions, main economic mechanisms that we highlight in this analysis will remain the same even in such extended environment.

In this model, government advertising can alter an insurer's incentive for advertising because both types of advertising can affect demand for an insurer. Moreover, there is possible strategic interactions among insurers because demand for an insurer depends not only on its own advertising but also other insurers' advertising.

We consider that each insurer chooses own advertising to maximize the total profits Π_{jmt} in each DMA-year market, mt.[19] Then, we characterize the static Bertrand-Nash equilibrium. As a result, under the Bertrand-Nash equilibrium, the equilibrium advertising expenditure are given as the solution to the first-order condition:

$$\frac{\partial \Pi_{jmt}}{\partial ad_{jmt}} = 0. \tag{9}$$

We use this equilibrium condition in our counterfactual analysis. Moreover, we also utilize Equation (9) to estimate the average annual flow profit per enrollee π_{jmt}. The main idea is that the first order condition will allow us to express π_{jmt} as a function of the derivative of insurer-level enrollment with respect to advertising ad_{jmt} evaluated at the observed level. We can calculate the derivative using our estimates of the consumer demand model. The detail of estimation procedure is described in Appendix A.

We find that the median of estimated π_{jmt} among insurers with positive advertising is about \$769. We view that this magnitude is reasonable. The average annual benchmark premium in marketplace in 2017 is about \$4,320 according to Kaiser family Foundation[20]. If insurers expect to have 10 to 15% profit margin, especially given the presence of 80% medical loss ratio requirement under the ACA, an insurer's perceived profitability we recovered looks reasonable.

[19] This is a limited approach because insurers may decide advertising to maximize their long-run profits. Fully characterizing the dynamic problem is a very challenging task; therefore, we plan to approach them after obtaining main results under the static decision problem.

[20] https://www.kff.org/health-reform/state-indicator/average-marketplace-premiums-by-metal-tier

6.2 Implication of Changing Government Advertising

We use the estimated equilibrium model to examine importance of government advertising by exogenously changing government advertising. Based on our estimates from the consumer demand model that advertising by state governments is not statistically significant, we only consider designs of federal government advertising spending. We first simulate market outcomes in a scenario where private insurers do not respond to the change. Then we calculate market outcomes by solving for an equilibrium where private insurers optimally adjust their advertising spending. Because there was no federal advertising in 2018, we focus on markets with positive federal government advertising in 2014-2017.

Table 12: Counterfactual Experiments: Changes in Federal Government Advertising Spending

		benchmark	0×fed ads		3×fed_ads	
		overall	partial eq.	full eq.	partial eq.	full eq.
All	enrollment (%)	19.07	18.65	18.67	19.59	19.57
markets	private advertising ($)	1.17	1.17	1.28	1.17	1.08
large government spending	enrollment (%)	17.15	16.01	16.08	18.26	18.20
market (>0.6)	private advertising ($)	1.73	1.73	2.22	1.73	1.47

Note: both enrollment and private spending are at the DMA-level. We calculate private advertising as per capital private advertising spending at the DMA level. In the benchmark economy, the magnitude of federal advertising is $0.38 per capita.

Table 12 shows main results. First, we find that reducing federal government spending to zero modestly reduces the market-level enrollment. Although the overall effect is small (19.07% to 18.65%), it depends on the baseline government spending. When the baseline government spending is more than $0.60 per capita (mean is $0.38 per capita), then we find that the decline in enrollment is about to 1.15 percentage point. Importantly, equilibrium responses of private insurers have little effects on market-level enrollment. This finding is important because we find that private insurers indeed increase their advertising substantially in response to the counterfactual change in federal advertising. On average, the magnitude of increase in advertising is 29% of federal advertising spending per capita ($0.38 per capita). In markets with large baseline government spending, we find that private advertising increases by $0.50 per capita, which is 40% of the baseline government advertising ($1.25 per capita). [21] The finding that market-level enrollment changes little suggests that private advertising does have very limited market expansion

[21] This result may be also affected by our specification of demand model, where we do not include the interaction between private and government advertising as a determinant of consumer demand. We also examined the robustness exercise by adding the interaction but the coefficient of the interaction is not statistically significant.

effects. Note that our estimates in the consumer demand model shows private advertising is effective in increasing an insurer's own demand. Thus, private advertising is driven by rent-seeking competition among insurers, which may lead to a waste of resources. This differs from federal advertising, which affects all the insurers more or less evenly (see Section 5.3.4). Moreover, this finding also indicates that government and private advertising are substitutes in the sense that a reduction in government advertising increases private advertising. However, the substitution is not perfect because private insurers may target different markets from the government.[22]

Table 12 also reports results from another counterfactual experiment, where government advertising is increased by three times. We find that market enrollment increases, close to 2 percentage points in market with large baseline government spending. Consistent with results from the scenario where we shut down government advertising, these additional government advertising lowers private advertising. However, the overall market-level enrollment will remain the same despite the decrease in private advertising. This finding suggests that government advertising may be beneficial not only to increase enrollment but also to mitigate possibly excessive advertising competition among private insurers. It also suggests that marketing campaign by the government will be beneficial and possibly an effective tool to mitigate consumer frictions in newly created private markets.

6.3 Welfare Implication of Targeting of Federal Advertising

Finally, we use our model to investigate how much the federal government and private insurers have different objectives in deciding where to target advertising. We do not consider state advertising by state governments because we did not find it very effective in increasing enrollments. We first specify the government objective function to choose their advertising as follows:

$$\max_{ad^f_{mt}} W_{mt} q_{mt}(ad^f_{mt}, ad^s_{mt}, \boldsymbol{ad^p_{mt}}) - C(ad^f_{mt}),$$

[22]One might think that we could validate our model externally by comparing our counterfactual results and empirical estimates of changes in private advertising in response to the cut of federal advertising in 2018. Because federal advertising was distributed unevenly across regions, one can potentially estimate the response by private insurers with a difference-in-differences regression. We estimated such a regression but did not find statistically significant responses by private insurers. However, this does not contradict our counterfactual result. Because we find that the effect of federal advertising decreases over time, the effect of federal advertising would have been much smaller than our estimate for the effectiveness of federal advertising. Thus, responses by private insurers were likely limited in 2018, and we do not find statistically significant estimates. In contrast, our counterfactual analysis is based on the estimate for the period that includes early years of the marketplace when federal advertising was the most effective.

where W_{mt} is the federal government's perceived social welfare from enrolling a consumer in DMA m in year t. This specification is similar to the specification of a private insurer's profit function. An important difference is W_{mt} and π_{jmt}. We consider that the parameter W_{mt} captures both a weighted average of consumer and producer surplus, government expenditures on subsidies, and redistributional preference held by the government. We can back out this parameter using the same approach to recover an insurer primitive π_{jmt}. We use this parameter to understand how heterogeneous government and firms are in terms of targeting advertising.[23]

We find that the median estimate of W_{mt} is about \$83.04. Although the magnitude is much smaller than our estimates of an insurer's profitability, it looks very reasonable if we take into account sizable government spending on premium subsidies. Importantly, although W_{mt} and π_{jmt} are positively correlated, the magnitude of their correlation coefficient is very small, only about 0.05. Given this large difference in profitability between private insurers and the government, it is likely very difficult for private markets to generate welfare-maximizing level of advertising. Our finding therefore provides additional evidence that marketing activities by the government will be desirable in these markets.

7 Conclusion

This paper has studied government advertising in the publicly designed private markets in the context of health insurance marketplaces. We first show the targeting nature of government advertising compared with private advertising. The government tends to advertise more in markets with unhealthy population, whereas private insurers advertise more in markets with healthy population. Then, we estimate the impact of government and private advertising on marketplace enrollment. Importantly, our empirical design exploits the discontinuity of TV advertising markets to address the endogeneity of advertising. We find that the government advertising has a market expansion effect, while the private advertising tends to steal consumers from other insurers. These findings suggest that government advertising may play an important role by reducing the possible information frictions that consumers face to sign up for health insurance plans. Finally, we estimate an equilibrium model of health insurance marketplace to examine alternative designs of government advertising. We show that government advertising may possibly mitigate excessive advertising competition across private insurers.

This is obviously a first step toward understanding how to market and outreach pub-

[23]Note that this analysis assumes that the federal government optimally choose the advertising based on their objective.

licly designed private markets. There are a number of interesting areas of research. First, it is important to explore the role of government advertising in other markets, such as mortgage or education markets. Moreover, another interesting research is to consider other marketing and outreaching tools that the government and private insurers exploit and understand its efficiency compared with government advertising.

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A Supply-Side Specification and Estimation

In our empirical analysis, we assume that the cost of advertising for each insurer is the actual advertising spending and the fixed (unobserved) cost, $C_{jmt}(ad^p_{jmt}) = ad^p_{jmt} + \triangle_{jmt}$.

This specification allows us to recover an insurer's primitive in a straightforward manner. First, among firms with positive advertisement expenditures, we can recover the profitabilityπ_{jmt} by utilizing an insurer's first order condition. First, from consumer-side demand estimates, we can analytically calculate the marginal enrollment at the observed advertising level. Then, we can obtain the estimates of π_{jmt} nonparametrically from the first order condition. Among firms with zero advertisement expenditure, we need to recover $\triangle_{jmt}$ and π_{jmt} jointly. A straightforward approach is to specify the functional form of $\triangle_{jmt}$ (e.g., Goeree (2008)); an alternative is to exploit the moment inequality approach to identify the bound of these estimates. Although both approaches could be implemented, we only reoptimize insurers that spent positive amounts of advertising spending. This choice is less problematic for our counterfactual that marginally change spending of government advertising.

B Content of Advertising

We first obtain the transcript of each advertisement through Amazon Web Service. Based on these transcripts, we create a list of dummy variables about the content of advertisement. To create these dummy variables, we thoroughly looked at a number of advertisement transcripts in details and list up the potential keywords that characterize contents of advertisements. We then classify each advertisement based on the following list of keywords. Although this approach is still not perfect, we find that they are very comprehensive and accurate based on our own ex post verification. The detailed are as follows:

- Reform: This dummy variable takes one if an advertisement contains at least one of the following words: "affordable care act", "new law", "health care law", "health care reform law", "health care reform", "new health care", "reform", "health care act", "recent changes in health care", "changes that are coming in the health care system", "health care changes", and "changes in our health care"'.

- Market: This dummy variable takes one if an advertisement contains at least one of the following words: "marketplace", "market place", "medical insurance market", "exchange", "health insurance market", "healthcare dot", and "

- Healthcare: This dummy variable takes one if an advertisement contains at least one of the following words: "healthcare dot."′

- Open Enrollment:. This dummy variable takes one if an advertisement contains at least one of the following words: "open enrollment", "deadline","choose or change plan", "last day", "enrollment period", "registration period", "open registration", "enrollment is now open", "February fifteen", "fifteenth of February", "December fifteen", "fifteen of December", "march thirty", "December 15", "January thirty first", "enroll-a-thon"′. If advertising contains "open enrollment for state and county employees","April thirtieth", then we assign the dummy to take zero.

- Uninsured: This dummy variable takes one if an advertisement contains at least one of the following words: "uninsured", "still need health insurance", and "existing condition"′.

- Penalty: This dummy variable takes one if an advertisement contains at least one of the following words: "penalty", "penalties", "the fine", "required to have health insurance", "required by law", "requirement", "required to have".

- Financial: This dummy variable takes one if an advertisement contains at least one of the following words: "financial assistance", "financial help", "income information", "estimated income", "tax credit", "financial aid", "subsidy", "subsidies", "federal assistance", "government aid", "government to help", "money from the government", "qualify for assistance", "help pay", "help with their monthly payment", "eligible for money", "how much money you could get from the government", "government helping to pay", "federal help", "assistance to pay", "eligible for money", "getting money to help", "sum city", "financial health", "national assistance", "receive financial", "qualify for assistance", and "aid for your health insurance"′.

- ACA: this dummy variable takes one if at least one of dummy variables created above takes one.

- Low Price: This dummy variable takes one if an advertisement contains at least one of the following words: "discount", "low monthly", "lower monthly", "lowest monthly", "afford health care", "less money", "budget friendly", "save money", "pay less", "fits your budget", "fits your options in your budget", "cheaper", "affordable option", "affordable coverage", "affordable health insurance", "affordable premium", "affordable plan", "affordable price", "lowest cost", "low cost", "low-cost", "low pre-

mium", "lower premium", "lowest premium", "low price", "lower price", "lowest price", "best price", "price you can afford", and "price that's not too big"' "

  - The ACA dummy can be equal to zero for an advertisement with the "Low Price" dummy equal to one.

- Net Price for ACA: this dummy variable takes one if at least one of "Financial", "Penalty" and "Affordability" dummies take one and if the ACA dummy takes one.

C Additional Tables

Table 13: Targeting of Federal Advertising

	(1) FedACA$_pp$	(2) FedACAPrice$_pp$	(3) FedACAFinPrice$_pp$	(4) FedACAFinPenPrice$_pp$	(5) FedReform$_pp$	(6) FedMarket$_pp$	(7) FedOpenEnroll$_pp$	(8) FedPenalty$_pp$	(9) FedFinancial$_pp$	(10) FedFinPen$_pp$
Share of Poor or Fair Health	0.866***	0.043	0.585**	0.586**	-0.155	0.866***	0.483***	0.002	0.645***	0.682***
	(0.299)	(0.222)	(0.251)	(0.251)	(0.132)	(0.299)	(0.155)	(0.002)	(0.184)	(0.197)
% FPL $\leq$ 138	-0.124	0.069	0.009	0.008	0.061	-0.124	-0.056	-0.001	-0.048	-0.053
	(0.204)	(0.131)	(0.153)	(0.153)	(0.097)	(0.204)	(0.092)	(0.001)	(0.101)	(0.107)
% FPL from 138 to 250	-0.092	-0.125	-0.103	-0.104	-0.053	-0.092	-0.037	-0.001	-0.028	-0.043
	(0.230)	(0.141)	(0.165)	(0.165)	(0.113)	(0.230)	(0.104)	(0.001)	(0.113)	(0.120)
% FPL from 250 to 400	0.344	0.305	0.304	0.304	0.076	0.344	0.241	-0.000	0.210	0.229
	(0.286)	(0.212)	(0.220)	(0.220)	(0.133)	(0.286)	(0.159)	(0.000)	(0.162)	(0.178)
% age $\leq$ 18	0.371	0.026	0.253	0.251	0.023	0.371	0.123	-0.002	0.213	0.209
	(0.318)	(0.215)	(0.247)	(0.247)	(0.144)	(0.318)	(0.180)	(0.001)	(0.191)	(0.205)
% age from 18 to 34	-0.205	-0.236	-0.191	-0.192	-0.200**	-0.205	0.035	-0.001	0.031	0.022
	(0.274)	(0.177)	(0.206)	(0.206)	(0.100)	(0.274)	(0.149)	(0.001)	(0.158)	(0.169)
% age from 35 to 54	-0.364	-0.393	-0.409	-0.411	-0.207	-0.364	-0.134	-0.001	-0.159	-0.190
	(0.399)	(0.312)	(0.335)	(0.335)	(0.159)	(0.399)	(0.258)	(0.001)	(0.259)	(0.283)
No. of Insurers	0.014**	0.002	0.011**	0.010**	0.004	0.014**	0.001	-0.000	0.007*	0.007*
	(0.006)	(0.003)	(0.005)	(0.005)	(0.003)	(0.006)	(0.002)	(0.000)	(0.004)	(0.004)
Market Size (100,000)	0.023***	0.009***	0.016***	0.016***	0.008***	0.023***	0.003**	0.000	0.009***	0.009***
	(0.005)	(0.002)	(0.003)	(0.003)	(0.002)	(0.005)	(0.001)	(0.000)	(0.003)	(0.003)
N. Obs.	476	476	476	476	476	476	476	476	476	476
Adj. R^2	0.225	0.219	0.257	0.257	0.451	0.225	0.547	0.021	0.500	0.225

Table 14: Targeting of State Advertising

	(1) StateACA$_{pp}$	(2) StateACAPrice$_{pp}$	(3) StateACAFinPrice$_{pp}$	(4) StateACAFinPenPrice$_{pp}$	(5) StateReform$_{pp}$	(6) StateMarket$_{pp}$	(7) StateOpenEnroll$_{pp}$	(8) StatePenalty$_{pp}$	(9) StateFinancial$_{pp}$	(10) StateFinPen$_{pp}$
Share of Poor or Fair Health	2.189	-0.663	0.936	0.883	0.088	2.189	1.232	0.005	1.460	1.438
	(2.041)	(0.622)	(1.380)	(1.391)	(0.126)	(2.041)	(0.891)	(0.139)	(1.384)	(1.386)
% FPL $\leq$ 138	-3.371***	-0.033	-1.724**	-1.708**	-0.252	-3.371***	-1.600***	0.051	-1.839**	-1.796**
	(0.949)	(0.368)	(0.707)	(0.716)	(0.153)	(0.949)	(0.421)	(0.095)	(0.704)	(0.712)
% FPL from 138 to 250	-0.127	0.227	0.059	0.053	0.047	-0.127	-0.982	-0.001	-0.407	-0.360
	(1.304)	(0.356)	(0.839)	(0.834)	(0.062)	(1.304)	(0.607)	(0.109)	(0.872)	(0.870)
% FPL from 250 to 400	1.443	0.928	0.653	0.669	-0.142	1.443	-0.475	0.155	0.101	0.141
	(1.313)	(0.633)	(0.904)	(0.905)	(0.167)	(1.313)	(0.511)	(0.118)	(0.857)	(0.860)
% age $\leq$ 18	-0.791	-0.243	-1.150	-1.296	-0.185	-0.791	-0.013	-0.181	-0.600	-0.764
	(1.711)	(0.566)	(1.119)	(1.117)	(0.120)	(1.711)	(0.650)	(0.117)	(1.175)	(1.170)
% age from 18 to 34	0.257	1.006**	-0.155	-0.170	-0.002	0.257	0.854	0.037	-0.305	-0.310
	(1.269)	(0.476)	(0.956)	(0.955)	(0.086)	(1.269)	(0.515)	(0.084)	(1.043)	(1.042)
% age from 35 to 54	-2.795	-0.806	-1.925	-2.051*	-0.006	-2.795	0.678	0.029	-2.013	-2.127*
	(1.771)	(0.672)	(1.165)	(1.155)	(0.102)	(1.771)	(0.772)	(0.203)	(1.241)	(1.235)
No. of Insurers	0.070**	0.022**	0.054**	0.050**	-0.003	0.070**	0.034**	-0.002	0.042**	0.040*
	(0.029)	(0.009)	(0.021)	(0.021)	(0.002)	(0.029)	(0.015)	(0.004)	(0.021)	(0.021)
Market Size (100,000)	0.014	0.000	0.009	0.010	0.001	0.014	0.002	0.002	0.009	0.010
	(0.012)	(0.003)	(0.008)	(0.008)	(0.001)	(0.012)	(0.006)	(0.001)	(0.010)	(0.010)
N. Obs.	302	302	302	302	302	302	302	302	302	302
Adj. R^2	0.207	0.202	0.143	0.147	0.174	0.207	0.214	0.011	0.115	0.118

Table 15: Targeting of Private Advertising

	(1) PrivAll$_{pp}$	(2) PrivACA$_{pp}$	(3) PrivACAPrice$_{pp}$	(4) PrivACAFinPrice$_{pp}$	(5) PrivACAFinPenPrice$_{pp}$	(6) PrivReform$_{pp}$	(7) PrivMarket$_{pp}$	(8) PrivOpenEnroll$_{pp}$	(9) PrivPenalty$_{pp}$	(10) PrivFinancial$_{pp}$	(11) PrivFinPen$_{pp}$
Share of Poor or Fair Health	-1.694*	-0.997**	0.020	-0.555	-0.679	-0.680***	-0.458**	-0.440	-0.423*	-0.589	-0.760*
	(0.897)	(0.491)	(0.289)	(0.458)	(0.464)	(0.247)	(0.214)	(0.385)	(0.230)	(0.383)	(0.399)
% FPL $\leq$ 138	0.779	0.796***	0.002	0.616***	0.690***	0.441**	0.243**	0.492**	0.402***	0.622***	0.703***
	(0.565)	(0.266)	(0.127)	(0.228)	(0.228)	(0.177)	(0.122)	(0.217)	(0.153)	(0.202)	(0.208)
% FPL from 138 to 250	-0.065	0.313	-0.243	0.137	0.211	0.400**	0.044	0.258	0.037	0.336	0.389
	(0.666)	(0.376)	(0.225)	(0.336)	(0.337)	(0.202)	(0.167)	(0.266)	(0.180)	(0.270)	(0.274)
% FPL from 250 to 400	0.128	0.545	0.134	0.436	0.470	0.178	0.149	0.375	0.070	0.308	0.287
	(0.630)	(0.335)	(0.196)	(0.293)	(0.298)	(0.215)	(0.155)	(0.250)	(0.160)	(0.245)	(0.252)
% age $\leq$ 18	-1.449	-0.132	-0.175	-0.393	-0.409	-0.386*	-0.013	-0.050	-0.361*	-0.361	-0.497
	(0.912)	(0.478)	(0.310)	(0.416)	(0.436)	(0.225)	(0.309)	(0.346)	(0.205)	(0.302)	(0.335)
% age from 18 to 34	-0.375	0.328	0.082	0.116	0.133	0.031	0.099	0.087	-0.194	0.076	0.023
	(0.770)	(0.377)	(0.232)	(0.344)	(0.354)	(0.156)	(0.198)	(0.310)	(0.202)	(0.285)	(0.305)
% age from 35 to 54	-0.604	-0.006	-0.105	0.083	0.052	0.362*	-0.338	-0.136	-0.255	0.403	0.214
	(1.042)	(0.523)	(0.368)	(0.481)	(0.501)	(0.192)	(0.337)	(0.409)	(0.257)	(0.356)	(0.393)
No. of Insurers	0.084***	0.029***	0.013***	0.024***	0.024***	0.011**	0.009*	0.018***	0.003	0.017***	0.017***
	(0.016)	(0.007)	(0.004)	(0.006)	(0.006)	(0.005)	(0.005)	(0.006)	(0.004)	(0.006)	(0.006)
Market Size (100,000)	0.024***	0.017***	0.004	0.012***	0.012***	0.005***	0.005*	0.014***	0.005***	0.011***	0.012***
	(0.007)	(0.004)	(0.003)	(0.004)	(0.004)	(0.002)	(0.003)	(0.003)	(0.001)	(0.003)	(0.003)
N. Obs.	983	983	983	983	983	983	983	983	983	983	983
Adj. R^2	0.156	0.194	0.034	0.147	0.155	0.289	0.027	0.153	0.118	0.170	0.169

Table 16: Coefficient Estimates: Interaction between Government and Private advertising

	(1) 2016	(2) 2017	(3) 2018
Log of Fed Spend	0.124*	0.108*	0.110*
	(0.069)	(0.065)	(0.063)
Log of Priv Spend	0.115**	0.089*	0.102**
	(0.050)	(0.047)	(0.043)
Log of Fed Spend × Log of Priv Spend	0.020	0.057	0.020
	(0.080)	(0.077)	(0.075)
Log of State Spend	0.089	0.044	-0.050
	(0.084)	(0.075)	(0.078)
Log of State Spend × Log of Priv Spend	-0.155**	0.108	0.098
	(0.074)	(0.130)	(0.125)
No. of Insurers	-0.256***	-0.382***	-0.383***
	(0.058)	(0.057)	(0.050)
No. of Insurers × No. of Insurers	0.011**	0.025***	0.026***
	(0.005)	(0.006)	(0.005)
FirmBorderYear FE	Y	Y	Y
County FE	Y	Y	Y
FirmRatingYear FE	Y	Y	Y
N. Obs.	26,754	32,946	38,272
Adj. R^2	0.932	0.929	0.929

Note: the estimation uses data from 2014-2018.