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

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Abstract

This paper studies government and private marketing activities in the context of the Affordable Care Act health insurance marketplace. Using detailed TV advertising data, we present evidence that government advertising and private advertising are targeted to different geographical areas and provide different messaging content. Then, by exploiting discontinuities in advertising along the borders of local TV markets, we estimate the impacts of government advertising and private advertising on enrollment. We find that government advertising has a market-expansion effect, whereas private advertising tends to steal consumers from other insurers, which may cause excessive private advertising spending. Using the equilibrium model of marketplaces, we explore the impact of changing government advertisement spending. We find that government advertising increases the total program enrollment and reduces inefficient rent-seeking advertising competition among private insurers.

JEL Codes: G2, I1, I3, L1, M3.
Keywords: market-based public program, health insurance, government advertising, advertising competition

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1 Introduction

The government often conducts marketing and outreach activities for public programs. In *traditional* public programs–such as Medicaid, the Supplemental Nutrition Assistance Program (SNAP), and the Supplemental Security Income Program–where the government directly provides the benefit to enrollees, government marketing activities are done partly in response to low take-up among eligible populations. Common explanations for the low take-up are lack of information about eligibility and transaction costs associated with enrollment (Currie (2006)). Government marketing activities are considered to be an important policy to efficiently deliver public programs by mitigating these choice frictions (Aizer (2007); Finkelstein and Notowidigdo (2019)).

Government marketing activities are also used to advertise *market-based* public programs, where benefits are provided by private firms in regulated markets. Market-based public programs have become common in markets for health insurance, education, and mortgages.[1] Many studies document significant choice frictions in these programs as well, which suggests a potential positive role of marketing activities.[2] In contrast to traditional public programs, private firms participating in a market-based program often conduct advertising for the program.[3]

This practice raises a natural but yet-to-be-answered market design question: what are appropriate interventions for the government in the presence of private marketing activities? The answer depends on how private marketing activities work. If a firm's marketing merely steals enrollees from other firms and have a limited effect on the total program enrollment, the government may want to intervene by directly marketing the program. However, if a firm's marketing has positive spillover to other firms by informing potential program enrollees of general information about the program, the government may instead want to subsidize private marketing. Moreover, the government's objectives might differ from those of private firms (e.g., its redistribution preference). Such a difference in objectives may also call for the government's intervention in marketing.

This paper studies the effects of marketing activities by the government (both federal and state) and private insurers in the Affordable Care Act (ACA) health insurance marketplace. Among possible marketing tools, we focus on TV advertising because advertising is the largest component of government marketing activities. The Department of Health

[1]Market-based health insurance programs include the Affordable Care Act marketplace, Medicare Advantage, and Medicare Part D. An example for education benefits is a charter school. The Making Home Affordable program (MHAP) was set up in 2009 to help underwater homeowners modify or refinance their mortgages through private lenders. The federal government's advertising of the MHAP cost more than $125 million (`makinghomeaffordable.gov/press-release/Pages/pr_09242014.aspx`).

[2]For example, see Polyakova (2016) and Handel et al. (2020) for health insurance, Andrabi et al. (2017) and Allende et al. (2019) for education markets, and Johnson et al. (2018) for mortgage markets.

[3]For example, see Hastings et al. (2017) for pensions and Aizawa and Kim (2018) for health insurance.

and Human Services (HHS), which is responsible for health programs, typically spends more on adverting than other departments except for the Department of Defense (Kosar (2014)). Moreover, our specific context–the ACA marketplace–is highly policy relevant. Recently, the federal marketing budget for the ACA marketplace has been decreased substantially, which has spurred interest in the potential benefits and costs of government marketing activities in market-based programs.[4] In this paper, we first document how the government and private insurers target their advertising in the marketplace. Then, we estimate the impact of government and private advertising on enrollments. Finally, we examine the equilibrium impact of changing government advertising, taking into account its interaction with private advertising.

We exploit detailed TV advertising data from Kantar Media, which allow us to observe all the relevant advertising sponsors in this market. The data also contain rich measures of advertising content, including a video file of each advertisement. This information enables us to classify advertisements into different categories, including whether the advertisement provides specific information about the ACA marketplace. We first document that certain types of content–for example, the open enrollment period and the availability of financial assistance–are commonly discussed in advertisements by both the government and private insurers. However, more than 60% of private advertisements do not provide specific information about the marketplace but merely promote a private insurer's brand. Then we document that private advertising is geographically targeted to markets with higher potential profitability, whereas advertising by both federal and state governments is targeted to a broader set of markets. These findings suggest that the government and private insurers have different incentives behind their marketing activities.

Using insurer-level enrollment data, we then estimate a model for consumer demand for ACA health plans to study the effectiveness of advertising by the government and private insurers. In our model, we allow advertising by federal and state governments and by private insurers to have different effects on the decision to purchase health insurance. To address the potential endogeneity concern that advertising may be targeted to certain markets based on unobserved characteristics, we exploit the discontinuity in advertising spending along the borders of local TV markets (e.g., Shapiro (2018), Spenkuch and Toniatti (2018), and Shapiro et al. (2019)). We utilize the border identification approach to estimate not only the average effect of advertising by different sponsors, but also how the effect of advertising differs depending on its contents. The latter can be informative about mechanisms behind the effects of advertising by the government and private insurers.

We find that government advertising, especially by the federal government, has a

[4]Before 2018, the federal government spent $100 million annually on marketing for the marketplace, which was comparable to advertising spending by private insurers for the marketplace based on our data in this paper. In 2018, the federal government drastically cut its spending to $10 million.

market-expansion effect, increasing overall enrollment for the marketplace. The estimate of demand elasticity with respect to government advertising is about 0.05. This magnitude is comparable to findings for advertising by private firms for various products studied by Shapiro et al. (2019). In contrast, although private advertising increases enrollment for insurers conducting advertising, it just leads to reallocation of enrollees among insurers with a limited market-expansion effect. This finding is consistent with the view that advertising by private insurers mainly has a business-stealing effect. We also find that federal advertising that provides information about the open enrollment period and financial assistance under the ACA is much more effective in increasing enrollment. However, private advertising with specific ACA-related information does not contribute to increase enrollment, which may explain the lack of positive spillover effects of private advertising.

Our finding of the business-stealing effect of private advertising indicates that there may be excessive advertising spending via rent-seeking competition among insurers. Thus, a natural market design question is, what is a practical intervention for the government to mitigate this inefficient advertising competition and increase the program enrollment at the same time? We consider government advertising, because it can potentially crowd out private advertising. We model and estimate the supply side of the marketplace, where insurers optimally choose the level of advertising spending given the level of government advertising. Then, we simulate the effect of changing government advertising on the market equilibrium.

We find that increasing government advertising by three times from its baseline level leads to an increase in market-level enrollment of 7.6% (1.30 percentage points of potential marketplace enrollee) in markets with relatively large baseline federal advertising spending. At the same time, private advertising spending decreases, on average, by \$0.25 per dollar increase in federal advertising. Importantly, private advertising that is crowded out by federal advertising is mostly excessive and inefficient. The overall market-level enrollment changes very little regardless of whether we allow private insurers to respond to the change in government advertising. Moreover, private advertising has a limited effect on consumer switching across insurers within the marketplace especially in markets with more rival insurers because rent-seeking insurers would increase advertising spending in equilibrium in response to rivals' advertising spending. This limited consumer switching suggests that this additional private advertising is unlikely to induce consumers to switch to better insurers, and thus is excessive.[5] Thus, our finding suggests that government advertising can be an effective tool to lower choice frictions for

[5]As Finkelstein et al. (2019) show, the welfare gain from inducing consumers to switch toward better plans is likely to be much smaller than the welfare gain from increasing program enrollment (i.e., switching from being uninsured to insured) in part because the marketplace regulates minimum quality of plans.

consumers and mitigate inefficiency in private advertising competition. More broadly, our analysis illustrates mechanisms through which government marketing activities can address various sources of inefficiencies in market-based public programs in general.

Related Literature. Our paper contributes to three strands of literature. First, it is most related to the literature studying the 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; and Cabral et al. (2018), Curto et al. (2020), Duggan et al. (2016), Tebaldi (2017), and Polyakova and Ryan (2019) for capitation payments or subsidy designs. Several studies (e.g., Cebul et al. (2011) and Aizawa and Kim (2018)) examine private marketing activities in employer-sponsored health insurance and Medicare Advantage. A few recent studies in the health policy literature (Karaca-Mandic et al. (2017) and Gollust et al. (2018)) document a negative association between government advertising and the number of uninsured individuals in the first year of the ACA.[6] We contribute to this literature by evaluating government marketing as a market design tool and showing how it interacts with marketing competition by private insurers.

More broadly, this paper contributes to the active literature on government interventions that increase take-up of public programs. Most studies evaluate marketing and outreach activities for traditional public programs, such as Medicaid (Aizer (2007)) and SNAP (Finkelstein and Notowidigdo (2019)).[7] Very recently, Domurat et al. (2019) and Goldin et al. (2019) study randomized experiments of direct mailings with information on the marketplace that the government sent to specific populations.[8] They do not study private marketing activities or the interaction between government and private marketing activities in market-based public programs, which are the main topics of this paper.

Finally, this paper contributes to the literature on advertising. A growing number of studies evaluate 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), 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 pensions. More recently, Shapiro et al. (2019) estimate the effect of advertising on consumer demand in a variety of products based on the border identification approach. Finally, our analysis is also related to the growing literature evaluating the effectiveness of advertising content (e.g., Bertrand et al. (2010)).

[6] Barry et al. (2018) also analyze the content of ACA advertising over time and discuss whether it is designed to attract young and healthy individuals.

[7] See also Hastings and Weinstein (2008) who study the importance of outreach in public schools.

[8] Domurat et al. (2019) consider individuals who had accounts in marketplaces but did not sign up. Goldin et al. (2019) consider individuals who were uninsured and paid the tax penalty in the previous year.

The paper proceeds as follows. Section 2 provides institutional background on the marketplace. Section 3 introduces our main data and shows descriptive evidence. Section 4 presents our demand model and its estimates. Section 5 discusses our supply side model and counterfactual simulation results. Finally, Section 6 concludes.

2 Background on the Health Insurance Marketplace

The health insurance marketplace is a federal/state-based health insurance program for the non-elderly (people younger than 65) in the United States. It was established in 2014 as part of the ACA. The marketplace is designed to provide health insurance for non-elderly uninsured individuals, which was close to 20% of the population before the ACA. In the marketplace, private insurers offer health plans, and the federal government offers premium and cost-sharing subsidies to low-income enrollees. Each plan is categorized based on a "metal" ranking, which provides different levels of generosity: Bronze, Silver, Gold, and Platinum. Individuals can decide to purchase health plans during the open enrollment period, typically starting in the beginning of October of the preceding year when the new coverage begins. Each plan is an annual contract, and individuals need to re-enroll every year.

Rating Regions. Each state is divided into geographical rating regions, which are groups of counties or zip codes. Within each geographical rating region, insurers are not allowed to explicitly discriminate their pricing and product offerings based on the 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 (age 64) and the youngest (age 18) must be equal to a factor of 3; the smoker's insurance premium is 1.5 times as high as that for non-smokers.

Consumer Subsidies. Consumers are offered premium subsidies from the federal government. The amount of the subsidy depends on household income. A household with a lower income receives a more generous subsidy. Moreover, the subsidy depends on whether the state government expanded Medicaid. If Medicaid is expanded, subsidies are given to households with incomes between 138% and 400% of the federal poverty level (FPL); households with incomes below 138% of the FPL qualify for Medicaid. Without Medicaid expansion, subsidies are given to households with incomes between 100% and 400% of the FPL; households with incomes below 100% of the FPL can still purchase a plan from the marketplace without subsidies.[9] Consumers purchasing Silver plans also

[9]The ACA also imposes the tax penalty to the uninsured, known as the individual mandate. Households with income less than 100% of the FPL will be exempt from the individual mandate if the state

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. To mitigate insurers' incentives to selectively enroll healthy, low-cost individuals (i.e., risk selection), the ACA uses a risk adjustment system, which is a budget-neutral transfer scheme in which insurers receive transfers based on the relative (within state) risk composition of their insured population. The risk of an enrollee is assessed based on a risk score, which is calculated based on a variety of concurrent diagnoses. Budget neutrality implies that insurers who enroll relatively healthier individuals make payments to insurers who cover less healthy populations.[10, 11]

Because the risk scores are based on observed enrollee characteristics, these scores may not perfectly reflect a consumer's true risk. Previous work has documented that eliminating incentives for insurers to select on risk is difficult in the context of Medicare Advantage (e.g., Brown et al. (2014); Newhouse et al. (2015)). Therefore, it is possible that insurers may still gain from risk selection despite the presence of a risk adjustment system.

Marketplace Administration and Marketing. State governments have three options to administer marketplaces. First, they can participate in the federally facilitated marketplace, which is operated by the HHS. Second, they can create their own marketplaces (state marketplaces). Third, they can partner with the federal marketplace (partnership marketplaces). Each of these three options provides state governments with different levels of freedom in designing their marketplaces. For example, under different models, states are given different levels of ability to tailor consumer outreach and assistance to their populations. Under the state marketplace model, states assume full responsibility for operating consumer assistance, including marketing through TV advertising. Their marketing expenses are largely funded by the federal government. In the federally facilitated marketplace, however, the federal government is responsible for conducting these activities. In the partnership marketplace, enrollment is conducted through the central website for the federally facilitated marketplace (HealthCare.gov), but the state retains the outreach function.

government does not expand Medicaid.

[10] This design is different from other health insurance markets, such as Medicare Advantage, where the amount of risk adjustment transfers does not depend on the 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 the risk compositions of enrollees of other insurers.

[11] The ACA previously incorporated two additional features into the risk adjustment program: reinsurance and risk corridors. However, both were terminated by the end of 2016.

3 Data and Descriptive Evidence

This paper combines data from multiple sources. We use the enrollment data for 2014–2018 from the Centers for Medicare and Medicaid Services (CMS) to construct market shares for insurers. We obtain detailed information on advertising from Kantar Media. This data set provides occurrence-level TV advertising information on local and national advertisements by private insurers and federal and state governments for 2013–2018.

3.1 Data Sources

3.1.1 Firm- and Market-Level Data

Our analysis combines enrollment data of federally facilitated and partnership marketplaces and the two largest state marketplaces from California (CA) and New York (NY). Each year, the CMS releases enrollment data for 38 states in federally facilitated or partnership marketplaces. The data provide information on enrollment at the insurer-county level for each year from 2014 to 2018 and its breakdown by gender, age, household income, and smoking status. In addition, we also obtain enrollment data from state marketplaces in CA and NY. These data provide total enrollments for each insurer-county-year but do not include totals by demographic group.

To construct market shares for each insurer in a county, we obtain county-level market size from the American Community Survey (ACS). 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 the number of individuals who individually purchased health insurance instead of obtaining it from their employers. This number measures the number of potential marketplace enrollees. We also obtain county-level health characteristics, such as the fraction of populations with poor or fair self-reported health from the County Health Rankings by the Robert Wood Johnson Foundation (CHR).[12]

3.1.2 Advertising Data

Our advertising data are from the Campaign Media Analysis Group at Kantar Media. The data provide detailed characteristics of advertising related to health insurance, particu-

[12]Note that the health measures reported in the CHR data 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 to 2018 is based on actual self-reported health status as of two years before. In other words, the data from 2016 to 2018 provide 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 for 2016 and later to those later years. 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.

larly the ACA health insurance marketplace, at the occurrence level. There are two unique aspects of the data that make it suitable for our research. First, the data allow us to identify which entity (the federal government, state governments, or private insurers) sponsored a given advertisement. Moreover, the data contain information about ACA-related political advertising and advertising by insurance navigators, who help consumers with enrolling for the marketplace. Second, we can access a video file of each advertisement in the data, which allows us to characterize the message content of each advertisement and see how content varies across sponsors.

The main measure of our analysis is each sponsor's per-capita advertising spending at a local TV market (usually called a designated market area (DMA)), which typically consists of a major city and surrounding counties.[13] We create this measure by combining spending on advertisements on local DMA-level TV channels and spending on advertising on national network TV.[14]

Identifying Marketplace-Related Advertisement We exploit the detailed information in the database to identify which advertisements are related to marketplaces. Using Amazon Web Services, we transcribed each advertisement and examined its content based on keywords. As a result, we can identify whether an advertisement (i) is related to the marketplace, (ii) merely promotes a private insurer's brand, or (iii) is related to health insurance but not about the marketplaces (i.e. Medicare). In our analyses, we consider types (i) and (ii) and exclude type (iii).

Depending on advertisement sponsors, we use a slightly different algorithm to classify each advertisement into type (i), (ii), or (iii). First, for advertisements by the federal government, we initially select those with the HHS as their sponsor names.[15] Among this set, we identify marketplace related advertisements (type (i)) by checking the transcript for mentions of "HealthCare.gov." Because there are only about 100 distinct advertisements by the HHS, we verified our classification by watching individual advertisements. Type (ii) does not exist for federal advertising, and we exclude type (iii)–for example, ones in which HHS promotes Medicare.

[13]We also observe gross rating points (GRP), which is often used in other research on advertising. However, we believe that per-capita advertising spending is more suitable for this paper. We observe GRPs only for a subset of advertisements in the data, whereas we observe dollar spending for all advertisements. Further, GRPs measure the share of the general population exposed to a particular advertisement. However, because the ACA marketplace is mainly relevant for a very particular set of the population, GRPs may misrepresent how much of the population is exposed to a relevant advertisement.

[14]Specifically, we sum two ratios: (i) the ratio of a sponsor's total spending in local TV channels in a DMA to the DMA-level market size and (ii) the ratio of a sponsor's national network TV spending to the national market size. The way in which we construct the per-capita spending is similar to Sinkinson and Starc (2018).

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

Second, for advertising by state governments, we initially select those advertisements with sponsor names that match names of state marketplaces such as Covered California and New York State of Health. Among this set, we again identified marketplace related advertisements (type (i)) by checking their transcripts and individual advertisement videos visually. Type (ii) advertisements from state governments do not exist, and we exclude type (iii) advertisements from state governments–for example, those about Children's Health Insurance Programs.

Third, for private advertising, we rely only on transcripts because it is not feasible to watch each of the thousands of distinct advertisements by private insurers. We initially exclude advertisements with type (iii) keywords such as "Medicare Advantage," "Medicare Part D," "Medigap," and "employer-sponsored insurance." Among the remaining advertisements, we identify type (i) with keywords related to the marketplace such as "open enrollment" and "financial assistance." The remainder are classified as type (ii).

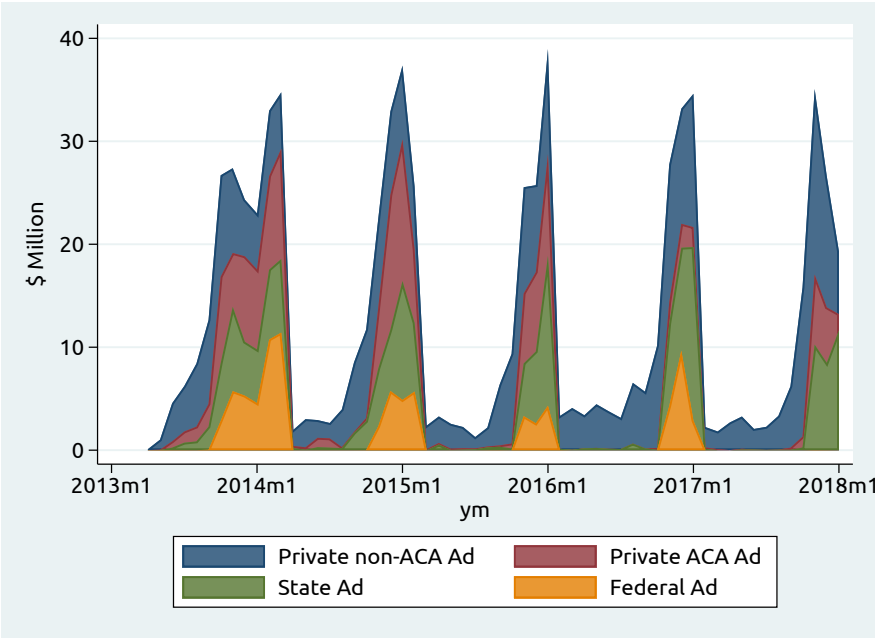
3.2 Summary Statistics

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 (federal and state combined) is still sizable, generally more than $100 million per year. This amount is comparable to total private advertising for health insurance (ACA and non-ACA advertisements combined). Regardless of sponsors, most advertisements were placed around the open enrollment periods of the marketplace.

In 2017, the federal government decided to cut its total marketing budget for 2018 to only $10 million. As seen in Figure 1, TV advertising in 2018 by the federal government is reduced to almost zero. 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 this relationship as causal. However, this data pattern motivates us to study interactions between government and private advertising in Section 5.

Figure 2 shows DMAs in which different sponsors advertised for the 2014 open enrollment period. The figure shows that federal and state governments advertised in very different DMAs–state governments advertised mainly in DMAs with state or partnership marketplaces, while the federal government advertised mainly in DMAs with federally facilitated marketplaces. The same figure also shows that the distribution of government and private advertising spending differs significantly across DMAs. For example, com-

Figure 1: Time Series of Advertising Spending



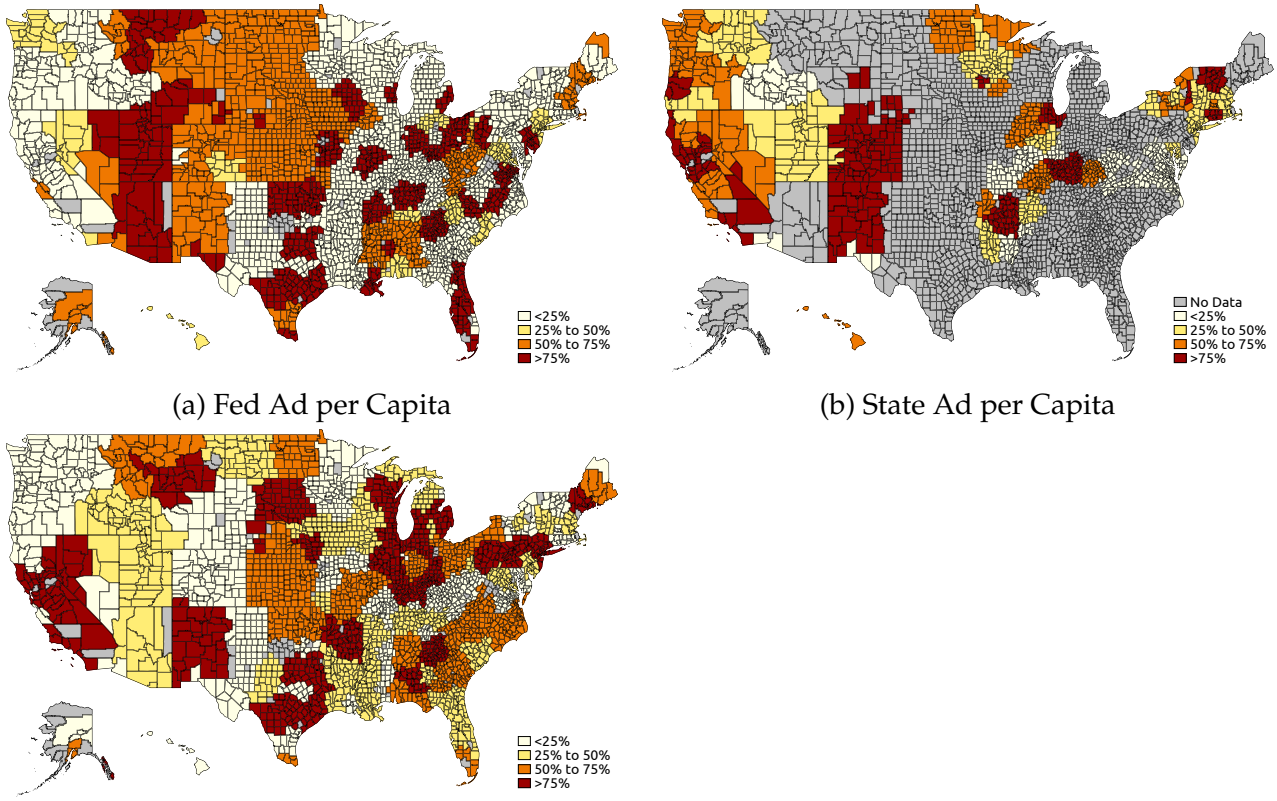
Note: This figure plots monthly expenditures in millions for TV advertisements by the federal and state governments and private insurers' ACA-related and non-ACA-related advertisements. Data source: Kantar Media.

pared with private insurers, the federal government advertises extensively in Arizona and Florida.

Table 1 presents summary statistics on characteristics of markets, split by the intensity of federal, state, and private advertising spending. For columns regarding state advertising ((3) and (4)), we restricted the sample to DMAs that include counties from states responsible for marketing the marketplace. The table shows that government and private advertising spending are not perfectly correlated with each other. Comparing Columns (1) and (2), it is apparent that private advertising spending is lower in DMAs with above-median federal advertising spending. The table also shows that almost all DMAs where state governments directly advertised the marketplace have expanded Medicaid (comparing Columns (3) and (4) with other columns).[16] Private advertising is also larger in those DMAs. Moreover, regardless of advertising sponsors, advertising is larger in DMAs with a greater market size; private advertising is larger for DMAs with a greater number of insurers, whereas either federal or state advertising does not seem highly correlated with the number of insurers in a DMA. Lastly, demographic characteristics considered for this table do not seem highly correlated with any types of advertising. However, this

[16]Every state with positive advertisement spending also expanded Medicaid. The Medicaid dummy is not equal to one in Columns (3) or (4) because some DMAs include counties from states with and without expanded Medicaid.

Figure 2: Geographical Patterns of Government and Private Advertising



(a) Fed Ad per Capita

(b) State Ad per Capita

(c) Private Ad per Capita

Note: This figure plots geographical patterns of advertisements by the federal and state governments (Panels (a) and (b)) and private insurers (Panel (c)). In each panel, a DMA is highlighted in different colors depending on relative advertising spending. The larger the total spending in an DMA is, the darker its color is. DMAs for which state governments are not responsible for marketing are highlighted in grey and denoted as "No Data" in Panel (b). Data source: Kantar Media.

result does not rule out the possibility that advertising is still targeted based on these demographic variables if these demographic variables are correlated with other factors that are also taken into account for targeting. In Section 3.3, we use DMA-level regressions to study more systemically how advertising is targeted.

Table 2 shows summary statistics of advertisement content depending on sponsor types (federal and state governments as well as private insurers). With transcripts of advertisements in our sample, we first consider the following advertisement contents: whether an advertisement mentions the open enrollment period, financial assistance under the ACA, healthcare reform, being uninsured, or the financial penalty of not having health insurance. Details on how these variables are constructed are in Appendix D. We then tabulate the proportion of advertisements that mention keywords related to each topic by sponsor type.[17]

[17] Apparently, the types of content we consider in Table 2 is not necessarily exhaustive. For example, one

Table 1: Summary Statistics at DMA-Year Level

	By Fed Ad Spend		By State Ad Spend		By Priv Ad Spend	
	(1)	(2)	(3)	(4)	(5)	(6)
	Below Median	Above Median	Below Median	Above Median	Below Median	Above Median
Fed Ad per Capita ($)	0.14	0.50	0.27	0.17	0.25	0.35
State Ad per Capita ($)	0.41	0.22	0.19	1.88	0.26	0.40
Priv Ad per Capita ($)	1.16	0.94	0.76	1.53	0.11	2.02
Medicaid Expanded	0.66	0.64	0.94	0.98	0.61	0.69
Market Size (100,000)	1.99	2.95	2.00	3.62	1.26	3.57
No. of Insurers	3.55	3.37	3.46	3.79	2.89	4.06
Share: Income $\leq$ 138% of FPL	0.23	0.23	0.23	0.19	0.23	0.23
Share: Age $\geq$ 55	0.18	0.18	0.18	0.19	0.18	0.18
Share: Poor or Fair Health	0.17	0.17	0.17	0.16	0.18	0.17
N. Obs.	434	350	124	124	392	392

Note: This table reports summary statistics of market characteristics depending on federal, state, and private advertising spending. Odd (even)-numbered columns present characteristics of DMAs below (above) the medians of the three types of advertising. We restricted the sample year up to 2017 for this table because there is no federal advertising in 2018, although our demand estimation in Section 4 uses the sample up to 2018. For Columns (3) and (4), we restricted the sample to DMAs that include counties from states reponsible for marketing the marketplace. The number of observations is not balanced for Columns (1) and (2) because there are many DMAs that received zero local federal advertising. "Medicaid Expanded" is the fraction of markets where Medicaid was expanded under the ACA. "Share: Income$\leq$138% of FPL" is the share of individuals with incomes below or equal to 138% of FPL. "Share: Age$\geq$55" is the share of individuals aged 55 or above. "Share: Poor or Fair Health" is the share of individuals with poor or fair self-reported health. Data source: Kantar Media.

There are certain similarities among advertisements by different sponsors. For example, all sponsor types commonly discuss the open enrollment period and financial assistance in their advertisements. Either of these two types of content has the highest share in ACA-related advertisements for all sponsors. Moreover, these two types of content are often discussed together in the same advertisement by all sponsor types. The fourth row of Table 2 shows that there are more advertisements that discuss both the open enrollment period and financial assistance than advertisements that discuss contents other than the open enrollment period or financial assistance.

However, there are also significant differences in content between government and private advertisements. For example, more than 60% of private advertisements do not mention any of the keywords related to the marketplace that we considered, whereas all federal and state advertisements are ACA-related (by definition).[18] These private ad-

could also look at whether the federal government tried to use advertising as a tool of political persuasion or whether an advertisement conveys misinformation about the marketplace. We focus on the types of content in the table because they are identified in a relatively objective way. Moreover, we believe that the misinformation channel is less relevant in our specific context because of regulations that ban marketing activities providing misinformation in health insurance markets (e.g., see CMS Managed Care Manual for regulations of marketing activities).

[18]We also checked a random sample of private advertisements visually to see whether they show the web address of the marketplace (e.g. Healthcare.gov), but none of them, including even ACA-related ones,

Table 2: Ad Contents

	(1) Private	(2) Federal	(3) State
Share: Any ACA-related	0.37	1.00	1.00
Share: Open Enrollment	0.24	0.22	0.24
Share: Financial Assistance	0.22	0.31	0.42
Share: Open Enrollment and Financial Assistance	0.14	0.20	0.16
Share: Healthcare Reform	0.14	0.18	0.02
Share: Uninsured	0.02	0.03	0.10
Share: Penalty	0.09	0.00	0.02
N. Obs.	998,017	249,215	508,275

Note: This table reports summary statistics of messages in advertisements by private insurers and the federal and state governments for 2014–2018. The unit of observation is each advertisement occurence, and reported numbers are averages weighted by each advertisement's dollar cost. Numbers in each column do not necessarily sum up to one because each advertisement can have multiple messages. Data source: Kantar Media.

vertisements without ACA-related content usually seem to promote an insurer's brands, quality, and various insurance options provided by its plans. On the other hand, even when federal or state advertisements do not mention the *specific* content defined above, they still inform consumers of the presence of marketplaces, always showing the web addresses of the federal and state marketplaces, as in Figure 4 in the Online Appendix.

This difference in contents between governments and private insurers is indicative of their different incentives. The large fraction of private advertisements unrelated to the marketplace reflects that the goal of private advertising is to maximize an insurer's own profit. Such a goal may not always be aligned with the government's likely goal to increase total enrollment in the marketplace. For example, such private advertisements unrelated to the marketplace may be effective in increasing enrollment for an insurer at the expense of enrollment for other insurers, with only a limited net impact on the total marketplace enrollment. In contrast, the government may aim to reduce transaction costs of enrolling in the marketplace by providing specific information. For this reason, we expect that advertisements from different sponsors providing different content have different effects on demand, which we will examine more closely in our demand analysis in Section 4.

3.3 Suggestive Evidence for Targeting Advertising

We now carry out preliminary analyses to explore how advertising by governments and private insurers are geographically targeted. We investigate how advertisement spending

do. In contrast, federal and state advertisements always show the web address of their marketplaces.

is correlated with DMA characteristics by estimating the following regression:

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

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 DMA-level characteristics considered in Table 1. ξ_t refers to a year fixed effect. Although we are reluctant to view our estimates as causal, we aim to learn which market characteristics are associated with greater advertising spending by sponsor type.

Table 3: Targeting of Advertising: Aggregate Results

	(1) Federal	(2) State	(3) Private (All)	(4) Private (ACA)
Share: Income $\leq$ 138% of FPL (%)	-0.001	-0.032***	0.016**	0.008**
	(0.002)	(0.008)	(0.008)	(0.003)
Medicaid Expanded=1	-0.098*		0.545**	0.195*
	(0.058)		(0.224)	(0.099)
Medicaid Expanded=1 $\times$ Share: Income $\leq$ 138% of FPL (%)	0.003		-0.018**	-0.005
	(0.002)		(0.009)	(0.005)
Share: Age $\geq$ 55 (%)	0.001	-0.019	0.017**	0.003
	(0.002)	(0.014)	(0.008)	(0.004)
Share: Poor or Fair Health (%)	0.002	0.010	-0.008	-0.002
	(0.002)	(0.011)	(0.008)	(0.005)
No. of Insurers	0.017***	0.116***	0.059***	0.019***
	(0.006)	(0.025)	(0.015)	(0.007)
Log of Market Size	0.029***	-0.010	0.147***	0.074***
	(0.008)	(0.053)	(0.025)	(0.013)
Year FE	Y	Y	Y	Y
N. Obs.	784	332	983	983
Adj. R^2	0.148	0.238	0.212	0.210

Note: This table reports estimates of the coefficients in Equation (1). Because there is no federal advertising spending in 2018, we restricted our sample years to 2014–2017 for Column (1). For Column (2), we restricted the sample to DMAs that include counties from states for which states are reponsible for marketing the marketplace. For the same column, we do not include the dummy variable for Medicaid expansion because every state with positive advertisement spending expanded Mediciad. Standard errors are in parentheses and clustered at the DMA level. The stars indicate: *** for p<0.01, ** for p<0.05 and * for p<0.1.

Table 3 presents estimates of the regression in Equation (1). Columns (1) and (2) report results for federal and state advertising, respectively. Column (3) presents results for all private advertising, and Column (4) restricts private advertising to ACA-related content. We find that government advertising is not particularly targeted based on DMA-level demographic characteristics other than the number of insurers and the market size, whereas private advertising varies more with demographic characteristics.

This finding may reflect different objectives of the government and private insurers. While private insurers likely advertise more in DMAs with higher returns from advertising, the government's objective is not necessarily aligned with the profit motive. For ex-

ample, we find that Medicaid expansion is associated with 72% ($\simeq 100 * (\exp(0.545) - 1)$) more total private advertising. In DMAs without Medicaid expansion, a one standard deviation increase in the share of individuals with incomes below or equal to 138% of the FPL (6.4 pp) is associated with 10% more total private advertising. However, such a correlation disappears among DMAs that expanded Medicaid. Moreover, private insurers also tend to target DMAs with larger shares of older individuals (aged 55 or above).

To interpret these results, we hypothesize that private insurers want to advertise in DMAs where a greater number of consumers are more responsive to advertising and/or are more profitable to insure. Private insurers may target DMAs with Medicaid expansion (conditional on the market size) because Medicaid can make the average risk pool of the marketplace less risky by absorbing low-income populations, which are more likely to be high-risk.[19] In DMAs with Medicaid expansion, private insurers are less likely to target households with incomes below 138% because they qualify for Medicaid but do not qualify for subsides in the marketplace. In DMAs without Medicaid expansions, however, individuals with incomes between 100% and 138% of the FPL can receive the largest federal subsidies (see Section 2 about Medicaid eligibility). Thus, they are likely responsive to advertising, which we confirm later in our demand analysis (Section **??**). Although these populations could be less healthy, profit-maximizing insurers may target DMAs with more individuals with such income levels to effectively increase the market share. Furthermore, enrolling older consumers can generate a larger profit to insurers in the long run despite their potentially higher costs in the short run.[20] Health plans in the marketplace are available for consumers below age 65; starting at age 65, these consumers can switch to *private* Medicare benefits. If insurers expect that consumers will remain with them after turning 65, they may be interested in attracting older consumers.

In contrast, federal advertising does not systemically vary with the share of low income individuals, its interaction with Medicaid expansion, or the share of older individuals. Although there is more federal advertisement spending in DMAs without Medicaid expansion, the estimated effect is marginally significant and much smaller in magnitude than that for private advertising, perhaps indicating that the federal government wants to reach out a broader population.

In addition to the demographic variables, we also examine the targeting based on the share of the population reporting poor or fair health across DMAs, but we do not find statistically significant correlations with advertising by any sponsor.[21] In Appendix E,

[19] See Sen and DeLeire (2018) for evidence that Medicaid expansion improves the risk pool of the marketplaces.

[20] Although older individuals spend more on health care and thus cost more to insurers, insurers can still charge a much higher premium to older individuals, which also mitigate insurers' short-run cost.

[21] We also examined other health measures such as health care costs, and the fraction of obesity and diabetes, but find similar patterns. These results are available upon request.

using the list of message content from Table 2, we investigate how per-capita advertisement spending for each type of content and sponsor is targeted to different DMAs. We find some evidence of targeting by content type. For example, private advertising emphasizing the penalty of not enrolling in health insurance follows similar patterns to overall private spending, while private advertising that emphasizes the open enrollment period is uncorrelated with DMA demographics.

These results suggest that governments and private insurers target advertising to different DMAs. One way to interpret these results is that different sponsors have different objectives. Private insurers seem to target DMAs with individuals who are likely more responsive to advertising and more profitable to insure. The government, on the other hand, may not be profit-maximizing and thus follows different targeting patterns. We next estimate the impact of advertising on consumer demand to better understand how advertising from different sponsors increases enrollments.

4 The Impact of Advertising on Consumer Demand

4.1 Market-level Analysis

To examine the effect of government and private advertising on consumer demand, we first examine its impact on market-level enrollment in the marketplace. The primary objective of this analysis is to understand whether advertising has any meaningful effect on market expansion. Although advertising could potentially have an impact on Medicaid enrollment, we abstract from such an analysis.[22]

4.1.1 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 thus concentrate their advertising campaigns in such markets. In contrast, it is not clear whether the government implements a sophisticated targeting strategy. Even if the government is sophisticated, it is not obvious whether it targets market with high or low demand for insurance. Depending on how advertising and demand for insurance are correlated, a naive regression of county-level enrollment on advertising may lead to under- or over-estimation of the effects of

[22]Our preliminary analysis suggests that the effect on Medicaid enrollment is likely limited. This result is available upon request.

advertising.

In order to address the endogeneity of advertising, we build on the work of Shapiro (2018), Tuchman (2019), Moshary (2017), Aizawa and Kim (2018), and Spenkuch and Toniatti (2018) and implement a border identification strategy.[23] The border strategy exploits a discontinuity of advertising expenditures across a border between DMAs. This discontinuity arises because the 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 advertising across neighboring border counties in the same state but different DMAs.[24]

To implement the border strategy, we first identify pairs of adjacent border counties in the same state that belong to two different DMAs, which are referred to as a border pair. With fixed effects for border pair-by-year, we absorb unobserved heterogeneity in demand that is common for each border pair and year. Using the panel structure of our data, moreover, we additionally include county fixed effects to absorb county-level unobserved heterogeneity in demand that is persistent over time. With the two sets of fixed effects, remaining unobserved heterogeneity is at the level of each county and year within a border pair. Our identifying assumption is that the remaining unobserved heterogeneity is uncorrelated with advertising. In other words, we assume that growth in advertising spending in a DMA is uncorrelated with changes in county-level unobserved heterogeneity in demand over year.

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. The border strategy requires that growth in other marketing activities across a DMA border is uncorrelated with growth in TV advertising spending across the DMA border. For example, the state government may conduct outreach activities besides TV advertising such as sending reminders to specific enrollees (e.g., Domurat et al. (2019) and Goldin et al. (2019)). These activities often target specific individuals as opposed to a county as a whole. Other outreaching activities, such as in-person assistance programs, may have variation across counties. However, such activities will only violate the identifying assumption if geographical targeting in these activities does not systemically depend on variation of TV advertising across a DMA border *and* if these activities

[23]The main idea behind this type of border strategy is already presented in the seminal work by Holmes (1998) and Black (1999). See Li et al. (2020) for the relationship between the border strategy and the Waldfogel instrument (Waldfogel (2003)), which is commonly used in the industrial organization literature.

[24]We only compare border counties in the same state because marketplaces in different states can be very different.

are effective.[25] Private insurers may engage in other marketing activities, such as digital advertising. Regardless of its effectiveness, they are designed to target at the individual level and therefore are unlikely to discretely change across DMA borders in a way that is correlated with a growth in TV advertising.

The identifying assumption for the border strategy will be more plausible if county characteristics are indeed balanced in the cross section. Having balanced county characteristics in either side of the border is not a necessary condition of our identification assumption because we use the panel structure of the data. However, one might expect that counties with similar observed characteristics are likely to have similar trends for unobserved heterogeneity. Indeed, we find that market characteristics are also almost identical between pairs of border counties with different advertising, as discussed in detail in Appendix A.

An important caveat about the border strategy is that estimated effects of advertising are local to border counties. Thus, it might be difficult to extrapolate the estimated effects to non-border counties, which are excluded from the estimation sample. However, we also show in Appendix A that there are only limited observable differences between border and non-border counties, which suggests that estimates based on our border sample are unlikely to be very different from ones based on the entire sample.

Another caveat about the border strategy is that its reliance on many fixed effects potentially raises a concern about whether we have enough variation in advertising. In Appendix A, we report that the we still have enough variation in advertising that we can use for the border strategy.

4.1.2 Effects of Advertising on Market-level Enrollments

We estimate the following county-level regression:

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

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.[26] On the right-hand side, $ad^k_{bm(c)t}$ refers to the advertising expenditure of category k per potential marketplace enrollee in

[25] Because we control county fixed effects, some variations in in-person assistance programs, such as enrollment centers, are already controlled for in our analysis. Moreover, Myerson (2019) estimate that in-person assistance programs have no effects on marketplace enrollments although they increase Medicaid enrollment.

[26] Because a county can have multiple neighboring counties in different DMAs, it can belong to multiple border pairs. To make sure that the regression result is not driven by counties that belong to multiple border pairs, we weight each county by the inverse of the number of border pairs to which it belongs.

border pair b, DMA $m(c)$ to which county c belongs, and year t.[27] Advertising of category k refers to advertising by different sponsors. In the main specification, $K = \{f, s, mp\}$. $ad^{f}_{bm(c)t}$ and $ad^{s}_{bm(c)t}$ denote advertising by federal and state governments, respectively, and $ad^{mp}_{bm(c)t}$ is *market-level* private advertising, defined as the sum of advertising expenditures by all insurers in each DMA and year. In some specifications, we include advertising of other categories to control for additional variables that also vary discretely across DMA borders: insurance navigators (nv) and political advertising on the ACA by Democrats (*dem*) and Republicans (*rep*).[28] Note that TV advertising decisions are typically made on the basis of a DMA, 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 county-year pair (ct). We include the number of insurers and the market size. To control for unobserved heterogeneity in demand, we include fixed effects for a border pair-by-year (ξ_{bt}), county (ξ_c), and rating area-by-year $(\xi_{r(c)t})$. As discussed above, the border strategy relies on the first two fixed effects. The first controls for time-varying unobserved heterogeneity across border pairs, and the second controls for time-invariant unobservables that vary within border pairs at the county level. In addition, a rating area is a collection of counties within which an insurer sets characteristics for its plans. Thus, $\xi_{r(c)t}$ controls for effects of plan characteristics on enrollments, although we do not explicitly include specific plan characteristics in the regression models.

4.1.3 Estimation Results

Table 4 presents regression results from various specifications. Columns (1)—(3) differ only in included fixed effects, and Column (4) controls for additional advertising categories as well as the full set of fixed effects. Standard errors in all specifications are

[27] Throughout the paper, we measure advertising spending as a flow, as opposed to a stock. A stock measure of advertising spending is more appropriate for markets where consumers make purchasing decisions at a relatively high frequency , such as weekly or monthly frequency. For example, see Shapiro (2018), Sinkinson and Starc (2018), Dubois et al. (2018), and Tuchman (2019), who study consumer purchases of pharmaceuticals, e-cigarettes, and junk food, respectively. We view that a flow measure is more appropriate for our context because advertising is concentrated around the open enrollment in each year and because health insurance purchasing decision is only made once in a year during the oper enrollment period.

[28] The classification of political advertising is based on information on the political party affiliation of advertising sponsors in the data.

Table 4: The Effects of Advertising on Market-level Enrollments

	(1)	(2)	(3)	(4)
Fed Spend ($)	0.041	0.041***	0.050**	0.050**
	(0.027)	(0.015)	(0.022)	(0.022)
State Spend ($)	-0.028	0.019	-0.011	-0.008
	(0.024)	(0.023)	(0.030)	(0.029)
Priv Spend ($)	0.006	0.011	0.023	0.024
	(0.011)	(0.012)	(0.019)	(0.018)
Navi Spend ($)				-0.055
				(0.120)
Dem Spend ($)				0.049***
				(0.017)
Rep Spend ($)				-0.015*
				(0.008)
No. of Insurers	0.046***	0.012*	0.012	0.013
	(0.007)	(0.007)	(0.008)	(0.008)
Market Size	0.000	-0.009***	-0.026***	-0.026***
	(0.000)	(0.003)	(0.006)	(0.006)
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	0.707	0.911	0.916	0.916

Note: This table reports the estimates of the coefficients in Equation (2). Different columns have different combinations of Border×Year fixed effects, County fixed effects, and Rating Area×Year fixed effects. The unit of the market size (the number of potential enrollees) is in thousands. Standard errors are in parentheses and clustered at the DMA×Year level. The stars indicate: *** for p<0.01, ** for p<0.05 and * for p<0.1.

clustered at the level of DMA-by-year because the advertising variables vary at this level.

In almost all specifications, the coefficient estimates for advertising by the federal government are positive and statistically significant, and their magnitudes are largely invariant across the four specifications. Based on the estimates in Column (3), we find that a 1% increase in federal advertising leads to a 0.05% increase in the market shares of individuals that enrolled in the marketplace. Extrapolating the coefficient to larger changes, if the federal government doubles advertising spending, then the market-level share will increase by 5%. Given the unconditional average of market-level shares is 0.2, a 5% increase is equal to a 1 percentage point increase in the market share. 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 very small and almost close to zero. This small average effect of state advertising could mask heterogeneous effects of advertising by different states. In marketplaces for which state governments are responsible for marketing activities instead of the federal government, each state government organizes its own marketing activities. Thus, it is reasonable to expect that some states have more resources available for designing more effective mar-

keting activities than others. To explore this possibility, in Section 4.4.1, we examine how effective state advertising is in CA relative to other states, where the state government spent a large amount of resources for marketing its own marketplace.[29] We find a large and positive effect of state advertising in CA, which is indicative of heterogeneous effects of advertising by different state governments.

Next, we find that market-level private advertising is not effective in increasing market level enrollments regardless of specifications. The point estimates are smaller than federal advertising in all specifications. We cannot conclude that the effect of federal advertising is statistically different from the effect of private advertising because of the relatively large standard errors. However, our finding suggests that private advertising can be quite limited in expanding total marketplace enrollments.

There are two possibilities for this limited effect of private advertising. First, private advertising is not effective for increasing demand for private insurers. Although this possibility raises the question of why a rational insurer would waste resources on advertising, several papers have already found that the effect of advertising on a firm's own demand is quite limited.[30] Second, even if private advertising is effective in increasing demand for insurers that conduct advertising, it does so by stealing consumers from other insurers. In this case, private advertising may just reallocate consumers among insurers and thus 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 (4), we include additional categories of advertising in the regression to control for other factors that also vary discretely across DMA borders: advertising by insurance navigators and political advertising on the ACA by Democrats and Republicans. The coefficient estimates for the three main advertising variables do not vary with the additional variables. Interestingly, the estimated effects of 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.

4.2 Demand Model

We now analyze the impact of advertising on enrollment at the insurer level. This analysis will help us understand whether private insurer advertising is effective in increasing enrollment for the advertising insurer. Moreover, this demand model will be a basis to examine the equilibrium impact of government advertising, which requires an equilibrium

[29] See Lee et al. (2017) for the summary of marketing campaign of CA marketplace programs.
[30] For example, see Blake et al. (2015), Lewis and Rao (2015), and Sinkinson and Starc (2018).

model of the health insurance marketplace.

4.2.1 Utility Specification

Consider individual i who lives in 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 option is always available, a consumer has a total of $J_{ct}+1$ options. The consumer optimally chooses the insurer that maximizes his utility.[31] We assume that the consumer obtains indirect utility u_{ijct} from insurer $j > 0$ as follows:

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

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 advertisement sponsor and content. It is also affected by non-advertising utility from an insurer (ξ_{jct}).[32] The set of advertising categories we consider in the main specification is a collection of the per-capita spending by different advertising sponsors: $K = \{f, s, p, r\}$, each element of which is defined as follows. 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, if advertising by governments increases an insurer's market shares, it will increase all other insurers' market shares in the same way, thereby expanding the total enrollment in marketplace plans. We relax this assumption in Section 4.4.2.

We let $ad^p_{jm(c)t}$ denote advertising by insurer j, which varies over insurers within the same market. An important 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 at the expense of rivals' market shares. 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

[31] Because plan-level enrollment data are available, it is possible to model plan choice within insurers. However, the data provide the total enrollment for each plan aggregated across multiple counties. Moreover, because the effects of advertising on market- and insurer-level demand are the first order channels, we leave this extension for future work.

[32] 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.

that $ad^r_{jm(c)t} = \sum_{h \neq j} ad^p_{hm(c)t}$.[33] The coefficient for $ad^r_{jm(c)t}$ will determine whether private advertising just steals business from rivals or has positive spillover to rivals. If the coefficient is negative, advertising will have the business-stealing effect. Note that the positive coefficient does not necessarily imply that advertising will have positive spillover to rivals. Whether advertising has positive spillover depends on relative magnitudes of the effectiveness of an insurer's own advertising and rivals' advertising–i.e., β_p and β_r. To the extent that some private advertising provides specific information about the marketplace–for example, the open enrollment period–it could potentially have positive spillover to rivals. On the one hand, if the coefficient β_r is positive and large enough, then private advertising can increase not only the insurer's own demand, but also rivals' demand, thereby leading to 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 categories in K in 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 ($ad^{rep}_{jm(c)t}$). Note that advertising of these categories does not vary across insurers within a DMA in each year.

The non-advertising utility (ξ_{jct}) denotes utility from characteristics of an insurer's plans such as premiums, generosity of coverage, provider networks, and so on. It also includes an insurer's characteristics such as brand image. For the purpose of this paper, it is not very crucial to estimate how much utility depends on specific plan characteristics. Thus, we do not explicitly model how each plan characteristic affects utility.

A consumer's outside option ($j = 0$) is to stay as uninsured, 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_{ijct} is an individual i's preference shock for each plan. We assume that ϵ_{ijct} is independently and identically distributed according to a Type I extreme-value distribution.

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 when discussing identification.

[33] We also experimented with an alternative specification, where we define rivals' advertising as the average per-capita spending by rivals. This variable definition does not affect our results.

4.2.2 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_{ijct}, that

$$\delta_{jct} = \ln(s_{jct}) - \ln(s_{0ct}),$$

where s_{jct} denotes insurer $j's$ empirical market share. We will denote the empirical counterpart of δ_{jct} by $\hat{\delta}_{jct}$. 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 an ordinary least square regression is likely to result in biases in our advertising coefficients (β_k) because of endogeneity of advertising, which was discussed earlier in Section 4.1.1. 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

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

First, ξ_{jbt} 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, $\xi_{jr(c)t}$ denotes fixed effects for insurer j, rating area $r(c)$, and year t. An insurer is restricted to offer the same price for a given plan within a rating area and a year. Thus, we indirectly control for an insurer's plan characteristics with $\xi_{jr(c)t}$. Third, ξ_{jc} refers to insurer$\times$county fixed effects, which capture any time-invariant factor that commonly affects demand for an insurer in a county. 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:

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

The identifying assumption is that none of the advertising variables are correlated with the structural error term $\Delta\xi_{jbct}$–i.e., unobserved heterogeneity in demand for an insurer

that varies at the level of county and year within a border pair.

4.2.3 Estimation Results

Table 5: Estimated Coefficients in Insurer-Level Demand Model

	(1)	(2)	(3)	(4)	(5)	(6)
Fed Spend ($)	-0.009	0.079	0.132***	0.125**	0.126**	0.129**
	(0.059)	(0.050)	(0.049)	(0.055)	(0.054)	(0.055)
State Spend ($)	0.012	-0.050	-0.032	-0.033	-0.029	-0.028
	(0.042)	(0.056)	(0.059)	(0.068)	(0.067)	(0.066)
Priv Spend ($)	0.217***	0.307***	0.148***	0.093**	0.092**	0.090**
	(0.034)	(0.049)	(0.040)	(0.046)	(0.046)	(0.046)
Rival Spend ($)					-0.037	-0.043
					(0.047)	(0.046)
Navi Spend ($)						-0.390
						(0.265)
Dem Spend ($)						0.049
						(0.036)
Rep Spend ($)						0.017
						(0.019)
No. of Insurers	-0.190***	-0.203***	-0.188***	-0.091***	-0.089***	-0.087***
	(0.017)	(0.021)	(0.025)	(0.026)	(0.026)	(0.025)
Market Size	0.001***	-0.012***	-0.022***	-0.021***	-0.021***	-0.022***
	(0.000)	(0.004)	(0.005)	(0.005)	(0.005)	(0.005)
FirmBorderYear FE	Y	Y	Y	Y	Y	Y
County FE		Y	Y			
FirmCounty FE				Y	Y	Y
FirmRatingYear FE			Y	Y	Y	Y
N. Obs.	39,782	39,750	38,296	36,558	36,558	36,558
Adj. R^2	0.791	0.822	0.895	0.942	0.942	0.942

Note: This table reports the estimates of the coefficients in Equation (7). Different columns have different combinations of Firm×Border×Year fixed effects, County fixed effects, Firm×County fixed effects, and Firm×Rating Area×Year fixed effects. Columns (4) and (5) present the estimates with specifications with additional advertising variables. The unit of the market size (the number of potential enrollees) is in thousands. Standard errors are in parentheses and clustered at the DMA×Year level. The stars indicate: *** for p<0.01, ** for p<0.05 and * for p<0.1.

Table 5 presents coefficient estimates in the utility function described in Equation (3) with different specifications. Columns (1)–(6) differ only in the included fixed effects and advertising controls. Standard errors for all specifications are clustered at the level of DMA-by-year because main advertising variables vary at this level.

Table 5 shows that, in all specifications, an insurer's own private advertising is effective in increasing demand for an insurer. Based on the estimate from Column (4), which contains the most extensive set of fixed effects, the average elasticity of insurers' demand with respect to advertising is 0.03 among insurers that had positive advertising spending.[34] The magnitude of this estimated impact of *private advertising* is largely consistent

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

with typical findings in the marketing literature estimating the elasticity of demand with respect to advertising (see Shapiro et al. (2019)).

We also find that the estimates for rivals' advertising in Columns (5) and (6)) are small and negative, and they are not statistically significant. This finding suggests that private advertising does not have positive spillover to rivals and that it merely has a business-stealing effect. This finding is consistent with the finding from the county-level regression in Section 4.1.3 that market-level aggregate private advertising has limited market-expansion effects. If demand for an insurer increases at the expense of its rivals, private advertising may have very limited effects on increasing the market-level enrollment.

The estimates for advertising by federal and state governments are consistent with our finding with the market-level regression. Federal advertising is effective in increasing demands for all insurers, whereas advertising by state governments has limited effects. The estimates from this model of demand provide evidence that private advertising has a very different effect on enrollment than does advertising by the federal government. While federal advertising increases market-level enrollments, advertising by a private insurer only reallocates demand to its products away from its competitors, with a limited net effect on overall enrollment.

4.2.4 Advertising Content

Our findings so far are that federal advertising has the market-expansion effect and that private advertising does not have positive spillover to other insurers with limited net effect on the total program enrollment. To better understand the mechanisms behind the result, we now estimate a model that allows for advertising with different contents to have different impacts on demand. We do not allow for the separate effect for each of the types of content we considered in Section 3 because it will be difficult to precisely estimate effects for content types that are infrequently provided in advertisements. Thus, we consider separate effects only for the two most common content types: the open enrollment period (OE) and financial assistance (FA).

One difficulty in estimating content-level effects is that it is difficult to identify which particular content is effective because an advertisement often contains multiple types of content. Table 10 in the Online Appendix shows which types of content tend to be provided together in general. As discussed in Section 3, there are many advertisements that provide contents on both OE and FA. In contrast, the other types of content–healthcare reform, being uninsured, and the penalty for not having health insurance–are much less likely to be provided along with the content on OE or FA. Moreover, the other types of content do not tend to appear together in the same advertisement, either.

Based on these data patterns, we allow for the separate effect for the following four

different types of advertising to reasonably isolate effects of content: (i) advertising that provides content on both OE and FA; (ii) advertising that provides content on either OE or FA, but not both; (iii) advertising that provides the other types of content but not contents on OE or FA; (iv) advertising that provides no specific information on the marketplace. Note that there are no federal or state advertisements of type (iv) by definition. In contrast, more than 60% of private advertisements did not provide any specific information on the marketplace, as shown in Section 3.

Table 17 in the Online Appendix presents coefficient estimates.[35] Column (1) reports estimates for a model, where we combine types (ii), (iii), and (iv) into one group while type (i) has its own effects. In Column (2), we allow for each of the four types to have separate effects. We find that the coefficient estimates for federal advertising of type (i)–providing content about *both* OE and FA–are very large and statistically significant in both columns, suggesting complementarity between the two content categories for consumers. Column (1) shows that federal advertising other than type (i)–a combination of types (ii), (iii), and (iv)–has a much smaller estimate that is not statistically significant. Column (2) presents separate estimates for federal advertising of types (ii) and (iii), but neither of the two estimates is statistically significant. Note that as we include more advertising types in the model, we are likely left with less variation in advertising of each certain type, leading to larger standard errors. The relatively large standard errors for estimates in Table 17 make it difficult to statistically distinguish whether certain types of content are more effective than others. Nevertheless, our results indicate that federal advertising that provides contents about both OE and FA played a major role in driving the market-expansion effect of federal advertising.[36]

In contrast, the coefficient estimate for private advertising of type (i) is small and not statistically significant in either column. Based on the estimates in Column (1), the estimate for private advertising of type (i) is statistically smaller than the estimate for federal advertising of type (i).[37] This result suggests that federal advertising is a more effective tool through which to provide information about the marketplace, thereby increasing the

[35]One potential concern about this specification is that because each advertisement enters the regression in log, the four types of advertising variables do not sum up to the total advertising spending in log. We also estimate a similar model with the level of each advertising variable as a robustness check. The results are not qualitatively different from the results from the main model and are reported in Table 18.

[36]Based on the estimates in Column (1), federal advertising of type (i) is statistically greater than federal advertising of types (ii), (iii), and (iv) combined at a significance level below 10%. The standard error of the difference between the two coefficient estimates is 0.17 with a t-statistics of 1.32. However, we cannot reject the null hypothesis that the two coefficients are statistically the same.

[37]The standard error for the difference of the two coefficients is 0.15 with t-statistics of 1.66. The null hypothesis is that the estimate for private advertising is greater than the estimate for the federal advertising at a significance level below 5%. With the two-sided test, the null hypothesis that the two coefficient are the same is rejected at a significance level below 10%.

total enrollment.[38] Column (1) also shows that the coefficient estimate for non-type (i) private advertising is positive and statistically significant. Column (2) shows separate estimates for types (ii), (iii), and (iv), and we find that only private advertising of type (iv)–not providing any specific information on the marketplace–is statistically significant. These results hint at a possible reason why private advertising does not have positive spillover. If private advertising was very effective in providing general information about the marketplace such as OE or FA, it would have positive spillovers to rivals' enrollments and have greater impacts on market-level enrollments.[39,40]

4.3 Robustness Checks

4.3.1 Specifications of Advertising Variables

In our main specifications in Equations (2) and (3), we used a log-transformation of advertising variables ($\ln(1 + ad)$). Although this specification is common in many studies on TV advertising, one may wonder whether our results are robust to this specific functional form. Moreover, there are some DMAs with no federal or state advertising, and some insurers did not advertise at all in certain DMAs in certain years. Thus, the estimated effects of advertising could reflect changes in advertising spending only on the extensive margin (whether advertising is positive or zero), not on the intensive margin (the effect of dollar changes in advertising).

We estimate our models with alternative specifications. First, we estimate the model with the level of advertising instead of the log specification. Second, we specify a more flexible functional form by distinguishing the effects of advertising on the extensive and intensive margins. Results with the alternative specifications are reported in Tables 14 and 15 in the Online Appendix.

We find that advertising effects are robust to the alternative specifications. First, even with the level of advertising in the estimating equations, our main results remain qualitatively unchanged: the effects of federal advertising are positive and significant in both market- and insurer-level models, and private advertising is also positive and significant in the insurer-level demand model. Second, the estimates of intensive-margin effects of

[38] It is not very clear why information provided from private advertising is not as effective without further information. It could be due to a consumers' mistrust of information from private firms. In the context of the mortgage market, Johnson et al. (2018) find that many consumers did not act on information provided by banks on the federal refinancing program because of their suspicion of banks' motives.

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

[40] The null effect of advertising by private insurers that provide specific contents does not necessarily imply that private advertising is persuasive. It is still possible that private advertising that does not provide specific ACA-related information conveys information about quality of plans offered by private advertising sponsors. Such information could still be valuable to consumers in selecting a better plan within the marketplace. See Section 5.2 for more discussions on this point.

advertising are consistent with our baseline results without the extensive-margin effects. Most of the estimates for extensive-margin effects are not statistically significant, except for federal advertising in the market-level analysis.

4.3.2 Effects of Advertising in New vs. Mature Markets

One possibility is that the true effects of advertising may vary with the length of time the marketplace has been active, and our estimated effects are just the average effects. On the one hand, because many advertisements in our sample provide information about the marketplace to some degree, this information provision may have a larger market expansion effect in the early years of the marketplace. On the other hand, advertisements providing information about the open enrollment period could be effective even in the later years of the marketplace. Moreover, if there is a steady influx of new customers to the marketplace each year, then advertising may still be effective even when the marketplace is mature.

Table 16 presents results, which show that the effectiveness of advertising does not decrease over time. With Columns (1) and (2), we compare the estimates obtained with the subsample that includes data up to 2016 and the full sample (up to 2018). Given the standard errors of the estimates for federal and private advertising, we cannot statistically distinguish the estimates in Columns (1) and (2). Additionally, Column (3) presents the estimates for the specification where the advertising variables are interacted with a linear time trend. The estimates for the interaction terms suggest that the effectiveness of advertising had been stable at least for the first five years.

4.4 Heterogeneous Effects and Interaction between Government and Private Advertising

The results above show that advertising by the federal government and private insurers is effective, on average, in increasing market- or insurer-level enrollments. Here, we investigate whether advertising is more effective for certain markets and for certain consumers, and whether private advertising is more effective depending on government advertising.

4.4.1 Heterogeneous Effects

So far, we estimate the average effect of advertising on consumer demand. An obvious question is whether it masks an important heterogeneous effects. We examine whether the effect of advertising depends on certain market characteristics (e.g., the market structure or other health care policies) or on consumers with different characteristics. We also examine more closely the null effect of state advertising.

The detail of specifications and results are reported in Online Appendix B. We briefly summarize main findings. First, we find little effects of interaction between the market structure and advertising on consumer demand, but we find some interaction effects between each state's Medicaid expansion status and advertising. Second, we find that advertising in the marketplaces has little heterogeneous effects across consumer with different health status, based on several proxy variables (age, income, and market-level health variables). This result suggests that advertising in marketplaces has limited effects on the risk pool or the degree of adverse or advantageous selection. Third, we find that there are meaningful heterogeneity in the effects of advertising by different state governments . In particular, state advertising in California (CA) has a large positive effect on enrollment. Although it is beyond the scope of this paper to examine why state advertising in CA is very effective, we conjecture that it could be due to a large amount of marketing resources available for the CA marketplace (Lee et al. (2017)).

4.4.2 Interaction between Government and Private Advertising

The previous specifications assume that there is no complementarity between federal and private advertising in terms of their effects on demand. We conducted an additional analysis by adding interaction terms between federal and private advertising in the demand model. In Table 23 in the Online Appendix, we show that the estimate for the interaction term is statistically insignificant and close to zero. This finding suggests that the effect of private advertising does not vary depending on federal advertising spending in the same market. The lack of complementarity also implies that federal and private advertising are substitutes from a private insurer's perspective, which has implications about how private insurers would respond to changes in federal advertising–a topic in the next section.

5 Equilibrium Model and Counterfactual Experiments

Our finding of the business-stealing effect of private advertising indicates that there may be excessive advertising spending in equilibrium via rent-seeking competition among insurers. Moreover, private advertising has a limited market-expansion effect, which indicates that the government cannot rely on private marketing activities to increase the total enrollment of the marketplace. A natural question is, what is a practical policy intervention that mitigates excessive private advertising and increases the total enrollment at the same time? Although the government could ban or tax private advertising by private insurers in the marketplace in theory, such policy interventions are likely difficult to be implemented in reality. An alternative, more realistic possibility is for the government

to increase its advertising. Given the lack of complementarity between government and private advertising, additional government advertising will reduce a private insurer's incentive for advertising. Thus, this policy approach can potentially mitigate excessive private advertising competition. In this section, we first set up the supply-side of the marketplace and characterize the equilibrium. Then, we estimate the supply side parameters and conduct counterfactual experiments.

5.1 Supply-Side Model of Advertising in Health Insurance Marketplaces

5.1.1 Equilibrium

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.[41] Then, an insurer's annual profit at DMA market is expressed as

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

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 each private insurer ($\boldsymbol{ad^p_{mt}}$), and $C(\cdot)$ is the cost of advertising by insurer j (ad^p_{jmt}). We use the demand model given by Equation (3).

We make several simplifying assumptions. First, private insurers only choose total advertising spending at each DMA market, abstracting from content choices.[42] Second, we abstract from potential heterogeneity in profits from consumers with different characteristics, given our finding of limited heterogeneous effects of advertising across different consumer types. Although it is certainly possible to relax both assumptions, the main economic mechanisms that we highlight in this analysis will remain the same even in such an extended environment.

[41] 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.

[42] Another important assumption is that each insurer is fully aware of the effectiveness of advertising on consumer demand. The existing literature points out lack of firms' knowledge on the effect of sophisticated targeted advertising (e.g., Blake et al. (2015)). To mitigate bias from potential model mis-specification, we focus on the average effect of advertising, about which insurers may have a more reasonable expectation. Moreover, we show in Section 5.1.2 that our estimate of an insurer's profitability is still reasonable, which alleviates concerns about mis-specification at least to some extent.

Each insurer chooses its own advertising to maximize the total profits Π_{jmt} in each DMA-year market, mt.[43] There are strategic interactions among insurers because demand for an insurer depends not only on its own advertising, but also on other insurers' advertising. We characterize the static Bertrand-Nash equilibrium, where the interior equilibrium advertising expenditure is the solution to the first-order condition:

$$\frac{\partial \Pi_{jmt}}{\partial ad^{p}_{jmt}} = 0. \tag{9}$$

In the counterfactual experiments that change government advertising, we use this equilibrium condition to find a new equilibrium. Now, we clarify mechanisms how the government advertising affects market equilibrium. Directly, government advertising increases consumer demand. Indirectly, government advertising also affects a private insurer's incentive for advertising. Because government advertising affects demand for private insurers, they will optimally adjust advertising, taking into account other insurers' incentives for advertising as described in Equation (8). This strategic interaction among private insurers will further affect demand. The eventual equilibrium enrollment is then determined by these direct and indirect effects.

5.1.2 Estimation

We 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^{p}_{jmt} evaluated at the observed level. We can calculate the derivative based on the demand model and the estimated coefficients given by Column (4) in Table 5. One important caveat is that this equilibrium condition does not necessarily hold, especially for insurers with zero equilibrium advertising. To keep our analysis simple, our counterfactual analysis considers re-optimization only by insurers with positive baseline advertising expenditures.[44] The detail of estimation procedure is described in Appendix C.

We find that the median estimated π_{jmt} among insurers with positive advertising is

[43] This approach is limited because insurers may decide how much to advertise to maximize their long-run profits. Fully characterizing the dynamic problem is a very challenging task and requires additional assumptions (e.g., time preference of insurers). Instead, we use this static equilibrium to illustrate the main mechanism that is likely to exist even in fully specified models as well. Moreover, the existing studies (e.g., Tebaldi (2017) and Polyakova and Ryan (2019)) also use the static equilibrium and capture an insurer's behavior reasonably well. Thus, we view our framework as a useful first step.

[44] This assumption is reasonable for the counterfactual experiment that increases government advertising which crowds out private advertising. We may underestimate private advertising responses for the counterfactual experiment which decreases government advertising. However, the main economic channels remain the same and allowing all insurers to re-optimize their advertising may rather strengthen our finding by increasing the response of excessive private advertising.

about $756. We view this magnitude as reasonable. The average annual benchmark premium in the marketplace in 2017 is about $4,320 according to the Kaiser Family Foundation.[45] If insurers expect to have about a 15% profit margin, especially given an 80% medical loss ratio requirement under the ACA, our estimated perceived profitability of $756 is reasonable.

5.2 Implication of Changing Government Advertising

We use the estimated equilibrium model to examine the importance of government advertising by exogenously changing its level. Based on demand estimates that state advertising is small on average, we only consider changing federal advertising. 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 in which 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 6: Counterfactual Experiments: Changes in Federal Government Advertising Spending

		Benchmark	Fed Ad×0		Fed Ad×3	
			Partial eq.	Full eq.	Partial eq.	Full eq.
All Markets	Enrollment (%)	18.98	18.64	18.65	19.55	19.54
	Private Advertising ($)	1.43	1.43	1.51	1.43	1.35
Market with Large Federal	Enrollment (%)	17.87	16.66	16.72	19.22	19.17
Ad Spending (top 10%)	Private Advertising ($)	1.65	1.65	2.22	1.65	1.38

Note: This table presents simulated outcomes in counterfactual scenarios. Column "Benchmark" presents outcomes observed in the data. Column "Fed Ad×0" presents outcomes in a scenario where federal advertising is shut down to zero. Column "Fed Ad×3" presents outcomes in a scenario where federal advertising is tripled. "Partial eq." present outcomes, assuming private insurers do not adjust their advertising. "Full eq." present outcomes, allowing for private insurers to re-optimize their advertising. We report outcomes for all markets and only for markets with large federal advertising spending. The latter is defined as markets with top 10% of federal advertising spending in the benchmark. The reported numbers are averages of DMA×Year-level enrollments and total private advertising spending per capita. In the benchmark economy, the average federal advertising is $0.32 per capita for all markets and $1.26 per capita for markets with large federal spending.

Table 6 shows the main results. First, we find that reducing federal government spending to zero modestly reduces the market-level enrollment. Although the overall effect is small (18.98% to 18.64%), market-level effects depend on the baseline government spending. For markets with larger baseline government spending (top 10% or above $0.68 per

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

capita), we find that the decline in enrollment is about 1.12 percentage points.[46] Importantly, equilibrium responses of private insurers have little effect 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, a dollar decrease in federal advertising spending per capita increases private advertising by \$0.25.[47] In markets with large baseline federal spending, we find that private advertising increases by \$0.45 per capita, which is equivalent to a \$0.36 increase for a dollar decrease in federal advertising.[48] This limited market-expansion effect of private advertising suggests that private advertising is driven by rent-seeking competition among insurers, which can lead to waste of resources. Moreover, government and private advertising are substitutes in the sense that a reduction in government advertising increases private advertising, which is partly driven by the lack of complementarity between federal and private advertising in terms of their effects on demand (see Section 4.4.2). However, the substitution between federal and private advertising has very different implications on marketplace enrollment.[49]

Table 6 also reports results from another counterfactual experiment, where government advertising is increased by three times. We find that market enrollment increases about 7.6% from the baseline economy (or 1.30 percentage points increase) in markets with large baseline federal advertisement spending. Consistent with results from the scenario where we shut down government advertising, this additional government advertising lowers private advertising: a dollar increase in federal advertising decreases private advertising of \$0.13. However, a comparison between "Partial eq." and "Full eq." shows that the overall market-level enrollment will remain almost the same despite the decrease

[46]The average baseline government spending is \$0.32 per capita for all markets and \$1.26 per capita for markets with large federal advertising spending.

[47]This number is obtained by dividing the change in private advertising (0.08) by the baseline federal advertisement spending (0.32).

[48]This result may also be affected by the specification of the demand model, where we do not include the interaction between private and government advertising as a determinant of consumer demand. As discussed in Section 4.4.2, however, we do not find a statistically significant estimate for the interaction term between the two advertising variables.

[49]One might think that we could further 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 (DID) regression. We explored the possibility but found that the common trend assumption in DID is unlikely to be met. Comparing neighboring DMAs with larger and smaller pre-2018 federal advertisement spending, we found that pre-2018 private advertisement spending did not change similarly over years between the two types of DMAs, possibly because the marketplace was still evolving differently across markets in its first few years. When we estimated the DID regression despite the likely violation of its identifying assumption, we found that the point estimates of the impact of the 2018 cut in federal advertising on private advertising tend to be positive–consistent with our counterfactual results–but are statistically insignificant due to large standard errors. Given the difficulty of applying the DID research design, we do not rely on the DID estimates to validate the counterfactual results.

in private advertising.

Then a natural question is whether all of private advertising is a waste of resources. The lack of the market-expansion effect on the extensive margin does not necessarily imply that private advertising is inefficient. For example, private advertising could still induce consumers to switch to better insurers on the intensive margin and thus improve consumer welfare if insurers that spend more on advertising tend to provide better plans. Although the literature documents that the welfare gain from switching to better plans is much smaller than the welfare gain from increasing program enrollment, crowding out of private advertising by federal advertising could lead to some welfare loss.[50] The magnitude of this potential welfare loss due to the crowding out will depend on how much private advertising induces consumers to switch to a different insurer within the marketplace in equilibrium after accounting for rival insurers' advertising responses. For example, in the extreme case that advertising competition is pure rent seeking, private advertising would result in no changes in equilibrium allocation across insurers. Then, crowding out of private advertising will enhance the efficiency without leading to any welfare loss.

To examine this issue more closely, we compare an insurer's demand elasticity with respect to advertising with and without taking into account equilibrium responses by its rivals. Specifically, Table 24 in the Online Appendix reports baseline elasticities in partial equilibrium and compares this baseline to equilibrium elasticities that allow for endogenous insurer responses in our two sets of counterfactuals. We find that the equilibrium elasticities are lower than the baseline elasticities for markets with at least two insurers with positive baseline spending. This effect is much more significant in markets with more insurers with positive baseline spending.[51] Thus, once accounting for equilibrium responses by rivals, changes in private advertising lead to much smaller changes in the share of enrollment across insurers, suggesting the presence of excessive advertising spendings. At least in markets where insurers compete through advertising, federal advertising likely crowds out excessive private advertising without reducing the consumer's switching to better plans.

Although it is beyond the scope of our paper to conduct a full welfare analysis, it is

[50] The small welfare effect of inducing consumers to switch to better plans is due in part to the fact that the marketplace regulates the minimum quality of health insurance plans, which is set as 60% of actuarially fair value. Consistent with this view, Finkelstein et al. (2019) estimate that a consumer's willingness to pay for switching to a more generous plan is just 11% to 30% of willingness to pay from switching from being uninsured to being insured with a less generous plan in the Massachusetts marketplace.

[51] Note that this finding does not contradict the demand model estimate in Section 4.4.1 that there is little interaction between the market structure and advertising on consumer demand. Here, we show how the equilibrium elasticity differs by market structure while, in our demand estimates, we show how the effect of advertising on demand depends on the market structure, holding rivals' advertising fixed.

still valuable to discuss welfare implications of government advertising in this context.[52] In order to estimate the effect of government advertising on social welfare, we will need additional elements in our demand model to identify (i) the social surplus of increasing the program enrollment, (ii) the magnitude of choice frictions, and (iii) the social value and cost of advertising. Our finding does not speak to (i), and the existing studies have found it difficult to accurately estimate the social surplus of increasing the marketplace enrollment.[53] However, our findings can still speak to (ii) and (iii). First, we find that federal advertising likely reduces consumer choice frictions by providing information about the open enrollment period and financial assistance. Second, we also find that government advertising can mitigate excessive advertising costs incurred by private firms. Therefore, if the social surplus of increasing the program enrollment is at least positive, then our findings suggest that government advertising can be an effective market-design tool through which to enhance social welfare.

5.3 Welfare Implication of Targeting of Federal Advertising

Finally, we use our model to investigate the extent to which the objectives of the federal government and private insurers differ. We do not consider advertising by state governments because we did not find it very effective in increasing enrollments on average. We first specify the government objective function as follows:

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

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 that we have W_{mt} here instead of π_{jmt}. We assume that the parameter W_{mt} captures a weighted average of consumer and producer surplus, government expenditures on subsidies, and redistributional preferences (or preferences based on political economy) 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 shed further light on how government targeting differs from private targeting.

We find that the median estimate of W_{mt} is about \$65. Although the magnitude is

[52] Grossman and Shapiro (1984) offer a theoretical analysis that shows that the welfare impacts of advertising in an economy with differentiated products are highly non-trivial.

[53] See Finkelstein et al. (2019), Tebaldi (2017), and Polyakova and Ryan (2019) for welfare analysis of the marketplaces. For example, Finkelstein et al. (2019) points out that the willingness to pay for health insurance is strictly smaller than the claim cost for most consumers due to uncompensated care. Thus, calculating the social value of health insurance requires determining how much being insured reduces government spending via uncompensated care.

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 (about 0.10) is not very large. This number indicates that there is a large degree of disagreement between the federal government and private insurers in their objective functions. Thus, it is likely difficult for private markets alone to generate variation in advertising across markets that the government may want to achieve.

6 Conclusion

This paper studies government advertising in publicly designed private markets in the context of health insurance marketplaces. We first show suggestive evidence that advertisements by the government (both federal and states) and private insurers are targeted to different geographical areas and provide different messaging contents. Then, we estimate the impact of government and private advertising on marketplace enrollment. Our empirical design exploits discontinuities in advertising along the borders of local TV advertising markets to address the endogeneity of advertising. We find that government advertising has a market-expansion effect, while private advertising tends to steal consumers from other insurers. These findings suggest that government advertising may play an important role by reducing possible information frictions that consumers face to sign up for health insurance plans. Finally, we estimate an equilibrium model of the health insurance marketplace to examine the impact of changing government advertising spending. We find that government advertising increases total program enrollment and reduces inefficient rent-seeking advertising competition among private insurers, suggesting a welfare benefit of government advertising as a market design tool.

We view this study as a first step towards understanding government marketing and outreach activities for publicly designed private markets. Future work should explore the role of government advertising in other markets, such as those for education and mortgages. Another interesting avenue to explore is the effectiveness and efficiency of other marketing and outreach activities beyond TV advertising.

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Online Appendix (Not For Publication)

A Discussion on the Border Strategy

Differences between Pairs of Border Counties Table 7 compares market characteristics between border counties with low and high government and private advertising spending, where government advertising is defined as the sum of federal and state advertising. For the first two columns, we collect border counties with lower government advertising spending within each border pair in Column (1) and border counties with higher government advertising spending within each border pair in Column (2). We excluded border pairs with zero government advertising in both sides of borders from the sample used to produce 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 among potential enrollees are also very similar between the two groups of border counties. Lastly, health statuses measured 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 3.3 is likely to be driven by non-border counties, which do not share advertising market borders.

Differences between Border and Non-Border Counties An important caveat about the border strategy is that estimated effects of advertising are local to border counties. Thus, it might be difficult to extrapolate the estimated 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 8 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 small. For example, the differences in the number of insurers and HHIs do not exceed 10% of their unconditional averages. The distributions of ages and income groups are also similar between border and non-border counties. Lastly, the differences in county-level health statuses also do not exceed 10% of their unconditional averages. This suggests that although estimates from the border strategy will not be exactly the same as

Table 7: Comparing Either Side of Border Pairs

	Federal Ad		State Ad		Priv Ad	
	(1)	(2)	(3)	(4)	(5)	(6)
	Low	High	Low	High	Low	High
Fed Spend	0.227	0.582	0.266	0.177	0.243	0.275
	(0.202)	(0.497)	(0.374)	(0.180)	(0.329)	(0.377)
State Spend	0.161	0.100	0.515	1.462	0.205	0.269
	(0.489)	(0.448)	(0.845)	(1.246)	(0.652)	(0.776)
Priv Spend	0.879	0.955	1.014	1.306	0.567	1.624
	(1.404)	(1.375)	(1.439)	(1.582)	(0.890)	(1.948)
No. of Insurers	2.552	2.553	2.863	2.903	2.494	2.521
	(1.458)	(1.488)	(1.379)	(1.413)	(1.422)	(1.439)
HHI among Insuers	0.697	0.707	0.661	0.654	0.708	0.705
	(0.242)	(0.244)	(0.236)	(0.231)	(0.242)	(0.242)
Log of Market Size	1.542	1.565	1.496	1.518	1.491	1.539
	(1.197)	(1.217)	(1.281)	(1.307)	(1.210)	(1.244)
Share: Income $\leq$ 138% of FPL	0.245	0.243	0.208	0.210	0.244	0.243
	(0.088)	(0.085)	(0.079)	(0.080)	(0.088)	(0.089)
Share: Age $\geq$ 55	0.194	0.194	0.210	0.215	0.196	0.197
	(0.053)	(0.052)	(0.057)	(0.054)	(0.053)	(0.053)
Share: Poor or Fair Health	0.179	0.179	0.164	0.162	0.181	0.181
	(0.052)	(0.051)	(0.046)	(0.046)	(0.051)	(0.051)
Share: Obesity	0.319	0.320	0.300	0.297	0.319	0.319
	(0.041)	(0.040)	(0.041)	(0.044)	(0.042)	(0.043)
Share: Diabetes	0.118	0.118	0.106	0.106	0.118	0.118
	(0.023)	(0.023)	(0.020)	(0.021)	(0.024)	(0.024)
Healthcare Cost (in $1000s)	9.691	9.690	8.886	8.853	9.661	9.627
	(1.476)	(1.350)	(1.267)	(1.281)	(1.480)	(1.442)
N. Obs.	4,758	4,758	2,181	2,181	8,496	8,496

Note: This table compares market characteristics between border counties with low and high federal, state and private advertising spending. For the first two columns, we collect border counties with lower federal advertising spending within each of border pairs in Column (1) and border counties with higher federal 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 sample used to produce the table. For Columns (3) and (4), we group border counties similarly based on state advertising spending. For Columns (5) and (6), we group border counties similarly based on market-level private advertising spending. Standard errors are in parentheses.

Table 8: 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)
Share: Income $\leq$ 138% of FPL	0.229	0.240	0.236
	(0.082)	(0.087)	(0.085)
Share: Age $\geq$ 55	0.187	0.197	0.193
	(0.051)	(0.054)	(0.053)
Share: Poor or Fair Health	0.166	0.180	0.175
	(0.048)	(0.051)	(0.050)
Share: Obesity	0.309	0.318	0.315
	(0.042)	(0.042)	(0.042)
Share: Diabetes	0.109	0.117	0.114
	(0.022)	(0.024)	(0.024)
Healthcare Cost (in $1000s)	9.550	9.637	9.604
	(1.527)	(1.483)	(1.501)
N. Obs.	5,165	8,334	13,499

Note: This table presents market-level characteristics between border and non-border counties. Column (1) and (2) present characteristics of border and non-border counties, respectively. Column (3) present characteristics of all counties. Standard errors are in parentheses.

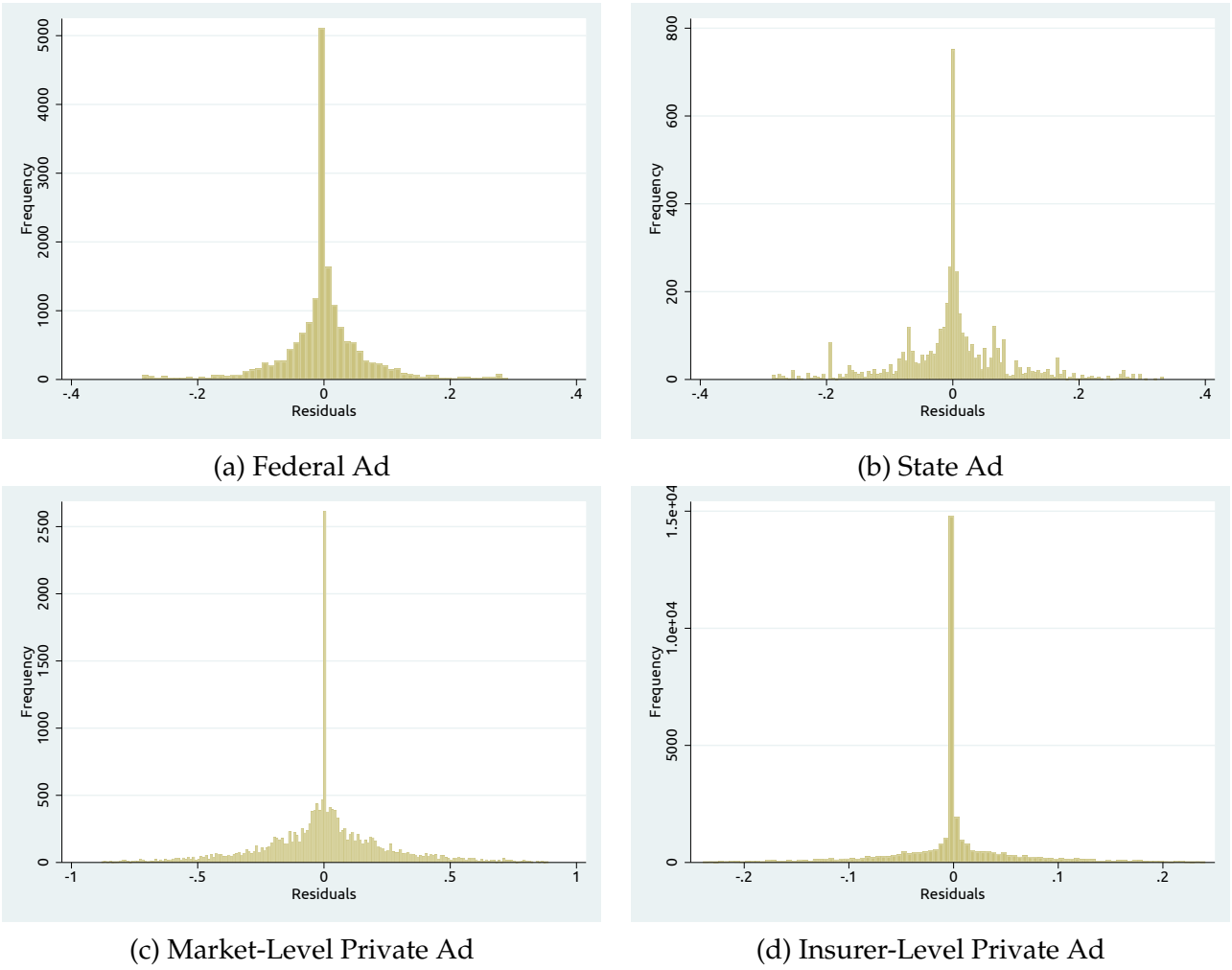
ones based on the entire data sample, the estimates are unlikely to be very different from ones based on the entire sample.

Variation in Advertising in Border Analysis One concern about the border strategy is that the extensive set of fixed effects employed by the strategy could leave very little variation in advertising spending. Thus, it is important to check whether remaining variation in advertising is sufficiently large.

We report the county-level residual variation in federal advertising, state advertising, and county-level private advertising. We also report insurer-level residual variation in insurer-level private advertising. The county-level residual variation is obtained by regressing each of the three advertising variables on the fixed effects for border pair-by-year (ξ_{bt}), county (ξ_c), and rating area-by-year ($\xi_{r(c)t}$), which appear in Equation (2). The insurer-level residual variation in private advertising is obtained by regressing insurer-level private advertising spending on the fixed effects for insurer-by-border pair-by-year (ξ_{jbt}), insurer-by-county ($\xi_{jr(c)t}$), and insurer-by-rating area-by-year (ξ_{jc}), which appear in Equation (6).

Figure 3 reports the distribution of these residuals, and Column (1) of Table 9 reports the ratio of the standard deviation of residual advertising spending to the unconditional mean of advertising spending. For each advertising sponsor type, there is a reasonable amount of variation in residual advertising spending. We find that the ratios range from 0.3 to 0.5, which are still sizable compared with the ratio of the standard deviation of

Figure 3: Residual Variation in Advertising Variables



(a) Federal Ad

(b) State Ad

(c) Market-Level Private Ad

(d) Insurer-Level Private Ad

Note: This figure plots the distribution of residual variation in advertising spending by the federal and state governments (Panels (a) and (b)) and private insurers at the market level and at the insurer-level (Panels (c) and (d)). For Panel (b), we excluded counties in states that delegated to the federal government the responsibility for marketing the marketplace because such counties do not have any variation on state advertising due to the institutional feature. Data source: Kantar Media.

the raw advertising spending to its unconditional mean in Column (2). In the figure for insurer-level private advertising, a mass of insurers with zero advertising spending during the entire sample period results in a large spike at zero. However, the ratio for the insurer-level private spending is still larger than ratios for most other advertising types, which suggests that there is still a reasonable amount of variation in its residual advertising spending.

Table 9: Residual Variation in Advertising Variables

	(1) Residual Variation	(2) Raw Variation
Federal	0.43	1.06
State	0.51	2.67
Market-level Private	0.32	1.58
Insurer-level Private	0.44	1.99

Note: This table presents the variation in advertising spending by each sponsor. Column (1) reports the ratio of standard deviation of residual adverting spending over the mean of unconditional advertising spending for each advertising sponsor. The column (2) reports the ratio of the standard deviation of unconditional advertising spending over the mean of unconditional advertising spending for each advertising.

B Detailed Discussion on Heterogeneous Effects

B.1 Heterogeneous Effects across Markets

First, we examine the possibility that the effects of private advertising varies with the market structure. How private advertising affects demand–whether it steals consumers from rivals or has positive spillover to rivals–may depend on the number of competing insurers. To examine this point, we allow for the effectiveness of advertising to depend on whether the number of insurers in a market is large enough (greater than or equal to five).[54]

The estimate is reported in Column (1) in Table 19. We find that the coefficient for rivals' advertising in markets with five or more insurers is positive but small and statistically insignificant. Moreover, the total effect of rivals' advertising is still slightly negative in the markets with a relatively large number of insurers. This finding strengthens the point that private insurers play a limited role in providing information that expands the total marketplace enrollment.

Next, we examine whether the effectiveness of advertising may depend on the choice of other policies. We specifically focus on whether the effect of advertising depends on a state's Medicaid expansion status, which also drives targeting of advertising to some extent. We report in Column (2) in Table 19 in the Online Appendix that the coefficient of the interaction term between federal advertising and the Medicaid expansion status is large and statistically significant. It suggests possible complementarity between federal advertising and Medicaid expansion status.[55] We also find that the coefficient of the in-

[54]We also tried a specification with interactions between the advertising variables and the number of insurers, and the result is not different qualitatively. Note that we do not use the Herfindahl-Hirschman index as a measure of market concentration, which itself is endogenous to advertising.

[55]A caveat in interpreting these results is that there can be other factors that also affect the effectiveness of advertising between states with and without Medicaid expansion.

teraction term between private advertising and the Medicaid expansion status is positive, but it is small and not significant. These results imply that advertising spending may not be necessarily larger in markets where advertising is more effective. This finding does not mean that advertising sponsors behave in a suboptimal way. Rather, they may target advertising based on per-enrollee profitability or social welfare weight, which may vary across markets.

B.2 Selection Effects of Advertising

In our main specification, we do not allow effects of advertising to vary with consumer demographics. We find that advertisements are more targeted to markets with higher shares of certain demographic groups in Section 3.3. Thus, it is natural to expect that advertising could be more effective for certain consumer types. These heterogeneous effects are important in health insurance markets because they may potentially affect the degree of adverse or advantageous selection.[56]

Unfortunately, our data do not provide information on enrollee-level health status. However, we can still examine whether the effect of advertising depends on a county-level health measure and whether the effect is different for consumers in different age and income groups. The demographic variables typically are highly correlated with health status.

Column (3) in Table 19 presents the estimates for the specification that allows for interactions between advertising variables and whether a market is "unhealthy." As in Section 3.3, we use a county's share of individuals self-reporting poor or fair health as a measure of county-level health status. We define an "unhealthy" market as a market in the top quartile of self-reported poor or fair health, which includes all markets with greater than 21% of individuals reporting fair or poor health. We find that none of the coefficients of the interaction terms are not significant, although the estimates are slightly noisy.

Then we estimate Equation (7) by allowing heterogeneous effects by age and incomes using demographic group-level market share data. We consider two age groups and two income groups: whether the age is at least 55 and whether the income is less than or equal to 138% of the FPL. To capture demand heterogeneity across different demographic groups, all of the usual fixed effects are now interacted with each demographic group. Because we do not have a breakdown of market shares by age or income groups for CA or NY, we exclude the two states from the sample for this analysis.[57]

[56] For example, Handel (2013) and Handel et al. (2019) argue that policies that affect consumer choice frictions have important equilibrium effects by changing the degree of adverse or advantageous selection if consumer choice frictions and their health types are correlated.

[57] Excluding the two states does not appear to change our results very much. We also estimated a model with interactions between the advertising variables and county-level demographic characteristics with the

The main results are reported in Table 20. We find that the coefficients for the interaction terms with demographic groups are relatively small and statistically insignificant, which is indicative of limited heterogeneity across demographic groups.[58]

B.3 State Advertising

We also examine whether the effect of state advertising is heterogeneous across states. As discussed earlier, it is reasonable to expect such heterogeneity because each state government organizes its own marketing activities for marketplaces, for which the federal government is not responsible for marketing. We focus on CA, which has spent a large amount of resources on marketing campaigns for its own marketplace (Lee et al. (2017)). Table 22 presents estimates of the model in which the effect of state advertising is allowed to be different for CA. In market-level regressions, the point estimate for the coefficient for CA advertising is positive and large, but it is imprecisely estimated, probably because we do not have enough statistical power due to the limited number of markets in CA in the border sample. In insurer-level regressions, the coefficient of state advertising in CA is very large and significant.

This result suggests that the small average effect of state advertising does not apply for the entire states. Although our goal in this paper is not to understand mechanisms why CA advertising is more effective than other state advertising, we conjecture that this result is potentially due to a large amount of marketing resources available for the CA marketplace.

C Supply-Side Specification and Estimation

In our empirical analysis, we assume that the cost of advertising for each insurer is observed 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 profitability π_{jmt} by imposing an insurer's first order condition. From consumer-side demand estimates, we can analytically calculate the marginal enrollment at the observed advertising

sample that includes CA and NY. As reported in Table 21, the results are not qualitatively different from the results with demographic group-level market shares.

[58] One natural question is whether this limited heterogeneity is due to a statistical power from our data. To properly address this question, one must acquire individual-level data, which is currently very challenging for federal marketplaces. However, it is also important that the lack of this heterogeneity is certainly plausible. For example, Aizawa and Kim (2018) find in Medicare Advantage that consumers with certain characteristics are more responsive to advertising, but many demographic characteristics, including income, are not associated with effectiveness of advertising. Thus, one must obtain richer measurements for enrollment to further pursue this issue.

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. One approach is to specify the functional form of $\triangle_{jmt}$ (e.g., Goeree (2008)); an alternative is to use the moment inequality approach to identify bounds of the parameters. Although both approaches could be implemented, we chose to let only insurers with positive baseline advertising spending re-optimize in the counterfactual to keep our analysis simple.

D Content of Advertising

We use Amazon Web Services (AWS) to transcribe the video of each advertisement. AWS automatically translate transcripts of advertisements in Spanish into English. We then view a sample of advertisements and generate a list of keywords that characterize the contents of the advertisement. Each advertisement in the sample is then classified based on these keywords and a set of dummy variables indicating the presence of each type of content is generated. Although this approach is necessarily ad hoc, we find that it performs well in ex post manual verification. The list of content types and keywords are shown below:

- Reform: This dummy variable is equal to one if an advertisement contains at least one of the following terms: "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", or "changes in our health care".

- Open Enrollment:. This dummy variable is equal to one if an advertisement contains at least one of the following terms: "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 is equal to one if an advertisement contains at least one of the following terms: "uninsured", "still need health insurance", or "existing condition".

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

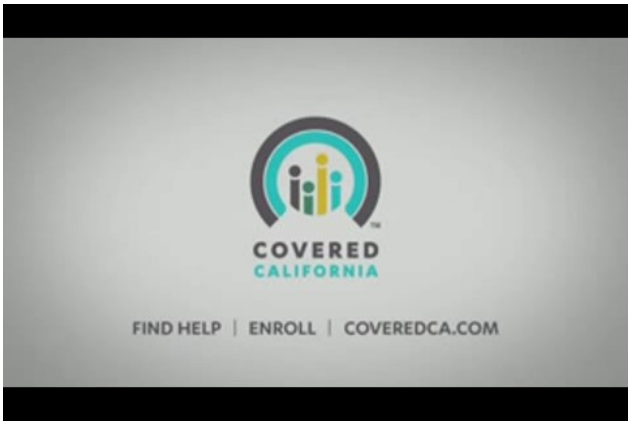
- Financial: This dummy variable is equal to one if an advertisement contains at least one of the following terms: "financial assistance", "financial help", "income information", "estimated income", "tax credit", "financial aid", "subsidy", "subsidies", "federal assistance", "government aid", "government 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", or "aid for your health insurance".
- ACA: this dummy variable is equal to one if at least one of dummy variables created above is equal to one.

E Additional Figures and Tables

Figure 4: Screenshots of Advertisements by Federal and State Governments



(a) Federal Government



(b) California State Government

Table 10: Cross Tabulation Ad Content Types

	(1) Open Enrollment=1	(2) Financial Assitance=1	(3) Healthcare Reform=1	(4) Uninsured=1	(5) Penalty=1
Share: Open Enrollment	1.00	0.51	0.36	0.11	0.82
Share: Financial Assistance	0.65	1.00	0.39	0.74	0.83
Share: Healthcare Reform	0.18	0.16	1.00	0.29	0.24
Share: Uninsured	0.03	0.14	0.13	1.00	0.09
Share: Penalty	0.20	0.16	0.11	0.10	1.00
N. Obs.	485,656	612,937	283,022	101,405	149,782

Note: This table reports cross tablutation of content types of advertisements by all sponsors during 2014–2018. Each column reports the share of different content types within advertisements that provide a specific content type. The unit of observation is each advertisement occurence, and reported numbers are averages weighted by each advertisement's dollar cost.

Table 11: Targeting of Federal Advertising

	(1) ACA-related	(2) Financial	(3) Open Enrollment	(4) Penalty	(5) Reform
Share: Income $\leq$ 138% of FPL (%)	-0.001	-0.000	-0.000	0.000	-0.000
	(0.002)	(0.001)	(0.001)	(0.000)	(0.001)
Medicaid Expanded=1	-0.098*	-0.043	-0.027	-0.001	-0.027
	(0.058)	(0.032)	(0.025)	(0.001)	(0.020)
Medicaid Expanded=1 $\times$ Share: Income $\leq$ 138% of FPL (%)	0.003	0.001	0.001	0.000	0.001
	(0.002)	(0.001)	(0.001)	(0.000)	(0.001)
Share: Age $\geq$ 55 (%)	0.001	-0.000	-0.000	0.000	0.001
	(0.002)	(0.001)	(0.001)	(0.000)	(0.001)
Share: Poor or Fair Health (%)	0.002	0.002*	0.002*	0.000	-0.001
	(0.002)	(0.001)	(0.001)	(0.000)	(0.001)
No. of Insurers	0.017***	0.008**	0.001	-0.000	0.006**
	(0.006)	(0.003)	(0.002)	(0.000)	(0.002)
Log of Market Size	0.029***	0.007**	0.004	0.000	0.009**
	(0.008)	(0.003)	(0.002)	(0.000)	(0.003)
Year FE	Y	Y	Y	Y	Y
N. Obs.	784	784	784	784	784
Adj. R^2	0.148	0.466	0.542	0.017	0.366

Note: This table reports estimates of the coefficients in Equation (1). Each column presents estimates from the same specification with the dependent variable of federal spending on advertisements providing a specific message. Because there is no federal advertising spending in 2018, we restricted our sample years to 2014–2017. Standard errors are in parentheses and clustered at the DMA level. The stars indicate: *** for p<0.01, ** for p<0.05 and * for p<0.1.

Table 12: Targeting of State Advertising

	(1) ACA-related	(2) Financial	(3) Open Enrollment	(4) Penalty	(5) Reform
Share: Income $\leq$ 138% of FPL (%)	-0.032***	-0.017***	-0.012***	-0.000	-0.002**
	(0.008)	(0.005)	(0.003)	(0.001)	(0.001)
Share: Age $\geq$ 55 (%)	-0.019	-0.014*	-0.008	0.002	0.001
	(0.014)	(0.007)	(0.005)	(0.001)	(0.000)
Share: Poor or Fair Health (%)	0.010	0.008	0.005	0.001	0.001**
	(0.011)	(0.007)	(0.004)	(0.001)	(0.001)
No. of Insurers	0.116***	0.072***	0.044***	-0.001	-0.001
	(0.025)	(0.017)	(0.015)	(0.003)	(0.002)
Log of Market Size	-0.010	-0.008	0.017	0.010**	0.003
	(0.053)	(0.032)	(0.020)	(0.005)	(0.003)
Year FE	Y	Y	Y	Y	Y
N. Obs.	332	332	332	332	332
Adj. R^2	0.238	0.185	0.184	0.036	0.162

Note: This table reports estimates of the coefficients in Equation (1). Each column presents estimates from the same specification with the dependent variable of state spending on advertisements providing a specific message. State's Medicaid expansion status is not included in covariates because state advertising are done in states expanding Medicaid at DMA level. Standard errors are in parentheses and clustered at the DMA level. The stars indicate: *** for p<0.01, ** for p<0.05 and * for p<0.1.

Table 13: Targeting of Private Advertising

	(1) All	(2) ACA-related	(3) Financial	(4) Open Enrollment	(5) Penalty	(6) Reform
Share: Income $\leq$ 138% of FPL (%)	0.016**	0.008**	0.005**	0.004	0.007***	0.005**
	(0.008)	(0.003)	(0.003)	(0.003)	(0.002)	(0.002)
Medicaid Expanded=1	0.545**	0.195*	0.075	0.104	0.159***	0.087
	(0.224)	(0.099)	(0.075)	(0.077)	(0.051)	(0.061)
Medicaid Expanded=1 $\times$ Share: Income $\leq$ 138% of FPL (%)	-0.018**	-0.005	-0.003	-0.002	-0.006***	-0.003
	(0.009)	(0.005)	(0.003)	(0.004)	(0.002)	(0.003)
Share: Age $\geq$ 55 (%)	0.017**	0.003	0.006**	0.003	0.004**	0.004**
	(0.008)	(0.004)	(0.002)	(0.003)	(0.002)	(0.002)
Share: Poor or Fair Health (%)	-0.008	-0.002	0.002	0.000	-0.003	0.000
	(0.008)	(0.005)	(0.003)	(0.004)	(0.002)	(0.003)
No. of Insurers	0.059***	0.019***	0.012*	0.012**	0.001	0.006
	(0.015)	(0.007)	(0.006)	(0.006)	(0.004)	(0.005)
Log of Market Size	0.147***	0.074***	0.052***	0.054***	0.021***	0.028***
	(0.025)	(0.013)	(0.009)	(0.010)	(0.006)	(0.006)
Year FE	Y	Y	Y	Y	Y	Y
N. Obs.	983	983	983	983	983	983
Adj. R^2	0.212	0.210	0.178	0.165	0.131	0.288

Note: This table reports estimates of the coefficients in Equation (1). Each column presents estimates from the same specification with the dependent variable of private spending on advertisements providing a specific message. Standard errors are in parentheses and clustered at the DMA level. The stars indicate: *** for p<0.01, ** for p<0.05 and * for p<0.1.

Table 14: Robustness : Market-Level Demand Analysis

	Log		Level	
	(1)	(2)	(3)	(4)
Fed Spend	0.050**	0.049**	0.031**	0.030**
	(0.022)	(0.021)	(0.013)	(0.013)
State Spend	-0.011	0.005	0.001	0.007
	(0.030)	(0.038)	(0.015)	(0.016)
Priv Spend	0.023	0.028	0.010	0.010*
	(0.019)	(0.019)	(0.006)	(0.006)
1[Fed Spend>0]		0.233***		0.236***
		(0.086)		(0.086)
1[State Spend>0]		-0.022		-0.025
		(0.021)		(0.018)
1[Priv Spend>0]		-0.009		-0.004
		(0.016)		(0.015)
No. of Insurers	0.012	0.012	0.013	0.013
	(0.008)	(0.008)	(0.008)	(0.008)
Market Size	-0.026***	-0.026***	-0.026***	-0.026***
	(0.006)	(0.006)	(0.006)	(0.006)
BorderYear FE	Y	Y	Y	Y
County FE	Y	Y	Y	Y
RatingYear FE	Y	Y	Y	Y
N. Obs.	18,154	18,154	18,154	18,154
Adj. R^2	0.916	0.916	0.916	0.916

Note: Column (1) of this table reports the estimates reported in Column (3) in Table 4. Column (2) reports the estimates of the specification that includes the dummy variables that equal to one if sponsor k ($k = f, s, mp$) has positive advertising spending. Columns (3) and (4) of this table reports the estimates of the specifications in Column (1) and (2), but we replace advertising variables $ln(1 + ad)$ with the level ad. All specifications include Border$\times$Year fixed effects, County fixed effects, and Rating Area$\times$Year fixed effects. The unit of the market size (the number of potential enrollees) is in thousands. Standard errors are in parentheses and clustered at the DMA$\times$Year level. The stars indicate: *** for p<0.01, ** for p<0.05 and * for p<0.1.

Table 15: Robustness: Insurer-level Demand Analysis

	Log		Level	
	(1)	(2)	(3)	(4)
Fed Spend ($)	0.125**	0.123**	0.070**	0.069**
	(0.055)	(0.055)	(0.032)	(0.032)
State Spend ($)	-0.033	-0.013	-0.025	-0.020
	(0.068)	(0.079)	(0.030)	(0.031)
Priv Spend ($)	0.093**	0.101**	0.035**	0.035**
	(0.046)	(0.049)	(0.015)	(0.015)
1[Fed Spend>0]		0.322		0.323
		(0.213)		(0.212)
1[State Spend>0]		-0.032		-0.025
		(0.054)		(0.047)
1[Priv Spend>0]		-0.010		0.003
		(0.035)		(0.034)
No. of Insurers	-0.091***	-0.091***	-0.090***	-0.091***
	(0.026)	(0.026)	(0.026)	(0.026)
Market Size	-0.021***	-0.021***	-0.021***	-0.021***
	(0.005)	(0.005)	(0.005)	(0.005)
FirmBorderYear FE	Y	Y	Y	Y
FirmCounty FE	Y	Y	Y	Y
FirmRatingYear FE	Y	Y	Y	Y
N. Obs.	36,558	36,558	36,558	36,558
Adj. R^2	0.942	0.942	0.942	0.942

Note: Column (1) of this table reports the estimates reported in Column (4) in Table 5. Column (2) reports the the estimates of the coefficients of the specification thaincludes the dummy variables that equal to one if sponsor k ($k = f, s, p$) has positive advertising spending. Columns (3) and (4) of this table reports the estimates of the specifications in Column (1) and (2), but we replace advertising variables $ln(1 + ad)$ with the level ad. All specifications include Firm×Border×Year fixed effects, Firm×County fixed effects, and Firm×Rating Area×Year fixed effects. The unit of the market size (the number of potential enrollees) is in thousands. Standard errors are in parentheses and clustered at the DMA×Year level. The stars indicate: *** for p<0.01, ** for p<0.05 and * for p<0.1.

Table 16: The Effects of Advertising: New vs Mature Markets

	(1) Up to 2016	(2) Up to 2018	(3) Linear Trend
Fed Spend ($)	0.119**	0.125**	0.102
	(0.061)	(0.055)	(0.067)
State Spend ($)	0.047	-0.033	-0.027
	(0.092)	(0.068)	(0.076)
Priv Spend ($)	0.134**	0.093**	0.080
	(0.067)	(0.046)	(0.050)
Linear Trend × Fed Spend ($)			0.048
			(0.046)
Linear Trend × State Spend ($)			-0.001
			(0.027)
Linear Trend × Priv Spend ($)			0.016
			(0.018)
No. of Insurers	-0.106***	-0.091***	-0.090***
	(0.028)	(0.026)	(0.026)
Market Size	-0.023***	-0.021***	-0.021***
	(0.007)	(0.005)	(0.005)
FirmBorderYear FE	Y	Y	Y
FirmCounty FE	Y	Y	Y
FirmRatingYear FE	Y	Y	Y
N. Obs.	25,074	36,558	36,558
Adj. R^2	0.948	0.942	0.942

Note: Columns (1) of this table presents the estimates with the sample period up to 2016; Column (2) presents the estimates with the full sample, which is up to 2018. Column (3) reports the estimates of the specifification that includes interactions between the linear time trend and each of federal, state, and private advertising spending. All specifications include Firm×Border×Year fixed effects, Firm×County fixed effects, and Firm×Rating Area×Year fixed effects. The unit of the market size (the number of potential enrollees) is in thousands. Standard errors are in parentheses and clustered at the DMA×Year level. The stars indicate: *** for p<0.01, ** for p<0.05 and * for p<0.1.

Table 17: Coefficient Estimates for Advertising Content (Log)

	(1)	(2)
Fed Spend:		
Open Enrollment and Financial	0.316**	0.325**
	(0.145)	(0.152)
Fed Spend:		
Not Both Open Enrollment And Financial	0.089	
	(0.061)	
Fed Spend:		
Either Open Enrollment or Financial (not both)		-0.056
		(0.261)
Fed Spend:		
Other ACA-related		0.102
		(0.073)
State Spend:		
Open Enrollment and Financial	0.092	0.121
	(0.120)	(0.122)
State Spend:		
Not Both Open Enrollment And Financial	-0.048	
	(0.069)	
State Spend:		
Either Open Enrollment or Financial (not both)		0.094
		(0.084)
State Spend:		
Other ACA-related		-0.100
		(0.069)
Priv Spend:		
Open Enrollment and Financial	0.058	0.076
	(0.066)	(0.070)
Priv Spend:		
Not Both Open Enrollment And Financial	0.096**	
	(0.047)	
Priv Spend:		
Either Open Enrollment or Financial (not both)		0.072
		(0.075)
Priv Spend:		
Other ACA-related		-0.062
		(0.070)
Priv non-ACA Spend		0.121**
		(0.057)
No. of Insurers	-0.089***	-0.088***
	(0.026)	(0.026)
Market Size (100,000)	-0.021***	-0.021***
	(0.005)	(0.005)
BorderYear FE	Y	Y
County FE	Y	Y
RatingYear FE	Y	Y
N. Obs.	36,558	36,558
Adj. R^2	0.942	0.942

Note: This table reports the estimates of the coefficients in specifications that include advertising content types. We use the log transformation of advertising spending in the estimation. The set of advertising content types considered in Column (1) is: (i) advertisements that provide information aboutthe open enrollment period and financial assistance and (ii) the rest of advertisements. The set of advertising content considered in Column (2) is: (i) advertisements that provide information about the open enrollment period and financial assistance, (ii) advertisements that provide content about the open enrollment period or financial assitance, but not both, (iii) the rest of ACA-related advertisements, and (iv) non-ACA related advertisements. The non-ACA related advertisements only exist for private insurers because advertisemnts by the federal or state governments are ACA-related by definition. All specifications include Firm×Border×Year fixed effects, Firm×County fixed effects, and Firm×Rating Area×Year fixed effects. The unit of the market size (the number of potential enrollees) is in thousands. Standard errors are in parentheses and clustered at the DMA×Year level. The stars indicate: *** for p<0.01, ** for p<0.05 and * for p<0.1.

Table 18: Robustness Check: Coefficient Estimates for Advertising Content (Level)

	(1)	(2)
Fed Spend:		
Open Enrollment and Financial	0.262**	0.272**
	(0.109)	(0.112)
Fed Spend:		
Not Both Open Enrollment And Financial	0.052	
	(0.034)	
Fed Spend:		
Either Open Enrollment or Financial (not both)		-0.054
		(0.180)
Fed Spend:		
Other ACA-related		0.063
		(0.040)
State Spend:		
Open Enrollment and Financial	-0.010	0.020
	(0.075)	(0.076)
State Spend:		
Not Both Open Enrollment And Financial	-0.027	
	(0.035)	
State Spend:		
Either Open Enrollment or Financial (not both)		0.060
		(0.053)
State Spend:		
Other ACA-related		-0.059*
		(0.036)
Priv Spend:		
Open Enrollment and Financial	0.026	0.034
	(0.029)	(0.032)
Priv Spend:		
Not Both Open Enrollment And Financial	0.040***	
	(0.015)	
Priv Spend:		
Either Open Enrollment or Financial (not both)		0.048
		(0.044)
Priv Spend:		
Other ACA-related		-0.024
		(0.032)
Priv non-ACA Spend		0.048***
		(0.018)
No. of Insurers	-0.089***	-0.087***
	(0.026)	(0.026)
Market Size (100,000)	-0.021***	-0.021***
	(0.005)	(0.005)
BorderYear FE	Y	Y
County FE	Y	Y
RatingYear FE	Y	Y
N. Obs.	36,558	36,558
Adj. R^2	0.942	0.942

Note: This table reports the estimates of the coefficients in specifications that include advertising content types. We use the level of advertising spending in the estimation. The set of advertising content types considered in Column (1) is: (i) advertisements that provide information aboutthe open enrollment period and financial assistance and (ii) the rest of advertisements. The set of advertising content considered in Column (2) is: (i) advertisements that provide information about the open enrollment period and financial assistance, (ii) advertisements that provide content about the open enrollment period or financial assitance, but not both, (iii) the rest of ACA-related advertisements, and (iv) non-ACA related advertisements. The non-ACA related advertisements only exist for private insurers because advertisemnts by the federal or state governments are ACA-related by definition. All specifications include Firm×Border×Year fixed effects, Firm×County fixed effects, and Firm×Rating Area×Year fixed effects. The unit of the market size (the number of potential enrollees) is in thousands. Standard errors are in parentheses and clustered at the DMA×Year level. The stars indicate: *** for p<0.01, ** for p<0.05 and * for p<0.1.

Table 19: Heterogeneous Effects Depending on Market Characteristics

	(1) Market Characteristics = No. of Insurer ≥ 5	(2) Market Characteristics = Medicaid Expansion	(3) Market Characteristics = Unhealthy
Fed Spend	0.136**	0.002	0.141**
	(0.053)	(0.067)	(0.059)
Market Characteristic=1 × Fed Spend	-0.156	0.216**	-0.129
	(0.188)	(0.105)	(0.081)
State Spend	-0.046	-0.116	-0.012
	(0.067)	(0.101)	(0.070)
Market Characteristic=1 × State Spend	0.153	0.105	-0.168
	(0.093)	(0.124)	(0.123)
Priv Spend	0.093*	0.070	0.085*
	(0.048)	(0.089)	(0.049)
Market Characteristic=1 × Priv Spend	-0.054	0.050	0.051
	(0.071)	(0.103)	(0.055)
Rival Spend	-0.040		
	(0.051)		
Market Characteristic=1 × Rival Spend	0.021		
	(0.068)		
No. of Insurers	-0.122***	-0.090***	-0.090***
	(0.027)	(0.025)	(0.026)
Market Size	-0.021***	-0.021***	-0.021***
	(0.005)	(0.005)	(0.005)
FirmBorderYear FE	Y	Y	Y
FirmCounty FE	Y	Y	Y
FirmRatingYear FE	Y	Y	Y
N. Obs.	36,558	36,558	36,558
Adj. R^2	0.943	0.942	0.942

Note: This table reports the estimates for the specifications that include interaction terms between market characteristics and advertising variables. Column (1) reports the estimates of the specfication with interaction terms between advertising variables and a dummy variable for a market with at least five insurers. Column (2) reports the estimates for the specification with interaction terms between advertising variables and a dummy variable for Medicaid expansion status under the ACA. Note that there are counties in states without Medicaid expansion that had exposure to state advertising if these counties border with other states with Medicaid expansion. Column (3) reports the estimates for the specification with interaction terms between advertising variables and a dummy variable for "unhealthy" markets. A market is defined as unhealthy if the share of individuals with fair or poor self-reported health status in the market is greater than the 75th percentile (21%). All specifications include Firm×Border×Year fixed effects, Firm×County fixed effects, and Firm×Rating Area×Year fixed effects. The unit of the market size (the number of potential enrollees) is in thousands. Standard errors are in parentheses and clustered at the DMA×Year level. The stars indicate: *** for p<0.01, ** for p<0.05 and * for p<0.1.

Table 20: Heterogeneous Effects for Demographic Groups

	(1) Demo=Age$\geq$ 55	(2) Demo=Income$\leq$ 138% of FPL
Fed Spend ($)	0.097*	0.102*
	(0.050)	(0.053)
State Spend ($)	-0.058	-0.054
	(0.074)	(0.079)
Priv Spend ($)	0.082*	0.091*
	(0.049)	(0.052)
Demo $\times$ Fed Spend ($)	0.061	0.054
	(0.087)	(0.090)
Demo $\times$ State Spend ($)	-0.052	0.050
	(0.135)	(0.137)
Demo $\times$ Priv Spend ($)	-0.008	-0.061
	(0.087)	(0.106)
No. of Insurers	-0.137***	-0.133***
	(0.022)	(0.027)
Market Size	-0.000***	-0.000***
	(0.000)	(0.000)
FirmBorderYearDemo FE	Y	Y
FirmCountyDemo	Y	Y
FirmRatingYearDemo FE	Y	Y
N. Obs.	68,206	68,042
Adj. R^2	0.917	0.906

Note: This table reports the estimates of the coefficients in the specification that includes interaction terms between advertising variables and dummy variables for individuals aged at least 55 and individuals with incomes below 138% of the federal poverty line FPL). For each column, we consider two demographic groups: whether or not an individual's age is at least 55 for Column (1) and whether or not an individual's income is below 138% of the FPL for Column (2). The unit of observation is at the level of each border pair, county, year, insurer, and demographic group. All specifications include Firm$\times$Border$\times$Year$\times$ Demographic Group fixed effects, Firm$\times$County$\times$ Demographic Group fixed effects, and Firm$\times$Rating Area$\times$Year$\times$ Demographic Group fixed effects. The unit of the market size (the number of potential enrollees) is in thousands. Standard errors are in parentheses and clustered at the DMA$\times$Year level. The stars indicate: *** for p<0.01, ** for p<0.05 and * for p<0.1.

Table 21: Heterogeneous Effects Across Markets with Different Age and Income Group Compositions

	(1) Demo = Share of Age$\geq$ 55	(2) Demo = Share of Income$\leq$ 138% of FPL
Fed Spend	-0.072	0.192
	(0.145)	(0.160)
Demo $\times$ Fed Spend	1.066	-0.278
	(0.866)	(0.545)
State Spend	0.174	0.001
	(0.147)	(0.173)
Demo $\times$ State Spend	-1.028	-0.236
	(0.735)	(0.630)
Priv Spend	0.170*	0.065
	(0.093)	(0.089)
Demo $\times$ Priv Spend	-0.359	0.131
	(0.369)	(0.302)
No. of Insurers	-0.115***	-0.114***
	(0.027)	(0.027)
Market Size	-0.026***	-0.027***
	(0.006)	(0.006)
FirmBorderYear FE	Y	Y
FirmCounty FE	Y	Y
FirmRatingYear FE	Y	Y
N. Obs.	34,208	34,208
Adj. R^2	0.940	0.940

Note: This table reports the estimates of the coefficients in the specification that includes interaction terms between advertising variables and county-level demographic variables. The demographic variables we consider are the share of potential marketplace enrollee aged at least 55 for Column (1), and the share of potential marketplace enrollees with incomes below 138% of the Federal Povery Level for Column (2). The average shares (standard deviations) of the former and the latter are 0.20 (0.054) and 0.23 (0.085), respectively. All specifications include Firm$\times$Border$\times$Year fixed effects, Firm$\times$County fixed effects, and Firm$\times$Rating Area$\times$Year fixed effects. Standard errors are in parentheses and clustered at the DMA$\times$Year level. The unit of the market size (the number of potential enrollees) is in thousands. The stars indicate: *** for p<0.01, ** for p<0.05 and * for p<0.1.

Table 22: Heterogeneous Effects of State Advertising in California

	Market-Level		Insurer-Level		
	(1)	(2)	(3)	(4)	(5)
Fed Spend	0.050**	0.050**	0.124**	0.124**	0.128**
	(0.022)	(0.022)	(0.054)	(0.054)	(0.055)
State Spend	-0.016	-0.013	-0.053	-0.049	-0.048
	(0.031)	(0.030)	(0.071)	(0.071)	(0.070)
1[State=CA]=1 × State Spend	0.085	0.095	0.298*	0.300**	0.300**
	(0.081)	(0.078)	(0.154)	(0.151)	(0.152)
Priv Spend	0.022	0.023	0.094**	0.093**	0.091**
	(0.019)	(0.018)	(0.046)	(0.046)	(0.046)
Rival Spend				-0.038	-0.043
				(0.047)	(0.047)
Navi Spend		-0.054			-0.384
		(0.120)			(0.265)
Dem Spend		0.050***			0.050
		(0.017)			(0.036)
Rep Spend		-0.015*			0.016
		(0.008)			(0.019)
No. of Insurers	0.012	0.013	-0.092***	-0.091***	-0.088***
	(0.008)	(0.008)	(0.025)	(0.025)	(0.025)
Market Size	-0.027***	-0.026***	-0.021***	-0.021***	-0.022***
	(0.006)	(0.006)	(0.005)	(0.005)	(0.005)
BorderYear FE	Y	Y			
County FE	Y	Y			
RatingYear FE	Y	Y			
FirmBorderYear FE			Y	Y	Y
FirmCounty FE			Y	Y	Y
FirmRatingYear FE			Y	Y	Y
N. Obs.	18,154	18,154	36,558	36,558	36,558
Adj. R^2	0.916	0.916	0.942	0.942	0.942

Note: This table reports the estimates of the coefficients in the specification that includes the interaction term between the California (CA) dummy and state advertising. Columns (1) and (2) are based on the market-level demand model. Columns (3) and (4) are based on the insurer-level demand model. The specifications in Columns (1) and (2) include Border×Year fixed effects, County fixed effects, and Rating Area×Year fixed effects. The specifications in Columns (3) and (4) include Firm×Border×Year fixed effects, Firm×County fixed effects, and Firm×Rating Area×Year fixed effects. The unit of the market size (the number of potential enrollees) is in thousands. Standard errors are in parentheses and clustered at the DMA×Year level. The stars indicate: *** for p<0.01, ** for p<0.05 and * for p<0.1.

Table 23: Coefficient Estimates: Interaction between Federal and Private advertising

	(1)
Fed Spend ($)	0.117*
	(0.064)
State Spend ($)	-0.034
	(0.067)
Priv Spend ($)	0.087*
	(0.051)
Fed Spend ($) × Priv Spend ($)	0.022
	(0.086)
No. of Insurers	-0.091***
	(0.026)
Market Size	-0.021***
	(0.005)
FirmBorderYear FE	Y
FirmCounty FE	Y
FirmRatingYear FE	Y
N. Obs.	36,558
Adj. R^2	0.942

Note: This table reports the estimates of the coefficients for the specification includes the interaction term between federal and private advertising. The specification include Firm×Border×Year fixed effects, Firm×County fixed effects, and Firm×Rating Area×Year fixed effects. Standard errors are in parentheses and clustered at the DMA×Year level. The unit of the market size (the number of potential enrollees) is in thousands. The stars indicate: *** for p<0.01, ** for p<0.05 and * for p<0.1.

Table 24: Counterfactual Experiments: Changes in Insurer-level Enrollment and Advertising

		All Markets			Large Fed Ad Market		
Number of insurers with positive baseline ads		Baseline	Fed Ad×0	Fed Ad×3	Baseline	Fed Ad×0	Fed Ad×3
1	Elasticity	0.029	0.029	0.030	0.038	0.037	0.029
	Private Advertising ($)	0.85	0.89	0.80	1.04	1.27	0.90
2	Elasticity	0.025	0.022	0.022	0.027	0.023	0.025
	Private Advertising ($)	0.69	0.76	0.64	0.93	1.41	0.73
3	Elasticity	0.028	0.022	0.022	0.026	0.021	0.022
	Private Advertising ($)	0.75	0.79	0.71	0.62	0.78	0.54
4+	Elasticity	0.024	0.019	0.019	0.020	0.012	0.013
	Private Advertising ($)	0.59	0.64	0.56	0.54	0.74	0.46

Note: This table presents insurer's demand elasticity with respect to advertising and insurer-level advertising spending. We report average elasticities and advertising spending for insurers with positive baseline advertising spending, depending on the number of such insurers in a market. We also report separately for markets with large federal advertising spending (top 10% markets). Baseline elasticities are elasticities in partial equilibrium, which do not take into account other insurers' equilibrium responses. "Fed Ad x 0" and "Fed Ad x 3" report equilibrium elasticities that allow for endogenous insurer responses in our two sets of counterfactuals. We also report average insurer-level advertising spending in the two sets of counterfactuals.