NBER WORKING PAPER SERIES

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Working Paper 27695
http://www.nber.org/papers/w27695

NATIONAL BUREAU OF ECONOMIC RESEARCH
1050 Massachusetts Avenue
Cambridge, MA 02138
August 2020

First draft: July 31, 2019. We are especially grateful to Brad Shapiro for a number of suggestions and discussions at various stages of this project. We thank Marika Cabral, Leemore Dafny, Liran Einav, Hanming Fang, Serafin Grundl, Ben Handel, Jonathan Kolstad, Corina Mommaerts, Matt Notowidigo, Ken Onishi, Elena Patel, Elena Prager, Mark Shepard, Amanda Starc, Justin Sydner, Chris Taber, and JoelWaldfogel, as well as many seminar and conference participants at DC IO Day, Federal Reserve Board, Midwest IO Fest (U.Chicago), National Tax Association Conference, NBER Insurance Meeting, NBER Summer Institute (health care), University ofWisconsin-Madison, and Virtual Quantitative Marketing Seminar for helpful comments. Joel McMurry and Logan Schultheis provided outstanding research assistance. The analysis and conclusions set forth are those of the authors and do not indicate concurrence by other members of the staff, by the Board of Governors, or by the Federal Reserve System, nor do they necessarily reflect the views of the National Bureau of Economic Research.

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NBER Working Paper No. 27695
August 2020
JEL No. G2,I1,I3,L1,M3

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 and private advertising are targeted to different geographical areas and provide different messaging content. Then, we estimate the impacts of government and private advertising on consumer demand by exploiting discontinuities in advertising along the borders of local TV markets. We find that government advertising has a market-expansion effect and enhances welfare. We also find that private advertising is not more effective than government advertising in increasing total program enrollment. Although private advertising is still effective in increasing insurer's own enrollment, it does not have positive spillovers to other insurers but has a modest business-stealing effect. We then develop and estimate an equilibrium model of marketplaces to illustrate mechanisms through which government advertising affects the market equilibrium. Our simulation suggests that government advertising can simultaneously increase total program enrollment and reduce excessive advertising spending among private insurers.

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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. For example, the government may not need to market these programs if private marketing is more effective in increasing program enrollment than government marketing or has positive spillovers to other firms by providing general information about the program. On the other hand, government marketing can be useful if private marketing merely steals enrollees from other firms and has a limited effect on total program enrollment, or if marketing is costly for certain firms due to a lack of economy of scale, for example, resulting from fixed costs of marketing. Moreover, the government's objectives might differ from those of private firms (e.g., a preference for redistribution). 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

[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.

of government marketing activities.[4] Credibly estimating how advertising works in the ACA marketplace is highly relevant for policy debates. For example, marketing experts who worked on the government's marketplace outreach activities argue that close to 40% of the ACA take-up rate is associated with government advertising and warn that the substantial reduction of the federal marketing budget for the marketplace in 2018 would be detrimental to marketplace enrollment.[5] Additionally, many regulations on pricing and plan designs in the marketplace make marketing activities of private insurers an even more important tool to increase their enrollment because advertising is less regulated. In this paper, we first document how the government and private insurers target their advertising. Then, we estimate the impact of government and private advertising on consumer demand. 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 identify the sponsor of each advertisement and to observe advertising content through 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– for example, the end date of the open enrollment period and the availability of financial assistance. We first document that although certain types of content are commonly discussed in advertisements by both the government and private insurers, about 60% of private advertisements do not provide specific information about the marketplace but merely promote a private insurer's brand. Then, we provide suggestive evidence 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 of 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.,

[4]The Department of Health and Human Services, which is responsible for health programs, typically spends more on adverting than other departments except for the Department of Defense (Kosar (2014)).

[5]See comments by individuals who worked on ACA outreach under the Obama administration in the following news articles `washingtonpost.com/news/powerpost/paloma/the-health-202/2017/10/23/the-health-202-obamacare-may-lose-1-1-million-because-of-advertising-cuts/59eccffd30fb045cba000924/` and `vox.com/the-big-idea/2017/9/12/16294784/aca-outreach-advertising-sabotage-funding`. 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.

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.

We find that government advertising, especially by the federal government, has a market-expansion effect, increasing overall enrollment for the marketplace. The estimated demand elasticity with respect to federal advertising is about 0.05, which is much lower than commonly asserted in public debates. However, it is much larger than typical estimates of effects of private advertising in other products (Shapiro et al. (2019)). Moreover, its cost effectiveness is comparable to a recent randomized experiment in which the IRS sent letters to the uninsured population who paid a tax penalty under the ACA (Goldin et al. (2019)). Using a welfare framework (e.g., Finkelstein and Notowidigdo (2019)), we show that federal advertising likely enhances welfare at least up to its observed level of spending.

Further, we find that private advertising is not more effective than federal advertising in increasing total program enrollment and that it is statistically less effective than federal advertising in some specifications. Although private advertising is effective at increasing own enrollment, it has a modest business stealing effect and does not have positive spillover to other insurers. 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 increasing enrollment, which may explain its lack of positive spillover effects.

Our demand analysis provides a number of new insights on government and private marketing activities in market-based programs. However, it alone does not take into account the equilibrium impact of government advertising on private advertising. If government advertising crowds out private advertising, then its equilibrium effect on total enrollment could be limited. The cost of crowding out also depends on whether private advertising is beneficial: while private advertising may induce consumers to switch to better plans, its spending can be excessive in the market equilibrium. To illustrate these trade-offs, 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 conduct counterfactual experiments that 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 enrollees) 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. Interestingly, the overall market-level enrollment changes modestly regardless of whether we allow private insurers to respond to the change in government advertising. This is partly because

advertising competition among private insurers leads to a prisoner's dilemma and thus excessive equilibrium advertising spending. Although private advertising may induce consumers to switch to better insurers, existing studies suggest that this welfare gain is very modest.[6] Thus, government advertising can be an effective tool to reduce both choice frictions for consumers and inefficiency in private advertising competition.

Our counterfactual experiments provide the *first* formal analysis that illustrates mechanisms through which government advertising interacts with private advertising in market-based public programs. Our structural equilibrium model is still stylized and can be extended to incorporate other ways that private and government advertising interact with each other. However, it offers a crucial first step to understand their interactions, and various channels we uncover in our analysis are likely relevant even in richer models.

Finally, while our findings are specific to the context of the ACA marketplaces, they have broad implications in evaluating the design of other market-based public programs. A common rationale for providing essential benefits for the society through a market-based approach is that private firms can provide services more effectively. However, one of important lessons from our analysis is that private marketing activities are not always more effective than government marketing activities. This suggests that policy makers should not rule out the possibility of utilizing government marketing as an important market design tool to mitigate consumer choice frictions.

Related Literature First, this paper contributes to the literature studying the design of health insurance markets. This 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 non-ACA health insurance markets. A few recent studies in the health policy literature (Karaca-Mandic et al. (2017), Gollust et al. (2018), and Shafer et al. (2020)) document how advertising is *correlated* with aggregate enrollment in Medicaid and the marketplace.[7] We contribute to this literature by providing the first estimate of *causal* impact of government advertising and then evaluating government marketing as a market design tool, including how it interacts with marketing competition by private insurers.

[6] 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.

[7] For example, Karaca-Mandic et al. (2017) document that advertising is positively correlated with Medicaid enrollment and negatively correlated with the number of uninsured. All of these studies explicitly acknowledge that they do not address the endogeneity of advertising and do not interpret their estimates as causal.

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)).[8] 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.[9] They do not study private marketing activities or the interaction between government and private marketing activities in market-based public programs, which is 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. Hastings et al. (2017) is the closest to ours in that it studies private marketing activities in a market-based public program (privatized pension). For private markets, see 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; and Shapiro (2018) and Sinkinson and Starc (2018) for pharmaceuticals. 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)).

The paper proceeds as follows. Section 2 provides institutional background on the marketplace. Section 3 introduces our main data and provides 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. 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.

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

[9] Domurat et al. (2019) consider individuals who had accounts in marketplaces but did not sign up.

Regulations on Health Insurance Plans. There are a number of regulations on plans sold in the marketplace. First, each plan must meet a minimum quality defined over the generosity and coverage of health care. Each plan is categorized based on a "metal" ranking, which indicates different levels of generosity: Bronze, Silver, Gold, and Platinum. Bronze plans are the least generous, which still cover health care costs of about 60% of actuarially fair value. These plans must cover essential benefits, including at least 10 different types of specified health services.

The premium is also subject to a number of regulations. First, it is subject to a modified community rating regulation within each rating region. Specifically, each state is divided into geographical rating regions, and a rating region consists of multiple counties or zip codes. Within each rating region, insurers are not allowed to explicitly discriminate their pricing and product offerings based on the consumer's health status.[10] Second, the medical loss ratio regulation requires an insurer to maintain a loss ratio–i.e., the ratio of total claim costs over the total premium revenues–of at least 80% at the state level. This regulation directly limits the markup that insurers can charge. Third, an insurer's request for a premium increase of more than 10% is subject to state- or federal-based rate reviews and must publicly disclose the proposed premium increase and the justification of the increase.

These numerous regulations on pricing and plan benefits make it more difficult for private insurers to compete with competitors via product designs only, which make marketing activities potentially more important in this market. In fact, the ACA did not impose any extra regulations on marketing activities in the marketplace. Thus, marketing activities are thus a potentially important way for insurers to enroll more consumers.

Consumer Subsidies. Consumers are offered premium subsidies from the federal government, with the amount of the dependent upon 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.[11] Consumers purchasing Silver plans also receive income dependent cost-sharing subsidies. Overall, the government spends close to $40 billion per year on premium and cost-sharing subsidies.

[10] Insurers can still charge different premiums based on an individual's age and smoking status under a pre-specified rule. The maximum premium ratio between the oldest (age 64) and the youngest (age 18) must be equal to a factor of 3, and the smoker's insurance premium is 1.5 times as high as that for non-smokers.

[11] 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 government does not expand Medicaid.

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 Department of Health and Human Services (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. In particular, different models allow more or less control in tailoring consumer outreach and assistance to state 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.

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, particularly 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 in 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 in 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 Advertisement Relevant for the Marketplace We exploit detailed information in the database to identify which advertisements are relevant for marketplaces. Using Amazon Web Services, we transcribed each advertisement and examined its content based on keywords. As a

[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.

[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.

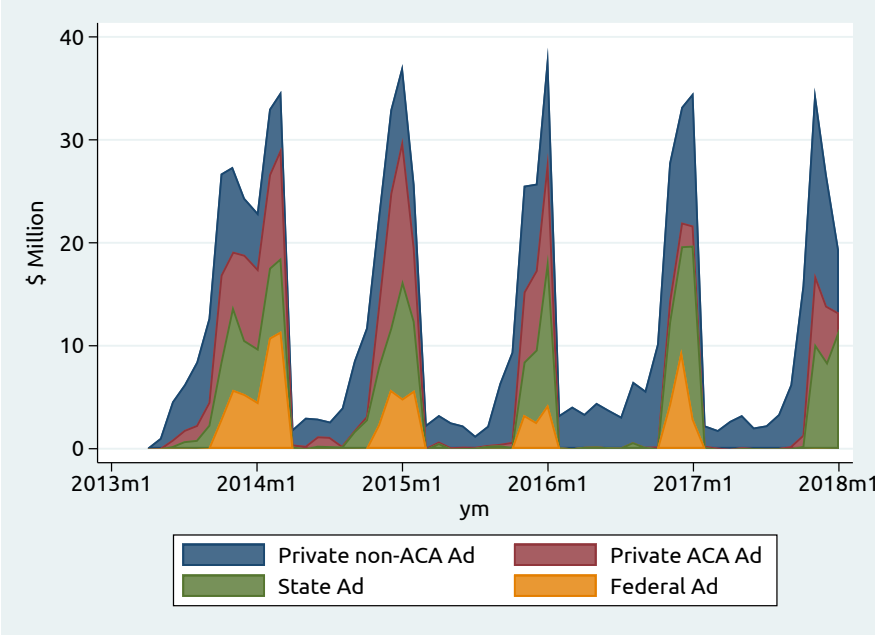
[14]Specifically, we sum two ratios: (i) the ratio of a sponsor's total spending in local TV channels in a DMA to the DMA-level market size and (ii) the ratio of a sponsor's national network TV spending to the national market size. The way in which we construct the per-capita spending is similar to Sinkinson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

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). We provide details in Appendix C.

3.2 Summary Statistics

First, we document the volume of advertising relevant for the marketplace 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.

Figure 1: Time Series of Advertising Spending

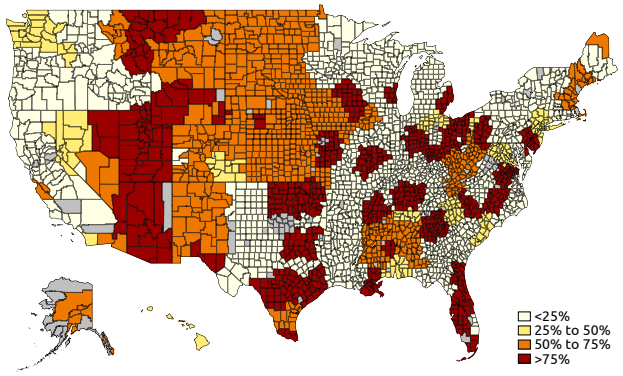


Note: This figure plots monthly expenditures in millions for TV advertisements by the federal and state governments and private insurers' ACA-related and non-ACA-related advertisements. The four different advertisement types are stacked in this figure. Data source: Kantar Media.

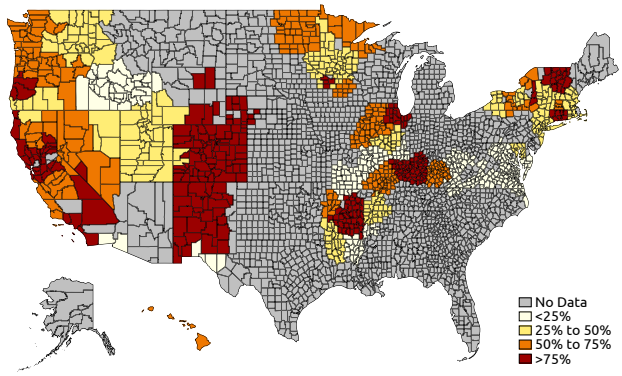
In 2017, the federal government decided to cut its total marketing budget for 2018 to only

$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 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.

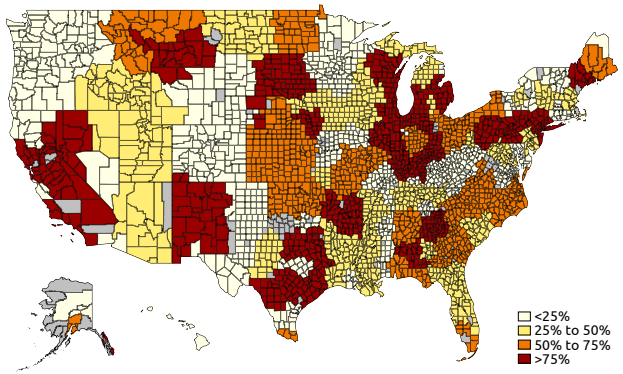
Figure 2: Geographical Patterns of Government and Private Advertising



(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.

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 sig-

nificantly across DMAs. For example, compared with private insurers, the federal government advertises extensively in Arizona and Florida.

Table 1: Summary Statistics at DMA-Year Level

	By Fed Ad Spend		By State Ad Spend		By Priv Ad Spend	
	(1) Below Median	(2) Above Median	(3) Below Median	(4) Above Median	(5) Below Median	(6) 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.

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).[15] Private advertising is also larger in those DMAs. Moreover, although advertising in general tends to be larger in DMAs with a greater market size, private advertising is especially larger in these markets. Lastly, demographic characteristics considered for this table do not seem highly correlated with any types of advertising. However, this 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

[15]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.

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: 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.

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 types of advertising content: 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 F. We then tabulate the proportion of advertisements that mention keywords related to each topic by sponsor type.[16]

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. These two types of content are the most common 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, about 60% of private advertisements do not mention any of the keywords related to the marketplace that we considered, whereas all federal and state advertisements

[16]The set of content we consider in Table 2 is not necessarily exhaustive. For example, one 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).

are ACA-related (by definition).[17] These private advertisements 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 content between advertisements sponsored by governments and private insurers is indicative of their different incentives. The large fraction of private advertisements unrelated to the specific information of the ACA 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, private advertisements unrelated to the marketplace may be effective in increasing enrollment for an insurer at the expense of enrollment for other insurers. 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 Geographical Targeting of Advertising

We now carry out preliminary analyses to explore how advertising, both by governments and private insurers, is geographically targeted. We investigate how advertisement spending is correlated with DMA characteristics by estimating the following regression:

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

The dependent variable ad_{mt}^{k} represents advertising spending per capita by sponsor type $k \in \{f,s,p\}$, 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 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 both governments and private insurers do more advertising in markets with more private insurers. However, government advertising is not particularly targeted based on DMA-level demographic

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

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 Medicaid. 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.

characteristics. In contrast, private advertising varies much more with demographic characteristics and health care policies. For example, we find that private advertising is significantly larger in markets with more potential enrollees. Moreover, Medicaid expansion is associated with 72% ($\simeq 100 * (\exp(0.545) - 1)$) more total private advertising. In addition to the demographic variables, we also examine 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.[18,19]

These differences may reflect different objectives of the government and private insurers. Private insurers have an incentive to conduct advertising to increase their profits. Thus, they may want to advertise in markets with more potential enrollees or markets with better risk pools. Medicaid expansion can make the average risk pool of the marketplace less risky by absorbing low-income populations, which are more likely to be high-risk.[20] 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

[18]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.

[19]In Appendix G, 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 also find differences in targeting of advertising that provide specific content by different sponsors.

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

increases enrollment.

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 estimate 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.[21]

4.1.1 Identification: Border Strategy

In estimating the effects of advertising, endogeneity of advertising is a threat to credible identification. 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 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.[22] 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 adjacent to at least one county in a different DMA. The border strategy relies on the regulation-induced discontinuities in exposure

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

[22] 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.

to advertising across neighboring border counties in the same state but different DMAs.[23] An advertising decision is likely based on characteristics of the entire DMA, not a specific border county. Differences in DMA-level characteristics between two neighboring DMAs can result in discontinuities of advertising exposures to two neighboring border counties in different DMAs although the two border counties likely have similar unobserved heterogeneity in demand.

To implement the border strategy, we first identify pairs of adjacent border counties in the same state that belong to two different DMAs, which we refer to as a border pair. With fixed effects for border pair-by-year, we control for unobserved heterogeneity in demand that is common within each border pair and year. Using the panel structure of our data, moreover, we additionally include county fixed effects to control for 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 time.

One important advantage of the border strategy is that it teases out separate exogenous variation in advertising by different sponsors. It is possible that advertising spending of private firms and the government are jointly determined in equilibrium in each DMA. However, what matters for the identification is that unobserved heterogeneity in consumer demand in border counties is uncorrelated with growth in advertising by different sponsors, which are determined at the DMA level. As long as our identification assumption is met, all we need to separately identify sponsor-specific effects of advertising is variation in the difference of advertising spending by different sponsors across border pairs.

Moreover, the border strategy allows us to identify the effect of advertising separately from other ways in which the government or insurers can increase enrollment. 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 outreach activities, such as in-person assistance programs, may vary across counties. However, such activities will violate the identifying assumption only if geographical targeting in these activities systemically depends on variation of TV advertising across a DMA border *and* if these activities are effective.[24] Private insurers may engage in other

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

[24] Because we control county fixed effects, some variation in in-person assistance programs, such as enrollment centers, is 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.

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 on 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 to the border strategy is that the estimated effect is only local to potential marketplace enrollees in border counties. Thus one must be cautious in generalizing the estimated effect to non-border counties. In Appendix A, we show that there is a considerable amount of overlapping support in observables between border and non-border counties. This suggests that the estimated effect of advertising could be generalizable to even non-border counties.

Another caveat to 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 we have enough advertising variation within border pairs to adopt this methodology.

4.1.2 Effects of Advertising on Market-level Enrollments

We estimate the following county-level regression:

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

The dependent variable refers to the log of the share of individuals that enrolled in marketplace plans in border pair b, county c, and year t. On the right-hand side, $ad^k_{bm(c)t}$ refers to the advertising expenditure of category k per potential marketplace enrollee in border pair b, DMA $m(c)$ to which county c belongs, and year t.[25] 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

[25] 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 open enrollment period.

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).[26] 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 logarithms, the coefficient β_k is an elasticity of county-level demand for marketplace plans with respect to advertising by a sponsor k.

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. An alternative way to control for differences in plan characteristics across rating areas and years is to further restrict the sample to border pairs that are included in the same rating area. We present estimates from the alternative sample in Section 4.3 for robustness checks.

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 two-way clustered at the level of DMA-by-year and county. The advertising variables vary at the DMA-by-year level, and the county is a unit of the panel structure in the data.

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

[26]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**
	(0.028)	(0.015)	(0.021)	(0.021)
State Spend	-0.028	0.019	-0.011	-0.008
	(0.035)	(0.027)	(0.034)	(0.034)
Priv Spend	0.006	0.011	0.023	0.024
	(0.016)	(0.012)	(0.018)	(0.017)
Navi Spend				-0.055
				(0.122)
Dem Spend				0.049***
				(0.016)
Rep Spend				-0.015*
				(0.008)
No. of Insurers	0.046***	0.012*	0.012	0.013
	(0.011)	(0.007)	(0.008)	(0.008)
Market Size	0.000	-0.009**	-0.026***	-0.026***
	(0.000)	(0.004)	(0.006)	(0.006)
BorderYear FE	Y	Y	Y	Y
County FE		Y	Y	Y
RatingYear FE			Y	Y
N. Obs.	18,862	18,840	18,182	18,182
Adj. R^2	0.707	0.913	0.919	0.919

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 two-way clustered at the DMA×Year and the County level. The stars indicate: *** for p<0.01, ** for p<0.05 and * for p<0.1.

advertising spending, then the market-level share will increase by 1 percentage point (pp) given that the unconditional average of the market-level take-up rate is 0.2. Another way to interpret the coefficient is that, conditional on advertising by other sponsors, eliminating federal advertising will decrease enrollment by 5%. This estimate is much smaller than those mentioned in policy debates which assert that 40% of enrollment is associated with federal advertising.[27]

Although the magnitude of the estimate seems modest, it is very large compared with a typical elasticity of demand with respect to TV advertising estimated with a credible research design. For example, Shapiro et al. (2019) show that the median of estimated advertising elasticities for many different private goods is 0.014. Moreover, in a context closer to that studied here, the effectiveness of federal advertising is quite comparable to the cost effectiveness of a direct mail reminder to enroll in the marketplace that the Internal Revenue Service sent to taxpayers, which is studied by Goldin et al. (2019). We provide a more detailed comparison in Online Appendix B.1.

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

[27] See footnote 5 for details.

marketing activities. Thus, it is reasonable to expect that some states have more resources available for designing more effective marketing 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.[28] 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 more effective than government advertising in increasing market-level enrollment in any specifications. The point estimates for the effect of private advertising are smaller than those for federal advertising and statistically insignificant in all specifications. Based on these estimates, we robustly reject that private advertising is more effective in expanding total enrollment than federal advertising.

There are two possibilities behind this result. First, as recent research on advertising documents, private firms may not necessarily be very good at using advertisements to increase demand.[29] Second, even if private advertising is very effective in increasing demand for insurers that conduct advertising, it does so, at least in part, by stealing consumers from other insurers. In this case, private advertising may reallocate consumers among insurers to some extent and thus result in a smaller market-level effect. In the next section, we will estimate the effect of advertising on individual insurer demand to further investigate this issue.

Our main specifications do not reject the possibility that federal advertising is equally as effective as market-level private advertising. However, we can make a slightly sharper comparison of the effects of federal and private advertising in an alternative specification where the advertising variables enter the regression in levels instead of logs (see Table 16 in Online Appendix). In this specification, federal advertising is more effective than private advertising at the 10% significance level. Table 16 also shows that with an alternative sample that is restricted to border pairs in the same rating area, we reach the same conclusion at the 5% significance level.

In Column (4) of Table 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 market-level enrollment, and its effect is comparable to federal advertising. On the other hand, the point estimate for Republican advertising is negative.

Given our estimates, it is difficult to clearly distinguish statistically the effectiveness of adver-

[28] See Lee et al. (2017) for the summary of marketing campaign of CA marketplace programs.

[29] For example, see Blake et al. (2015) and Lewis and Rao (2015).

tising by different sponsors except for a few specifications, partly due to relatively large standard errors of the estimates. Nevertheless, in Table 14 in the Online Appendix, we still find that the effect of federal advertising is statistically larger than the combined effect of non-federal advertising in the marketplace. Thus, federal advertising is more effective in increasing total enrollment than typical advertising by sponsors other than the federal government.

4.1.4 Welfare Implications of Federal Advertising

It is useful to investigate welfare implications of the magnitude of the market-expansion effect of federal advertising. Our welfare framework is motivated by Finkelstein and Notowidigdo (2019), who study welfare impacts of the government's information provision to potential public program enrollees who face choice frictions. We define total social welfare given federal advertising spending as $TSW = \int SS_h q_h(ad^f)dF(h) - ad^f$. TSW denotes total social welfare, and SS_h denotes the social surplus from enrolling a consumer of demographic type h. One can think that SS_h is the sum of consumer and producer surplus net of the government expenditure for an enrollee such as the premium subsidy. $q_h(ad^f)$ denotes total program enrollment given federal advertising spending ad^f, and this demand function embeds an individual's optimal decision to enroll in the marketplace subject to choice frictions such as being unaware of the marketplace. Federal advertising can reduce these choice frictions, thereby increasing take-up.[30] We assume away the possibility that federal advertising affects the social value of health plans, which implies that welfare gains from federal advertising calculated in our framework is likely a lower bound. For simplicity, we assume that $q'_h(ad^f) = \bar{q}'(ad^f)$. In other words, the marginal effect of federal advertising on take-up is the same for all consumers.[31] Moreover, we assume a partial equilibrium framework where private insurers do not change their advertising in response to federal advertising, which will be relaxed in a later analysis.

In this framework, federal advertising increases total social welfare if $\overline{SS} \times \bar{q}'(ad^f) > 1$. We define $\overline{SS} = \int SS_h dF(h)$, which is the social surplus from enrolling an *average* consumer. In Online Appendix B.2, we show based on our estimate of the effect of federal advertising that if $\overline{SS} > \$32$, then federal advertising enhances welfare. It is very difficult to credibly estimate the social value of health insurance $\overline{SS}$. However, as discussed in Online Appendix B.2, existing studies suggest that $\overline{SS}$ is likely to be much bigger than \$32 after taking into account government spending for

[30] Although there are various models with choice frictions that rationalize $q_h(ad^f)$, one plausible framework is a consideration set model, where federal advertising affects an individual's awareness of marketplaces (See Online Appendix B.2 for details). This is a reasonable description of an individual's decision process because we show in Section 4.2.4 later that federal advertising that provides specific information about marketplaces, such as the end date of the open enrollment period and financial assistance, is effective.

[31] Although this assumption could be restrictive, we do not find robust evidence for heterogeneity in advertising effects across demographic types later in Section 4.4.1.

uncompensated care for uninsured individuals. This result suggests that federal advertising likely enhances welfare in partial equilibrium.

Here, we further discuss how much more we can learn about the role of the federal government based solely on our market-level demand estimates. First, given our estimates, we rule out the possibility that private advertising is more effective than government advertising. This suggests that the government can possibly further expand total enrollment by directly advertising for the marketplace, although a more complete analysis should take into account private insurers' endogenous responses. Moreover, one of common arguments that support public provision of private goods is that private firms may lack economies of scale. In our context, the fixed cost of advertising is likely to account for the fact that small private insurers choose not to advertise.[32] Government advertising can induce more switching from uninsured to insured, including switching to those small insurers who still provide health insurance that satisfies the minimum quality. This strengthens the case for the government to directly advertise for the marketplace.

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 as well as its impact on other insurers. Moreover, this demand model will be an ingredient in our equilibrium model in Section 5.

4.2.1 Utility Specification

Consider individual i who lives in market ct, which is defined as a county-year pair. The number of marketplace insurers available in each market is denoted by J_{ct}. Because the outside option–for example, being uninsured–is always available, a consumer has a total of $J_{ct}+1$ options. The consumer optimally chooses the insurer that maximizes his utility.[33] We assume that the consumer obtains indirect utility u_{ijct} from insurer $j>0$ as follows:

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

[32] We find that the average enrollment size of insurers that did not advertise is about a half of that of insurers that did advertise. Although an insurer's enrollment size is endogenous to advertising, this stark difference in the size between the two types of insurers is unlikely due to advertising given our modest estimates of the effect of advertising.

[33] Because plan-level enrollment data are available, it is possible to model plan choice within insurers. However, the data provide 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.

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.[34] It is also affected by non-advertising utility from an insurer (ξ_{jct}).

The set of advertising categories we consider in the main specification is a collection of the per-capita spending by different advertising sponsors: $K = \{f, s, p, r, nv, dem, rep\}$, where an important change from the market-level analysis is our treatment of private advertising. 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 some business-stealing effects. In other words, its advertising will increase its own market share at the expense of rivals' market shares as well as the outside option. Thus, the effect on total enrollment can be smaller even if private advertising is as effective as government advertising in increasing demand for an individual insurer. To allow for a more flexible substitution pattern among insurers with respect to private advertising, we include advertising by an insurer's rivals (r) in some specifications such that $ad^r_{jm(c)t} = \sum_{h \neq j} ad^p_{hm(c)t}$.[35] The coefficient for $ad^r_{jm(c)t}$ will determine whether private advertising has positive spillover to rivals or steals business from rivals. If the coefficient, β_r, is positive and large relative to the coefficient on own advertising (β_p) , then private advertising has a positive spillover effect: that is, private advertising increases not only the insurer's own demand, but also rivals' demand, thereby leading to market expansion. To the extent that some private advertising provides general information about the marketplace–for example, the open enrollment period–it could potentially have positive spillover to rivals. Otherwise, private advertising increases own enrollment from the outside option and steal consumers from other insurers. In other words, if the coefficient β_r is positive but small or even negative, private advertising will have at least some business stealing effect.

As in the market-level analysis, we include federal (f), state (s), navigators (nv), Democrats (dem) and Republicans (rep) advertising. Note that each of advertising has the j subscript; however, it does 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.

Note that our demand model does not specify how advertising affects a consumer's choice.

[34] 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 or providing experience characteristics of product quality. We do not take this approach, however, because separately identifying different effects of advertising is challenging with our data.

[35] 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.

Although this specification is common in many studies in marketing, it is important to point out that it is consistent with many different models, including models with consumer choice frictions. For example, as Hastings et al. (2017) shows, our indirect utility function encompasses a pure consideration set model (e.g., Goeree (2008)) in which the role of advertising is to increase the probability that a consumer will consider the plan j. Instead of making specific assumptions on how advertising affects a choice, Section 4.2.4 shows which advertising content is more effective for a consumer's choice, which sheds some light on how advertising affects a choice.

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 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 uninsured or purchase an off-marketplace plan, from which a consumer receives utility of u_{i0ct}:

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

Note that the deterministic portion of u_{i0ct} 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.[36]

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. 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.

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 $\delta_{jct} \equiv u_{ijct} - \varepsilon_{ijct}$. Then it is easy to show, based on the assumption on ε_{ijct}, that

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

[36] One could assume a nested logit error term to allow for additional flexibility in substitution patterns. For example, we can have all inside options in a single nest. However, we would need an instrument to estimate the nesting parameter because we only have aggregate data on market shares. We find it challenging to come up with a reasonable instrument because we include an extensive set of fixed effects due to the border identification strategy. Thus, we do not consider a nested logit model.

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, as 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

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

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, 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. 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 $\xi_{jr(c)t}$. Alternatively, we control for this heterogeneity by further restricting our sample to border pairs in the same rating area. We show results with this alternative sample in Section 4.3 for robustness checks. 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:

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

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 presents coefficient estimates in the utility function described in Equation (3) with different specifications. Columns (1)–(7) differ only in the included fixed effects and advertising controls. Standard errors for all specifications are two-way clustered at the level of DMA-by-year

Table 5: Estimated Coefficients in Insurer-Level Demand Model

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Fed Spend	-0.009	0.079*	0.131***	0.125**	0.123**	0.129**	0.127**
	(0.059)	(0.043)	(0.048)	(0.053)	(0.053)	(0.054)	(0.054)
State Spend	0.012	-0.050	-0.033	-0.033	-0.031	-0.028	-0.025
	(0.054)	(0.052)	(0.059)	(0.070)	(0.070)	(0.069)	(0.069)
Priv Spend	0.217***	0.309***	0.149***	0.093*		0.090*	
	(0.042)	(0.056)	(0.043)	(0.048)		(0.047)	
Priv ACA Spend					0.048		0.042
					(0.054)		(0.054)
Priv non-ACA Spend					0.121**		0.121**
					(0.056)		(0.055)
Rival Spend						-0.043	-0.044
						(0.047)	(0.046)
Navi Spend						-0.390	-0.391
						(0.240)	(0.240)
Dem Spend						0.049	0.047
						(0.037)	(0.037)
Rep Spend						0.017	0.018
						(0.018)	(0.018)
No. of Insurers	-0.190***	-0.203***	-0.189***	-0.091***	-0.091***	-0.087***	-0.087***
	(0.020)	(0.019)	(0.023)	(0.024)	(0.024)	(0.024)	(0.024)
Market Size	0.001***	-0.012***	-0.022***	-0.021***	-0.021***	-0.022***	-0.022***
	(0.000)	(0.003)	(0.006)	(0.005)	(0.005)	(0.006)	(0.006)
FirmBorderYear FE	Y	Y	Y	Y	Y	Y	Y
County FE		Y	Y				
FirmCounty FE				Y	Y	Y	Y
FirmRatingYear FE			Y	Y	Y	Y	Y
N. Obs.	39,782	39,770	38,316	36,558	36,558	36,558	36,558
Adj. R^2	0.791	0.824	0.897	0.938	0.938	0.938	0.938

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. In Columns (5) and (7), we replace private advertising with private advertising that does and does not provide marketplace-related content. Columns (6) and (7) 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 two-way clustered at the DMA×Year level and the Firm×County level. The stars indicate: *** for p<0.01, ** for p<0.05 and * for p<0.1.

and insurer-by-county. The main advertising variables vary at the level of DMA-by-year, and the unit of panel structure in the data is at the level of insurer-by-county.

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 (6), 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.[37] The magnitude of this estimated impact of private advertising is largely consistent with typical findings in the marketing literature estimating the elasticity of demand with respect to advertising (see Shapiro et al. (2019)). In Columns (5) and (7), we include private advertising that does and does not provide content about

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

the marketplace instead of the total private advertising spending. We find that private advertising without marketplace-related content is statistically significant although we cannot statistically distinguish the two estimates.

We also find that the estimates for rivals' advertising in Columns (6) and (7) are small and negative, and they are not statistically significant. This finding suggests that private advertising does not have positive spillovers to rivals and that it has a business-stealing effect to some degree. In Table 15 in Online Appendix, we provide more direct evidence of the business-stealing effect of private advertising. The table reports a reduced-form model regression of the log of the enrollment size (not mean utility, as shown here) on advertising variables along with the usual fixed effects and controls. We find that rivals' advertising has a negative effect in markets with a smaller number of rivals conducting advertising and that its point estimate is almost identical to the coefficient estimate for own private advertising. Therefore, both our demand model and reduced-form model estimates suggest that private advertising increases enrollment from the outside option as well as other insurers and does not have positive spillovers to rivals.

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.

4.2.4 Advertising Content

Our demand estimates so far confirm that both federal and private advertising are effective in increasing enrollment to some degree. A natural question is which features of the advertising affect enrollment. We now utilize information on advertisement content to provide suggestive evidence about plausible mechanisms behind the results. Specifically, we estimate a model that allows for advertising with different content 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).

We briefly summarize main findings here and discuss the details of specifications and main findings in Online Appendix C. First, we find that the coefficient of federal advertising providing content about *both* OE and FA is very large and statistically significant. Moreover, it is larger than the rest of federal advertising, suggesting complementarity between the two content categories for consumers. In contrast, the coefficient of private advertising providing content about *both* OE and FA is very small and not statistically significant. Further, it is statistically smaller than the coefficient of federal advertising providing the same content. However, the coefficient of private advertising not providing any specific information about the marketplace is positive and statisti-

cally significant, which is consistent with our finding in Table 5. These results hint at a possible reason why private advertising does not have positive spillovers. 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.[38] Additionally, our finding also suggests a role of federal advertising in providing information about the marketplace, which results in higher program enrollment.[39]

4.3 Robustness Checks

4.3.1 Alternative Specifications

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).

Moreover, another question is whether our results are robust to an alternative way to control for unobserved heterogeneity that varies across rating areas. In the main specification, we included the fixed effects for rating area-by-year in the market-level regression and the fixed effects for insurer-by-rating area-by-year in the insurer-level demand model. An alternative way to control for this unobserved heterogeneity is to further restrict the sample to border pairs that are included in the same rating area.

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. Then we estimate the same regressions with the restricted border sample. Results with the alternative specifications are reported in Tables 16 and 17 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

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

[39] It is not very clear, without further information, why information provided from private advertising is not as effective. 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.

models, and private advertising is also positive and significant in the insurer-level demand model. Second, the estimates of intensive-margin effects of 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. Lastly, the estimates remain largely similar even with the restricted border sample.

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 simply the average effects over time. 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 18 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

Because this paper studies an insurance market, an obvious follow-up question is whether advertising has any significant heterogeneous effects. We examine whether the effect of advertising

depends on certain market characteristics or on consumers with different characteristics. We also examine more closely the null effect of state advertising.

The details of specifications and results are reported in Online Appendix D. Here, we briefly summarize main findings. First, we find some interaction effects between each state's Medicaid expansion status and advertising. Second, we do not find robust evidence that advertising has significant heterogeneous effects across consumers of different health status, based on several proxy variables (age, income, and market-level health variables). We interpret these results as showing that advertising has at most limited effects on the risk pool or degree of adverse selection in the ACA marketplaces. Third, we find that there is 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 so 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 25 in the Online Appendix, we present results for separate interaction models using both logs and levels of advertising spending as explanatory variables. Although the estimate of the interaction term in the log specification have a large standard error, it is more precisely estimated in the level specification. Both estimates are statistically insignificant, and the point estimates are close to zero. Even though the point estimates are positive, the magnitude is too small to suggest that there is important complementarity between federal and private advertising. Thus, we reach a robust conclusion 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 findings from the consumer demand model suggest that government advertising can be a useful tool to expand program enrollment for the marketplace. However, to fully assess the importance of government advertising, it is important to understand its effects on private advertising. Given the lack of complementarity between government and private advertising (see Section 4.4.2), gov-

ernment advertising may crowd out private advertising. An extreme possibility is that government advertising perfectly crowds out private advertising, failing to expand program enrollment. Moreover, the cost of crowding out depends on whether private advertising is beneficial: private advertising may induce consumers to switch to better plans; however, the spending of private advertising can be inefficient in the market equilibrium.

To illustrate these economic trade-offs, we set up the supply-side of the marketplace and characterize the equilibrium. We model an insurer's profit-maximizing advertising decision in an imperfect competitive market, following the literature of empirical industrial organization (e.g., Dubé et al. (2005), Goeree (2008), and Gordon and Hartmann (2016)). Then, we estimate the supply side parameters and conduct counterfactual experiments.

5.1 Supply-Side Model of Advertising in 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' geographical 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.[40] Then, an insurer's annual profit in DMA m and year t is expressed as

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

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 ($\overrightarrow{ad^p_{mt}}$), and $C(ad^p_{jmt})$ is the cost of advertising by insurer j. We use the demand model given by Equation (3) in Section 4.2.

Each insurer chooses its own advertising to maximize total profits Π_{jmt} in each DMA-year market, mt.[41] 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

[40] 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.

[41] 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, existing studies (e.g., Tebaldi (2017) and Polyakova and Ryan (2019)) also use a static equilibrium and capture an insurer's behavior reasonably well. Thus, we view our framework as a useful first step.

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. We now discuss mechanisms through which government advertising affects market equilibrium. Directly, government advertising increases consumer demand, possibly by mitigating consumers' choice frictions.[42] 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.

Our supply-side model imposes several strong assumptions and only incorporates a few specific mechanisms, which naturally raises concerns over the robustness of our results and warrants further discussion. First, we assume that insurers correctly know the effectiveness of their advertising. Second, we abstract from potential heterogeneity in profits across consumers with different characteristics because we did not find robust evidence for heterogeneous effects of advertising across consumer types. As pointed out by Blake et al. (2015), Lewis and Rao (2015) and Shapiro et al. (2019), it is difficult to justify the assumption that private firms have perfect information on the effectiveness of advertising in many product markets, where the estimated returns of advertising are very small or sometimes negative. Although it is difficult to compare our estimates of the return of advertising with a prior that advertisers typically have, we will show in Section 5.1.2 that our estimate of an insurer's profitability based on the advertising optimality condition is reasonable. Moreover, we focus on the average effect of advertising, instead of choices of advertising contents, to mitigate bias from mis-specification of the supply-side model.

However, it is still important to clarify how our results will be affected by these assumptions. For example, the main results will be qualitatively unchanged if private insurers simply misunderstand the effect of government and private advertising on own demand (as long as they believe advertising effective). However, if private insurers believe that the interaction between government and private advertising on demand is large and positive, which we clearly reject from our estimates in Section 4.4.2, government advertising may crowd in private advertising. Although one can still obtain qualitatively similar effects on the program enrollment in a model with a positive interaction between government and private advertising, our model would predict qualitatively

[42] As we explain in Section 4.2.1, our demand model implicitly captures the idea that government advertising mitigate consumers' choice frictions by increasing their awareness of the marketplace.

different implications about how private insurers would respond to changes in government advertising. Given our suggestive evidence in Section 3 and our understanding of this market, however, we believe that this possibility is not very plausible.[43] We acknowledge that the assumptions of our supply-side model are restrictive, and relaxing these assumptions to obtain more accurate policy predictions would be a fruitful area of research. However, we view the present effort, providing the first formal analysis of the effect of government advertising in a transparent and parsimonious equilibrium framework, as a crucial first step to understanding how government advertising affects private marketing activities in equilibrium.

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.[44] 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.[45] The details of the estimation procedure are described in Appendix E.

We find that the median estimated π_{jmt} among insurers with positive advertising is 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.[46] If insurers expect to have a 15% profit margin, especially given an 80% medical loss ratio requirement under the ACA, our estimated perceived profitability of \$756 is reasonable.

[43]For example, private insurers boosted their advertising in response to the decline of federal advertising, see, e.g., `https://www.forbes.com/sites/brucejapsen/2017/11/19/insurer-ads-boost-obamacare-despite-trumps-marketing-squeeze`

[44]We choose this specification partly because the estimated effect of rival advertising is negative but not statistically significant. Given the logit structure, our specification will still result in a modest business stealing effect. We therefore view that this is the most conservative choice given our estimate, which is also consistent with the finding of the modest business stealing effect from our reduced form regression of insurer-level enrollment in Table 15.

[45]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.

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

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 the effect of 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 displays the main results. First, we find that reducing federal government spending to zero modestly reduces 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 capita), we find that the decline in enrollment is about 1.12 percentage points.[47] Importantly, equilibrium responses of private insurers have a very small 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.[48] In markets with large baseline federal spending, we find that private advertising increases by $0.57 per capita, which is equivalent to a $0.45

[47]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.

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

increase for a dollar decrease in federal advertising.[49,50]

Table 6 also reports results from another counterfactual experiment, in which 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 by \$0.13. However, a comparison between "Partial eq." and "Full eq." shows that the private advertising crowded out by the government advertising has a small impact on the overall market-level enrollment.

These results suggest that changes in private advertising in response to the government advertising have a small effect on the total program enrollment. This is partly because advertising competition among private insurers leads to a prisoner's dilemma and thus excessive equilibrium advertising spending. To examine this issue more closely, we compare the elasticity of an insurer's enrollment with respect to advertising with and without taking into account equilibrium responses by its rivals. Specifically, Table 26 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 advertising spending. Thus, once accounting for equilibrium responses by rivals, changes in private advertising lead to smaller changes in the share of enrollment across insurers, suggesting the presence of excessive advertising spendings. At least in markets in which insurers compete through advertising, federal advertising likely crowds out excessive private advertising to some extent.

Of course, some of the private advertising crowded out by government advertising could increase consumer welfare if it induces consumers to switch to insurers that provide better plans. However, existing studies document that such welfare gain is likely to be much smaller than the

[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.

[50] 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.

welfare gain from increasing program enrollment, partly due to the presence of the minimum quality regulation imposed by the ACA.[51] Thus, welfare gains from an increase in government advertising through larger marketplace enrollment are likely to outweigh potential welfare losses from crowding out of private advertising.

Although it is beyond the scope of our paper to conduct a full welfare analysis, it is 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) how much advertising reduces choice frictions, (ii) the social surplus of increasing program enrollment, and (iii) the social value and cost of advertising. First, our demand model estimates provides estimates about how much advertising reduces choice frictions (item (i)). Second, we discussed the social surplus of increasing the program enrollment (item (ii)) in Section 4.1.3 based on the findings in the literature. Lastly, our equilibrium analysis provides a new insight for the social value and cost of advertising (item (iii)). Especially, crowding out of private advertising by government advertising has two effects: the first effect is to mitigate excessive advertising spending by private insurers, and the second effect is to reduce a potentially welfare enhancing switching of consumers to better insurers if they advertise more. Given the limited welfare gain in this market from consumer switching, our findings suggest that government advertising can be an effective market-design tool through which to enhance social welfare.

Much of the discussions so far focused on the efficiency aspect of government advertising. However, government advertising is also rationalized if the federal government and private insurers have different objectives. In Section 3.3, we found that the federal government and private insurers target their advertising differently, which indicates they likely have different objectives. Thus, it is likely to be difficult for private markets alone to generate geographical variation in advertising that the government would like 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 content. Then, we estimate the impact of government and pri-

[51] 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.

[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.

vate advertising on consumer demand. 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 and enhances welfare. Private advertising is not more effective than government advertising in increasing total program enrollment. Although private advertising is still effective in increasing insurer's own enrollment, it does not have any positive spillovers to other insurers. By using an estimated equilibrium model, we illustrate mechanisms through which government advertising affects the market equilibrium. Our simulation suggests that government advertising can simultaneously increase total program enrollment and reduce excessive advertising spending among private insurers. Overall, it suggests that government advertising can be an important market design tool for market-based public programs.

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. Moreover, it is likely to be fruitful to extend our equilibrium model to incorporate much richer structures to obtain deeper insights on interactions between government and private marketing activities.

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Online Appendix (Not For Publication)

A Discussion of the Border Strategy

Differences between Pairs of Border Counties Table 7 compares market characteristics between border counties with low and high federal and state government and market-level private advertising spending. For each of the three types of advertising, we identify which border county within a border pair has a smaller expenditure. We collect such border counties with respect to federal, state, and private advertising spending for Columns (1), (3), and (5), respectively. For even-numbered columns, we collect border counties with higher expenditures within border pairs.

The table shows that border counties with lower and higher advertising expenditures 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 (measured 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, average 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 to the border strategy is that the estimated effect is only local to potential marketplace enrollees in border counties. Thus one must be cautious in generalizing the estimated effect to non-border counties). 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. 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. Thus, these findings suggest a significant overlap in observables between border and non-border counties. This suggests that the estimated effect of advertising could be generalizable to even non-border counties.

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

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.

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 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.

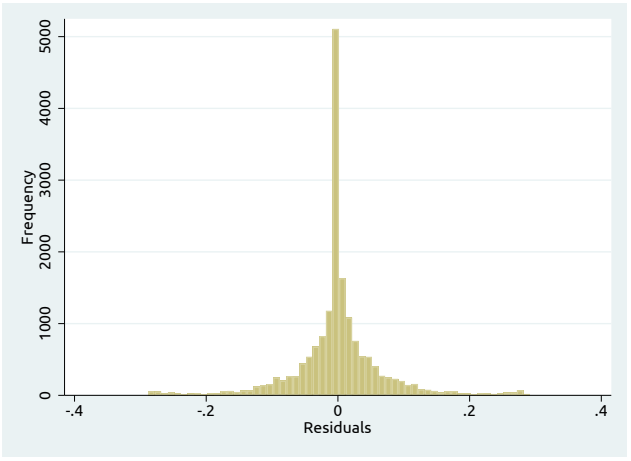
B Additional Discussions on Federal Advertising

B.1 Cost Effectiveness

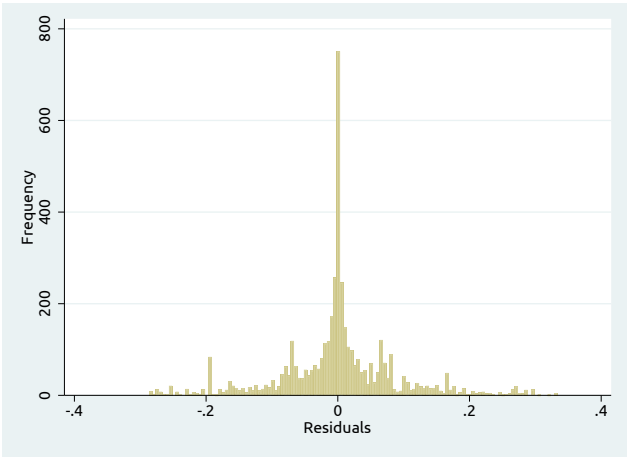
We compare our estimates of the effect of federal advertising on market-level enrollment to the finding in Goldin et al. (2019), who evaluate the randomized experiment of sending a direct mailing (a reminder) between 2016 and 2017 to individuals who paid the tax penalty because they were uninsured in 2015. They find that a reminder increases the probability of being insured (at least one month) by 0.85 percentage points, which reduces the probability of being uninsured by 2.7% in their sample. They also show that roughly two thirds of the marginal individuals enrolled in the marketplace, which implies that the probability of being uninsured decreased by 1.8% through an increase in marketplace take-up. These changes are induced by receiving one direct mailing from the federal government, whose cost is typically estimated to be about \$0.5-\$1.0.

In our estimation sample, those who choose the outside option accounts for about 80% of the market size. About 75% of them are uninsured, and a quarter of them obtain off-marketplace health plans. For the purpose of this comparison, we assume that the marginal effect of federal advertising is identical regardless of insured status. Then, our estimate implies that doubling federal advertising will reduce the total marketplace enrollment by 1 pp and thus the uninsured rate by 0.75 pp. This implies that the uninsured rate decreased by 1.25%. Now, our average federal advertising spending per capita is \$0.32. Because roughly 60% of population is uninsured, we can consider that these changes in enrollment is induced by \$0.53 (0.32/0.6) spending of federal advertising per each uninsured.

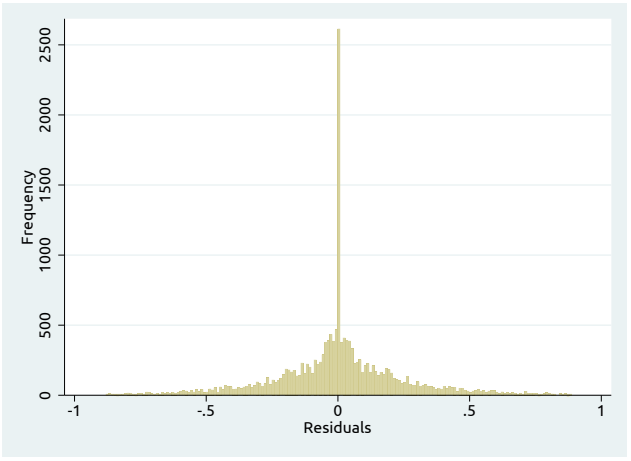
Figure 3: Residual Variation in Advertising Variables



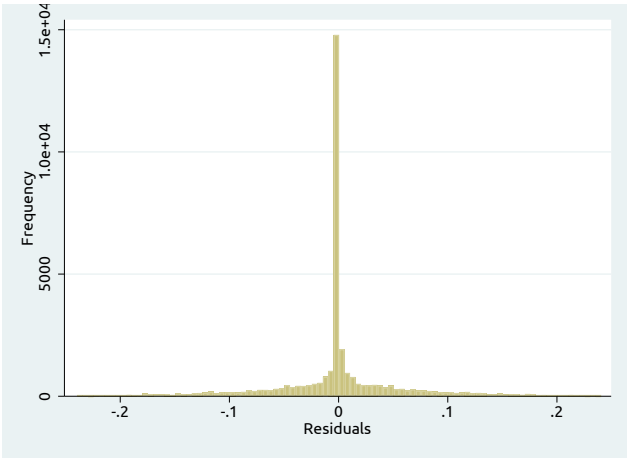
(a) Federal Ad



(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.

These back of envelope calculation suggests that the cost-effectiveness of TV advertising is comparable, 70% or more depending on the precise cost of direct email, with the direct mail experiment reported in Goldin et al. (2019).

B.2 Welfare Impact of Federal Advertising

We consider the welfare impact of increasing federal advertising spending by 1%. In an average market, per-capita advertising spending is \$0.32. Based on our demand estimate, a one-percent increase in federal advertising spending (\$0.0032) raises the marketplace enrollment by 0.05%, which is about an increase in total enrollment by 0.01 pp given the average enrollment of 20% of the market size. Then, as long as $\overline{SS} >$ \$32, a marginal increase in federal advertising enhances welfare.

What is a reasonable estimate of $\overline{SS}$ in the literature? Social welfare from enrolling a consumer should depend on consumer and producer surplus and government spending. Existing studies (e.g., Finkelstein et al. (2019), Tebaldi (2017), and Polyakova and Ryan (2019)) find it difficult to estimate accurately consumer and producer surplus in this context. Often, they tend to find that consumer welfare from marketplace plans is significantly lower than the actual cost of providing the plans or government spending. For example, Finkelstein et al. (2019) show that the median willingness to pay for health insurance among potential enrollees for the subsidized Massachusetts marketplace is about \$100 per month, which is just about 33% of corresponding median claim cost (\$333 per month). Finkelstein et al. (2019) argue that this is mainly due to the fact that even uninsured individuals are partially insured through uncompensated care, which may be financed by the government. Thus, the correct social welfare calculation must account for a reduction of uncompensated care. For example, they argue that the actual out-of-pocket cost of uninsured is just 20% of the total cost and that the rest of the cost is likely to be paid by the government. As a result, if an uninsured individual acquires insurance coverage, the government can potentially save \$266 per month (i.e. 80% of \$333), assuming that the cost of financing uncompensated cast is the social cost of having an uninsured individual. Thus, the net change in the social cost of insuring one person would be \$67 per month, which implies that annual welfare gain is about \$396 ($= (100 - 67) \times 12$). Although a more careful analysis in our own context is needed, the result suggests that increasing federal advertising is very likely to result in welfare gains.

Note that our analysis can be also interpreted through the framework to evaluate the marginal value of public funds (Hendren (2016); Finkelstein and Notowidigdo (2019)). For example, in their experiments of sending direct mailings to potential SNAP enrollees, Finkelstein and Notowidigdo (2019) interpret that the welfare effect of sending a mailing consists of three components: (i) the effect on consumer surplus (e.g., the reducing consumer's choice frictions), which can be posi-

tive; (ii) the direct government expenditure on the program (e.g., government payments for SNAP benefits for additional consumers), which reduces the welfare; (iii) fiscal externality, which is the government's additional expenditure because of a consumer's behavioral responses (e.g., the reduction of tax revenue due to the lower labor supply to be eligible for SNAP), which also reduces the welfare. Note that we considered the first two factors and miss the third factor (fiscal externality) in our welfare calculation. The fiscal externality could happen, for example, if advertising induces a consumer to reduce their working hours to be eligible to premium subsidies in the marketplace, leading to smaller tax revenues. We, however, view this channel as unrealistic because the subsidies are available for a wide range of incomes (up to 400% of the federal poverty level). The existing studies also support this interpretation (e.g., Aizawa (2019)). Moreover, it is likely that we understate the welfare benefit of federal advertising because we ignore its effect on infra-marginal populations. For example, federal advertising can decrease costs associated with enrolling for the marketplace even for consumers who would enroll in the marketplace even without advertising. Thus, the welfare gain could be larger than the one we calibrate in this paper.

Finally, we did not specify the consumer choice process in our welfare framework, which determines the take-up rate $q(ad^f)$. A model consistent with our framework is a model of consideration sets (e.g., Goeree (2008)). In a simple version of such a model, an individual considers the option of choosing a health plan from the marketplace with the probability $\lambda\left(ad^f\right)$. Then, an individual would maximize the following utility function:

$$\lambda\left(ad^f\right)\max\left\{U_{hix}+\varepsilon_{hix},U_o\right\}+\left(1-\lambda\left(ad^f\right)\right)U_o$$

where U_x is the utility from the choice x, and ε_{hix} is a preference shock for choosing a plan from the marketplace with the distribution F. Then, the take-up rate $q(ad^f)$ would be :

$$q(ad^f)=\lambda\left(ad^f\right)\left(1-F\left(U_o-U_{hix}\right)\right).$$

C Detailed Discussion of Effects of Advertising Content

In this section, we first discuss details of how we estimate the effect of advertising content on consumer demand and then document our findings. 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. As discussed in Section 3, there are many advertisements that feature both OE and FA content. 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 OE or FA. Moreover, the other types of content do not tend to appear together in the

same advertisement.

Based on these data patterns, we allow for the separate effect of the following four different types of advertising to reasonably isolate effects of content: (i) advertising that provides both OE and FA content; (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, about 60% of private advertisements did not provide any specific information on the marketplace, as shown in Section 3.

Table 19 in the Online Appendix presents coefficient estimates.[53] 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 type, leading to larger standard errors. The relatively large standard errors for estimates in Table 19 make it difficult to statistically distinguish whether certain types of content are more effective than others. At least, we can show from Column (1) that federal advertising of type (i) is statistically greater than federal advertising of types (ii), (iii), and (iv) combined at the 10% significance level.[54] Overall, our results indicate that federal advertising that provides both OE and FA content played a major role in driving the market-expansion effect of federal advertising.

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).[55] 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

[53] 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 20.

[54] 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 the same.

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

we find that only private advertising of type (iv)–not providing any specific information about the marketplace–is statistically significant.[56]

D Detailed Discussion of Heterogeneous Effects

D.1 Heterogeneous Effects across Markets

First, we examine whether the effectiveness of advertising may depend on the choice of other healthcare 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 (1) of Table 21 in the Online Appendix that the coefficient of the interaction term between federal advertising and Medicaid expansion status is large and statistically significant. It suggests possible complementarity between federal advertising and Medicaid expansion status.[57] We also find that the coefficient of the interaction term between private advertising and 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 in which 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.

D.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.[58]

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

[56]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.

[57]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.

[58]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.

and whether the effect is different for consumers in different age and income groups. These demographic variables typically are highly correlated with health status.

Column (2) in Table 21 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 significant, although the estimates are slightly noisy.

Then we estimate Equation (7) by allowing heterogeneous effects to vary by age and income using demographic group-level market share data. We consider two age groups and two income groups: whether an individual age is at least 55 and whether an individual 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.[59]

The main results are reported in Table 22. 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.[60]

D.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 24 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

[59]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 sample that includes CA and NY. As reported in Table 23, the results are not qualitatively different from the results with demographic group-level market shares.

[60]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 (e.g., consumers with better cognitive ability) 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.

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 is not homogeneous across all states. Although our goal in this paper is not to understand reasons 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.

E 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 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.

F Detailed Discussion of the Advertising Data

Identifying Advertisements Relevant for the Marketplace We exploit 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.[61] Among this set, we identify market-

[61] 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.

place 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, advertisements in which HHS promotes Medicare.

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 advertisement 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 first 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).

Identifying Advertising Content 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

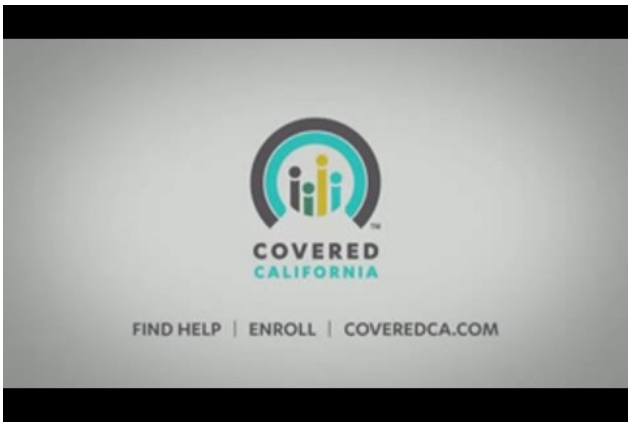
the dummy to take zero.

- 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.

G 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: Market-Level Demand Analysis: Federal vs Non-federal Advertising

	(1) Log ($ln(1+ad)$)	(2) Level (ad)
Fed Spend	0.053**	0.033**
	(0.021)	(0.013)
Non-fed Spend	0.005	0.002*
	(0.009)	(0.001)
No. of Insurers	0.012	0.012
	(0.008)	(0.008)
Market Size	-0.026***	-0.026***
	(0.006)	(0.006)
BorderYear FE	Y	Y
County FE	Y	Y
RatingYear FE	Y	Y
N. Obs.	18,182	18,182
Adj. R^2	0.919	0.919

Note: Non-fed Spend is the combined advertising spending by all sponsors other than the federal government: state governments, private insurers, navigators, Democrats, and Republics. Column (1) and (2) report estimates with the specifications, where the advertising variables enter in log and in level, respectively. In both colums, we can reject the null that the coefficient estimate for federal advertising is different from non-federal advertising at the 5% level. 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 two-way clustered at the DMA$\times$Year level and the County level. The stars indicate: *** for p<0.01, ** for p<0.05 and * for p<0.1.

Table 15: Reduced-Form Effect of Advertising on Insurer-Level Enrollment

	(1)	(2)	(3)
Fed Spend	0.087*	0.088*	0.091*
	(0.046)	(0.047)	(0.047)
State Spend	-0.052	-0.057	-0.057
	(0.066)	(0.066)	(0.065)
Priv Spend	0.089**	0.088**	0.086*
	(0.045)	(0.044)	(0.044)
Rival Spend	-0.031	-0.080*	-0.084*
	(0.041)	(0.047)	(0.048)
1[Num of Rivals with Positive Ads$\geq$2]=1 $\times$ Rival Spend		0.192**	0.194**
		(0.078)	(0.078)
1[Num of Rivals with Positive Ads$\geq$2]=1		-0.099*	-0.101*
		(0.059)	(0.058)
No. of Insurers	-0.095***	-0.095***	-0.094***
	(0.023)	(0.023)	(0.023)
Market Size	0.006*	0.006*	0.006*
	(0.003)	(0.003)	(0.003)
Navi Spend			-0.236
			(0.232)
Dem Spend			0.031
			(0.036)
Rep Spend			0.020
			(0.018)
FirmBorderYear FE	Y	Y	Y
FirmCounty FE	Y	Y	Y
FirmRatingYear FE	Y	Y	Y
N. Obs.	36,622	36,622	36,622
Adj. R^2	0.956	0.956	0.957

Note: This table reports estimates of effects of advertising on the log of insurer-level enrollment size. Each column reports estimates based on a different combination of advertising variables. Column (1) includes federal, state, private, and rival advertising. Column (2) includes adds the dummy of whether the number of rival advertisers is at least two, and its interaction with rival advertising. Column (3) adds navigator, Democrats and Republican advertising. All specifications include Firm$\times$Border$\times$Year fixed effects, Firm$\times$County fixed effects, and Firm$\times$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 two-way clustered at the DMA$\times$Year level and the Firm$\times$County level. The stars indicate: *** for p<0.01, ** for p<0.05 and * for p<0.1.

Table 16: Robustness: Market-Level Demand Analysis

	Log ($ln(1+ad)$)				Level (ad)			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Fed Spend	0.050**	0.049**	0.050**	0.049**	0.031**	0.030**	0.031***	0.031***
	(0.021)	(0.021)	(0.020)	(0.020)	(0.013)	(0.012)	(0.012)	(0.012)
State Spend	-0.011	0.005	-0.018	-0.006	0.001	0.007	-0.003	0.003
	(0.034)	(0.041)	(0.034)	(0.041)	(0.016)	(0.016)	(0.016)	(0.017)
Priv Spend	0.023	0.028	0.016	0.021	0.010	0.010*	0.006	0.007
	(0.018)	(0.019)	(0.018)	(0.018)	(0.006)	(0.006)	(0.006)	(0.006)
1[Fed Spend>0]		0.233**		0.269***		0.236**		0.273***
		(0.095)		(0.085)		(0.095)		(0.086)
1[State Spend>0]		-0.022		-0.017		-0.025		-0.022
		(0.019)		(0.019)		(0.017)		(0.017)
1[Priv Spend>0]		-0.009		-0.007		-0.004		-0.003
		(0.016)		(0.016)		(0.015)		(0.015)
No. of Insurers	0.012	0.012	0.016*	0.015*	0.013	0.013	0.016*	0.016*
	(0.008)	(0.008)	(0.009)	(0.009)	(0.008)	(0.008)	(0.009)	(0.009)
Market Size	-0.026***	-0.026***	-0.036***	-0.036***	-0.026***	-0.026***	-0.036***	-0.036***
	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)
Sample	Baseline	Baseline	Rating Area	Rating Area	Baseline	Baseline	Rating Area	Rating Area
BorderYear FE	Y	Y	Y	Y	Y	Y	Y	Y
County FE	Y	Y	Y	Y	Y	Y	Y	Y
RatingYear FE	Y	Y	Y	Y	Y	Y	Y	Y
N. Obs.	18,182	18,182	10,224	10,224	18,182	18,182	10,224	10,224
Adj. R^2	0.919	0.919	0.912	0.912	0.919	0.919	0.912	0.912

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) report the estimates of the same specifications as in Column (1) and (2) with the sample that includes only border pairs in the same rating area. Columns (4) through (8)report the estimates of the specifications in Columns (1) through (4), 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 two-way clustered at the DMA$\times$Year level and the County level. The stars indicate: *** for p<0.01, ** for p<0.05 and * for p<0.1.

Table 17: Robustness: Insurer-level Demand Analysis

	Log ($ln(1+ad)$)				Level (ad)			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Fed Spend	0.125**	0.123**	0.134**	0.134**	0.070**	0.069**	0.077**	0.078**
	(0.053)	(0.054)	(0.057)	(0.057)	(0.031)	(0.031)	(0.034)	(0.034)
State Spend	-0.033	-0.013	0.006	0.003	-0.025	-0.020	-0.013	-0.016
	(0.070)	(0.084)	(0.072)	(0.086)	(0.032)	(0.033)	(0.032)	(0.034)
Priv Spend	0.093*	0.101**	0.090*	0.104*	0.035**	0.035**	0.034**	0.035**
	(0.048)	(0.051)	(0.050)	(0.054)	(0.016)	(0.016)	(0.017)	(0.017)
1[Fed Spend>0]		0.322*		0.317**		0.323**		0.315**
		(0.164)		(0.146)		(0.163)		(0.145)
1[State Spend>0]		-0.032		-0.002		-0.025		0.009
		(0.058)		(0.062)		(0.050)		(0.055)
1[Priv Spend>0]		-0.010		-0.018		0.003		-0.005
		(0.034)		(0.035)		(0.032)		(0.033)
No. of Insurers	-0.091***	-0.091***	-0.066**	-0.067**	-0.090***	-0.091***	-0.065**	-0.066**
	(0.024)	(0.024)	(0.027)	(0.027)	(0.024)	(0.024)	(0.027)	(0.027)
Market Size	-0.021***	-0.021***	-0.038***	-0.038***	-0.021***	-0.021***	-0.038***	-0.038***
	(0.005)	(0.005)	(0.008)	(0.008)	(0.006)	(0.006)	(0.008)	(0.008)
Sample	Baseline	Baseline	Rating Area	Rating Area	Baseline	Baseline	Rating Area	Rating Area
FirmBorderYear FE	Y	Y	Y	Y	Y	Y	Y	Y
FirmCounty FE	Y	Y	Y	Y	Y	Y	Y	Y
FirmRatingYear FE	Y	Y	Y	Y	Y	Y	Y	Y
N. Obs.	36,558	36,558	19,712	19,712	36,558	36,558	19,712	19,712
Adj. R^2	0.938	0.938	0.926	0.926	0.938	0.938	0.926	0.926

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) report the estimates of the same specifications as in Column (1) and (2) with the sample that includes only border pairs in the same rating area. Columns (4) through (8)report the estimates of the specifications in Columns (1) through (4), 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 two-way clustered at the DMA×Year level and the Firm×County level. The stars indicate: *** for p<0.01, ** for p<0.05 and * for p<0.1.

Table 18: 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
	(0.058)	(0.053)	(0.066)
State Spend	0.047	-0.033	-0.027
	(0.090)	(0.070)	(0.082)
Priv Spend	0.134**	0.093*	0.080
	(0.064)	(0.048)	(0.053)
Linear Trend × Fed Spend			0.048
			(0.043)
Linear Trend × State Spend			-0.001
			(0.028)
Linear Trend × Priv Spend			0.016
			(0.018)
No. of Insurers	-0.106***	-0.091***	-0.090***
	(0.026)	(0.024)	(0.024)
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	0.942	0.938	0.938

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 two-way clustered at the DMA×Year level and the Firm×County level. The stars indicate: *** for p<0.01, ** for p<0.05 and * for p<0.1.

Table 19: Coefficient Estimates for Advertising Content (Log)

	(1)	(2)
Fed Spend:		
Open Enrollment and Financial	0.316**	0.325**
	(0.135)	(0.141)
Fed Spend:		
Not Both Open Enrollment And Financial	0.089	
	(0.060)	
Fed Spend:		
Either Open Enrollment or Financial (not both)		-0.056
		(0.237)
Fed Spend:		
Other ACA-related		0.102
		(0.068)
State Spend:		
Open Enrollment and Financial	0.092	0.121
	(0.108)	(0.110)
State Spend:		
Not Both Open Enrollment And Financial	-0.048	
	(0.072)	
State Spend:		
Either Open Enrollment or Financial (not both)		0.094
		(0.085)
State Spend:		
Other ACA-related		-0.100
		(0.075)
Priv Spend:		
Open Enrollment and Financial	0.058	0.076
	(0.064)	(0.069)
Priv Spend:		
Not Both Open Enrollment And Financial	0.096**	
	(0.048)	
Priv Spend:		
Either Open Enrollment or Financial (not both)		0.072
		(0.072)
Priv Spend:		
Other ACA-related		-0.062
		(0.063)
Priv non-ACA Spend		0.121**
		(0.055)
No. of Insurers	-0.089***	-0.088***
	(0.024)	(0.025)
Market Size	-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	0.938	0.938

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 two-way clustered at the DMA×Year level and the Firm×County level. The stars indicate: *** for p<0.01, ** for p<0.05 and * for p<0.1.

Table 20: Robustness Check: Coefficient Estimates for Advertising Content (Level)

	(1)	(2)
Fed Spend:		
Open Enrollment and Financial	0.262***	0.272***
	(0.101)	(0.103)
Fed Spend:		
Not Both Open Enrollment And Financial	0.052	
	(0.034)	
Fed Spend:		
Either Open Enrollment or Financial (not both)		-0.054
		(0.161)
Fed Spend:		
Other ACA-related		0.063*
		(0.038)
State Spend:		
Open Enrollment and Financial	-0.010	0.020
	(0.070)	(0.070)
State Spend:		
Not Both Open Enrollment And Financial	-0.027	
	(0.036)	
State Spend:		
Either Open Enrollment or Financial (not both)		0.060
		(0.053)
State Spend:		
Other ACA-related		-0.059
		(0.038)
Priv Spend:		
Open Enrollment and Financial	0.026	0.034
	(0.029)	(0.032)
Priv Spend:		
Not Both Open Enrollment And Financial	0.040**	
	(0.016)	
Priv Spend:		
Either Open Enrollment or Financial (not both)		0.048
		(0.044)
Priv Spend:		
Other ACA-related		-0.024
		(0.029)
Priv non-ACA Spend		0.048***
		(0.018)
No. of Insurers	-0.089***	-0.087***
	(0.024)	(0.025)
Market Size	-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	0.938	0.938

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 two-way clustered at the DMA×Year level and the Firm×County level. The stars indicate: *** for p<0.01, ** for p<0.05 and * for p<0.1.

Table 21: Heterogeneous Effects Depending on Market Characteristics

	(1) Market Characteristics = Medicaid Expansion	(2) Market Characteristics = unhealthy
Fed Spend	0.002	0.141**
	(0.067)	(0.058)
Market Characteristic=1 × Fed Spend	0.216**	-0.129
	(0.103)	(0.081)
State Spend	-0.116	-0.012
	(0.108)	(0.073)
Market Characteristic=1 × State Spend	0.105	-0.168
	(0.134)	(0.133)
Priv Spend	0.070	0.085*
	(0.088)	(0.051)
Market Characteristic=1 × Priv Spend	0.050	0.051
	(0.104)	(0.058)
No. of Insurers	-0.090***	-0.090***
	(0.024)	(0.024)
Market Size	-0.021***	-0.021***
	(0.005)	(0.006)
FirmBorderYear FE	Y	Y
FirmCounty FE	Y	Y
FirmRatingYear FE	Y	Y
N. Obs.	36,558	36,558
Adj. R^2	0.938	0.938

Note: This table reports the estimates for the specifications that include interaction terms between market characteristics and advertising variables. Column (1) 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 (2) 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 two-way clustered at the DMA×Year level and the Firm×County level. The stars indicate: *** for p<0.01, ** for p<0.05 and * for p<0.1.

Table 22: Heterogeneous Effects for Demographic Groups

	(1) Demo=Age$\geq$ 55	(2) Demo=Income$\leq$ 138% of FPL
Fed Spend	0.097**	0.102**
	(0.049)	(0.052)
State Spend	-0.058	-0.054
	(0.077)	(0.081)
Priv Spend	0.082	0.091*
	(0.051)	(0.054)
Demo $\times$ Fed Spend	0.061	0.054
	(0.084)	(0.085)
Demo $\times$ State Spend	-0.052	0.050
	(0.134)	(0.144)
Demo $\times$ Priv Spend	-0.008	-0.061
	(0.089)	(0.103)
No. of Insurers	-0.137***	-0.133***
	(0.022)	(0.026)
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	0.911	0.899

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 two-way clustered at the DMA$\times$Year level and the Firm$\times$County level. The stars indicate: *** for p<0.01, ** for p<0.05 and * for p<0.1.

Table 23: 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
	(0.147)	(0.156)
Demo $\times$ Fed Spend	1.066	-0.278
	(0.869)	(0.531)
State Spend	0.174	0.001
	(0.155)	(0.161)
Demo $\times$ State Spend	-1.028	-0.236
	(0.746)	(0.591)
Priv Spend	0.170*	0.065
	(0.090)	(0.088)
Demo $\times$ Priv Spend	-0.359	0.131
	(0.349)	(0.295)
No. of Insurers	-0.115***	-0.114***
	(0.026)	(0.026)
Market Size	-0.026***	-0.027***
	(0.007)	(0.007)
FirmBorderYear FE	Y	Y
FirmCounty FE	Y	Y
FirmRatingYear FE	Y	Y
N. Obs.	34,208	34,208
Adj. R^2	0.936	0.936

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 two-way clustered at the DMA$\times$Year level and the Firm$\times$County 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: 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**
	(0.021)	(0.021)	(0.053)	(0.053)	(0.054)
State Spend	-0.016	-0.013	-0.053	-0.049	-0.048
	(0.036)	(0.035)	(0.074)	(0.074)	(0.073)
1[State=CA]=1 × State Spend	0.085	0.095	0.298**	0.300**	0.300**
	(0.088)	(0.086)	(0.145)	(0.143)	(0.143)
Priv Spend	0.022	0.023	0.094**	0.093*	0.091*
	(0.018)	(0.017)	(0.048)	(0.048)	(0.047)
Rival Spend				-0.038	-0.043
				(0.047)	(0.047)
Navi Spend		-0.054			-0.384
		(0.122)			(0.240)
Dem Spend		0.050***			0.050
		(0.016)			(0.037)
Rep Spend		-0.015*			0.016
		(0.008)			(0.018)
No. of Insurers	0.012	0.013	-0.092***	-0.091***	-0.088***
	(0.008)	(0.008)	(0.024)	(0.024)	(0.024)
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.	18,182	18,182	36,558	36,558	36,558
Adj. R^2	0.919	0.919	0.938	0.938	0.938

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 two-way clustered at the DMA×Year level and the County level (or the Firm×County level for Columns (3) and (4)). The stars indicate: *** for p<0.01, ** for p<0.05 and * for p<0.1.

Table 25: Coefficient Estimates: Interaction between Federal and Private advertising

	(1) Log ($ln(1+ad)$)	(2) Level (ad)
Fed Spend	0.117*	0.062*
	(0.064)	(0.033)
State Spend	-0.034	-0.025
	(0.070)	(0.032)
Priv Spend	0.087*	0.029*
	(0.051)	(0.017)
Fed Spend × Priv Spend	0.022	0.010
	(0.086)	(0.012)
No. of Insurers	-0.091***	-0.090***
	(0.024)	(0.024)
Market Size	-0.021***	-0.021***
	(0.005)	(0.006)
FirmBorderYear FE	Y	Y
FirmCounty FE	Y	Y
FirmRatingYear FE	Y	Y
N. Obs.	36,558	36,558
Adj. R^2	0.938	0.938

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 two-way clustered at the DMA×Year level and the Firm×County 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 26: 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	0.039
	Private Advertising ($)	0.85	0.89	0.80	1.04	1.27	0.90
2+	Elasticity	0.026	0.022	0.022	0.026	0.020	0.022
	Private Advertising ($)	0.70	0.76	0.66	0.76	1.10	0.62

Note: This table presents elasticities of insurer's enrollment 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.